Medication Safety Education in Undergraduate Pharmacy and Nursing Schools in the UK and Saudi Arabia

This thesis was submitted for the degree of Doctor of Philosophy (PhD)

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[redacted]

Declaration of originality

I declare that the work presented in this thesis is my own and where this has been contributed to by others, it is appropriately acknowledged.

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Dedication

‘Be brave as your fathers before you. Have faith and go forward’.

Thomas Alva Edison

This thesis is dedicated to the loving and evergreen memory of my Father

Professor Ahmed Khalid Al Badali

Who encouraged me to pursue my dreams and finish my degree. Although he was my inspiration to pursue my doctoral degree, he departed unexpectedly from this life during my study and was most unfortunately unable to see my graduation. This is for him.

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My Mother and Sisters

Who never stop giving of themselves in countless ways.

Abstract

Introduction: This thesis focused on medication and patient safety from a global perspective (UK and Saudi Arabia), the rationale being the increase in medication error incidents resulting from a lack of proper patient safety education in nursing and pharmacy programmes which contribute to serious patient safety issues. Literature revealed the limitations on achieving positive outcomes in nursing and pharmacy education. **Aim**: to identify current medication and patient safety education in these countries and to analyse factors affecting adequate teaching and recommendations for improvement. **Research Methodology**: A systematic narrative review and mixed method research design were used to investigate many educational issues. **Data Collection**: used literature search for published papers, document review, semi-structured individual interviews and focus group for qualitative data and a questionnaire for quantitative data**. Data Analysis**: used systematic narrative analysis, thematic analysis and various statistical techniques to analyse data (separate data review for pharmacy and nursing). **Results:** revealed a disagreement on the explicitness and mode of integration, diverse content delivery, many educational didactic and interactive methods, a growing interest in simulation methods, the inter-professional learning method, curriculum guides and educational framework were rarely used and obstacles to integrating medication safety were identified. Furthermore, students' confidence in learning about patient safety domains between classroom and clinical settings differed**. Conclusion:** Although medication and patient safety education is well received, strategies are needed to improve medication and patient safety education to allow for effective integration in the curriculum. UK and Saudi Arabian educational and health sector policymakers should prioritise improving medication and patient safety education. **Recommendations:** Future researches should investigate the content, methods of delivering medication and patient safety education, curriculum guides, framework for teaching and factors that prevent the effective integration of medication safety education. Students' confidence in patient safety topics in classroom and clinical settings needs evaluation.

Publications

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1. AlHarbi, S.A. Al-Qhtani, N.M. Albadali, H.A. Albekairy, A.M. (2016) A comparative study of voluntarily reported medication errors among adult patients in intensive care (IC) and non IC settings in Riyadh, Saudi Arabia. *Tropical Journal of Pharmaceutical Research.* 15 (12): 2713-2718. . Available online at http://www.tjpr.org http://dx.doi.org/10.4314/tjpr.v15i12.25

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Table of Contents

Declaration of originality 2
Copyright declaration 3
Acknowledgment 4
Dedication 7
Abstract 8
Publications 9
Table of Contents 11
List of tables 17
List of figures 19
List of Boxes 19
List of abbreviations 19
Chapter 1: Introduction to Patient and Medication Safety Education 22
1.1 Overview of Chapter One 22
1.2 The Rationale for Conducting the Study in the UK and Saudi Arabia 22
1.3 Introduction to Patient Safety 23
1.4 Medication Safety and Errors 26
1.4.1 Introduction to Medication Safety and Errors – Concept and Definition 26
1.4.2 Prevalence of Medication Error Incidents Worldwide, in the United Kingdom and Saudi Arabia 27
1.5 Patient Safety Education and Training Models 28
1.5.1 Patient and Medication Safety Education Curriculum Guides, Regulatory Bodies and Standards for Pharmacy and Nursing in the UK 28
1.5.2 Patient and Medication Safety Education Curriculum Guides, Regulatory Bodies and Standards for Pharmacy and Nursing in Saudi Arabia 30
1.5.3 WHO Curriculum Guide for Patient Safety Education 32
1.5.3.1 Importance of Using the WHO Patient Safety Curriculum 32
1.5.3.2 What is Patient Safety? 33
1.5.3.3 Improving Medication Safety 34
1.5.4 Role of Pharmacists and Nurses in Improving Medication and Patient Safety 35

1.5.4.1 Role of Pharmacists 35
1.5.4.2 Role of Nurses 37
1.5.5 Some Educational and Training Models 38
1.6 Aims and Objectives 44
1.7 Summary 45
Chapter 2: Overview of Research Methods and Thesis Structure 46
2.1 Chapter Overview 46
2.2 Research Design: A Mixed Methods Approach 46
2.2.1 Rationale of the Research Design 47
2.2.2 Aspects of the Research 50
2.3 Qualitative Study 51
2.4 Quantitative Study 53
2.5 Thesis Structure 53
2.6 Summary 54
Chapter 3: Patient and Medication Safety Education – Systematic Narrative Review 55
3.1 Studies on the Problem of Medication Safety 55
3.2 Aim and Objectives 57
3.3 Method 57
3.3.1 Study Design 57
3.3.3 Search Strategy 58
3.3.4 Data Extraction and Synthesis 59
3.3.5 Quality Check for Empirical Articles 60
3.4 Results of a Literature Search Review 62
3.4.1 Description of Data Extracted 63
3.4.1.1 Empirical studies 64
3.4.1.2 Non-Empirical Studies 72
3.4.2 Description of Quality Checked Studies 73
3.4.3 Themes Emerging from the Study 74
3.4.3.1 The first theme focused on verification for current educational practice in medication safety in the nursing and pharmacy as presented in the literature. In addition, it includes a section relating to outcome measures used to evaluate educational interventions. 75

3.4.3.2 The second theme as mentioned earlier focused on subject matter (content), teaching and training approaches (methods) used in medication safety education as reported in the nursing, pharmacy and combined healthcare professions studies. 81
3.4.3.3 The Third Theme Focused on Guiding Principles and Curriculum Compositional Frameworks Employed in Medication Safety Education. 88
3.5 Discussion 100
3.5.1 Strengths and Limitations 110
3.5.2 Implications for Educational Practice and Future Research 111
3.5.3 Summary 112
Chapter 4: Interview Study to Explore Teaching Staff and Student Perspectives on Medication and Patient Safety Education 113
4.1 Introduction 113
4.2 Aims and Objectives 114
4.3 Method 115
4.3.1 Design 115
4.3.2 Setting 116
4.3.3 Participants and Sampling 118
4.3.3 *Research* Materials 118
4.3.4 Data Collection 119
4.3.5 Data Analysis 121
4.3.6 Ethical Issues 122
4.4 Results from the UK and Saudi Arabia 123
4.4.1 Document Review for Medication Safety Education 124
4.4.2.1 Themes Emerging from Teaching Staff Interviews 128
4.4.2.1.1 Nursing Teaching Staff in the UK and Saudi Arabia Themes 133
4.4.2.1.2 Pharmacy Teaching Staff in the UK and Saudi Arabia Themes 151
4.4.3.1 Themes that Emerged from Students' Interviews 175
4.4.3.1.1 Nursing Students in the UK and Saudi Arabia Themes 178
4.4.3.1.2 Pharmacy Students in the UK and Saudi Arabia Themes 194
4.5.1 Strengths and limitations 218
4.5.2 Summary 218

Chapter 5: Questionnaire study on the Perceptions of Nursing and Pharmacy Students on Medication and Patient Safety Education 219
5.1 Introduction 219
5.2 Aim and Objectives 221
5.3 Method 222
5.3.1 Design 222
5.3.2. Participants and Sampling 222
5.3.3 Research Materials 223
5.3.4 *Validity* 224
5.3.5 Data Collection 224
5.3.6 Data Analysis 225
5.3.7 Missing Data 225
5.3.8 Outliers 225
5.3.9 Ethical Issues 228
5.4.1 Demographic Information of the Observed Sample 229
5.4.2 Response Rate 231
5.4.6 Open Ended Questions 244
5.4.7 Frequencies Questions 254
5.5.1 The three Main Research Questions 259
5.5.2 Open-Ended Questions 266
5.5.3 Frequency Questions 269
5.5.4 Strengths and Limitations 273
5.5.5 Implication 274
5.5.6 Summary 275
Chapter 6: Research Findings and Discussion 276
6.1 introduction to Research Findings 276
6.2 Discussion of Research Findings in the Context of Prior Research 277
6.2.1 The Systemic Narrative Review 277
6.2.3 The Student's Questionnaire Study 286
6.3 Research Strengths and Limitations 290
6.4 Contribution of this Study to the Literature 293
6.5 Practical Recommendations 293

6.5.1 Development of IPL- Simulation Workshop 293
6.5.2 Development of a Practical Framework/Model 294
6.6 Implication of the Thesis 296
6.6.1 Implication Statement 296
6.6.2 Implications for Future Research 296
6.6.3 Implications for Educational and Clinical Practice 297
6.7 Conclusion 298
6.7.1 Summary of Key Findings 298
6.7.2 Overall conclusion 298
References 301
Bibliography 321
Appendix 1: List of free text words and MeSH used in search strategy 329
Appendix 2: Data extraction tables – systematic narrative review 331
Table 1. Nursing studies 331
Table2: Pharmacy studies 363
Table 3: Pharmacy, nursing and other profession studies 379
Appendix 3: Rating for Qualitative, Quantitative and Mixed Design Papers 398
Appendix 4: The three quality-check tool questions 415
Appendix 5: Participant information sheet for pharmacy and nursing teaching staff 417
Appendix 6: Participant information sheet for pharmacy and nursing students 418
Appendix 7: Consent form for interview study 420
Appendix 8: Topic Guide for Semi Structured Interview - Pharmacy and nursing teaching staff 421
Appendix 9: Topic Guide for Semi Structured and Focus Group - Pharmacy and nursing undergraduate students 424
Appendix 10: ICREC 15IC2586 JRCO HOD Full approval – Interview Study - from Imperial College London 426
Appendix 11: SP16-043 - approved ICF and SP16-043 - IRB Approval Memo for interview and questionnaire studies from King Abdullah International Medical Research Center 427

Appendix 12: IRB for approving interview and questionnaire studies at University of Dammam 429
Appendix 13: Interview study themes subthemes and quotes - NURSING TEACHING STAFF in the UK and SA 430
Appendix 14: Interview study themes subthemes and quotes - PHARMACY TEACHING STAFF in the UK and SA 450
Appendix 15: Interview study themes subthemes and quotes emerged - NURSING STUDENTS in the UK and SA 483
Appendix 16: Interview study themes subthemes and quotes emerged - PHARMACY STUDENTS in the UK and SA 504
Appendix 17: Summary of suggested strategies to improve medication safety based on methods recommended and barriers identified – interview study 538
Appendix 18: Correspondence emails acknowledging permission to use the H-PEPSS tool from Dr. Liane Ginsburg 547
Appendix 19: H-PEPSS tool 549
Appendix 20: Paper format questionnaire 552
Appendix 21: ICREC 16IC3171 JRCO HOD Full approval - Questionnaire Study – from Imperial College London 567
Appendix 22: Participant Information Sheet - Questionnaire study 568
Appendix 23: Determining sample size of a known population 570
Appendix 24: T-test for the pharmacy and nursing students rating of effectiveness of methods in the UK 571
Appendix 25: Chi-square test for rating of effectiveness for pharmacy and nursing students in the UK 572
Appendix 26: 'What modules or topics have helped you to understand medication safety?' 574
Appendix 27: 'What knowledge do you believe a qualified pharmacist and nurse will need to practise medication safety?' 577
Appendix 28: 'What skills do you believe a qualified pharmacist and nurse will need to practise medication safety?' 579
Appendix 29: What attitudes do you believe a qualified pharmacist and nurse will need to practice medication safety? 583

Appendix 30: Definition medication safety.....586

List of tables

Table 1. 1 WHO Curriculum Guide Topics (Adapted from WHO, 2011).....33
Table 1. 2 Educational and Training Frameworks (Models) 39
Table 3. 1 Inclusion and Exclusion Criteria.....59
Table 3. 2 Quality Check for the 82 Articles.....60
..... 73
Table 3. 4 Three Innovative Approaches as Described by Day et al. (2007) 82
Table 3. 5 Strategies Identified by Madhavanpraphakaran (2012) 85
Table 3. 6 Articles that Describe use of a Curriculum Guide or Framework 90
Table 3. 7 High Quality Studies 95
Table 3. 8 Opportunities to Curriculum Change Described by Hickey et al. (2010) 107
Table 4. 1 Aims and objectives.....114
Table 4. 2 The Methods used in Collecting Qualitative Data.....116
Table 4. 3 Universities which participated in the document review and interview studies in the UK and Saudi Arabia 117
Table 4. 4 Semi-structured Interviews: Number of Teaching Staff from Universities in the UK and KSA 123
Table 4. 5 Semi-structured Interviews - Composition and Number of Students from KSAU-HS and Imam Abdulrahman bin Faisal Universities in KSA.....123
Table 4. 6 Semi-structured Interviews - Composition and Number of Students from Universities 123
Table 4. 7 : Focus Groups –Composition and Size Number of Students from KSAU-HS in KSA 124
Table 4. 8 Themes Emerged in the Document Review Study from the UK Universities that Participated 126
Table 4. 9 Themes Emerged in the Document Review Study from Saudi Arabian Universities that Participated 127
Table 4. 10 Definitions of Themes and Sub-themes Emerging from Teaching Staff Interviews..... 131

Table 4. 11 Definitions of Themes and Sub-themes Emerging from Student Interviews ……. 177
Table 5. 1 Demographic Data……..230
Table 5. 2 Questionnaire Response Rate 232
Table 5. 3 Frequencies of Medication Safety Taught as UPL or IPL..... 233
Table 5. 4 Educational Methods Used in the UK and Saudi Arabia 233
Table 5. 5 Independent Samples T-test for Perceived Effectiveness of Methods Used to Deliver Medication Safety Education in the UK and Saudi Arabia 235
Table 5. 6 Independent Sample T-test for the Pharmacy and Nursing Students' Rating of Effectiveness of Methods in Saudi Arabia 236
Table 5. 7 The Effectiveness of Methods Used in Delivering of Medication Safety Education Per Year of Study as Perceived by Pharmacy Students in Saudi Arabia..... 237
Table 5. 8 The Effectiveness of Methods Used in Delivering of Medication Safety Education Per Year of Study as Perceived by Nursing Students in Saudi Arabia 238
Table 5. 9 Comparison of Confidence in Learning in Classroom and Clinical Settings Per Year of Study by Pharmacy Students in Saudi Arabia..... 240
Table 5. 10 Comparison of Confidence in Learning in the Classroom and Clinical Settings Per Year of Study by Nursing Students in Saudi Arabia..... 241
Table 5. 11 Comparison of Confidence in Learning in Classroom and Clinical Settings Per Year of Study by Pharmacy and Nursing Students in the UK..... 242
Table 5. 12 Comparisons of Pharmacy Students' Confidence Ratings in Two Learning Settings in Saudi Arabia 243
Table 5. 13 Comparisons of Nursing Students' Confidence Ratings in Two Learning Settings in Saudi Arabia 243
Table 5. 14 Comparisons of Pharmacy and Nursing Students' Confidence Ratings in Two Learning Settings in the UK..... 244
Table 5. 15Students' Responses on Methods Preferred 245
Table 5. 16 Modules which Helped Students in Understanding Medication Safety..... 246
Table 5. 17 Knowledge Needed as Perceived by Students..... 248
Table 5. 18 Skills Needed as Perceived by Students..... 249
Table 5. 19 Attitudes Needed as Perceived by Students..... 250
Table 5. 20 Definition of Medication Safety by Students..... 252

Table 5. 21 Responses of Pharmacy and Nursing Students Regarding who Teaches Medication Safety at the College. 255
Table 5. 22 Responses of Pharmacy and Nursing Students regarding Setting which Students Learn the Most about Medication Safety. 255
Table 5. 23 Responses of Pharmacy and Nursing Students regarding Current Medication Safety Education supporting Students' Understanding 256
Table 5. 24 Responses of Pharmacy and Nursing Students regarding the Mode of Integration of Medication Safety Education 258
Table 5. 25 Responses of Pharmacy and Nursing Students regarding Time Allocated for Medication Safety Education 258

List of figures

Figure 1. 1 Miller's Pyramid of Assessment of Clinical Skills (Adapted from Miller 1990) 43
Figure 2. 1 Exploratory Sequential Mixed methods Design (Adapted from Berman, 2017) 49
Figure 3. 1 Flow Diagram Illustrating the Search Strategy 62
Figure 4. 1 Data Analysis Framework - Pharmacy and Nursing Teaching Staff 130
Figure 4. 2 Data Analysis Framework - Pharmacy and Nursing Students 176

List of Boxes

Box 6. 1 Implications for Future Research 296
Box 6. 2 The Implication for Educational and Clinical Practice 297

List of abbreviations

APPE	Advanced Pharmacy Practice Experience
BMJ	British Medical Journal
CASP	Critical appraisal skills programme
CBAHI	Saudi Central Board for Accreditation of Healthcare Institution
CINAHL	Cumulative Index to Nursing and Allied Health Literature

CPS	Canadian Patient Safety Institute
DOH	Department of Health
ESR	Essential Safety Requirement
FDA	Food and Drug Administration
GCC	Gulf Cooperation Council
GPhC	General Pharmaceutical Council
HEE	Health Education England
HFACS	Human Factors Analysis and Classification System
H-PEPSS	Health Professional Education for Patient Safety Survey
HPPSACS	Healthcare Professionals Patient Safety Assessment Curriculum Survey
IOM	Institute of Medicine
IPA	International Pharmaceutical Abstracts
IPE	Inter-professional Education
IPL	Inter-professional learning
IPPE	Introductory Pharmacy Practice Experience
IPSG	International Patient Safety Goals
IRB	Institutional Review Board
ISMP	Institute for Safe Medication Practice
JCIA	Joint Commission International Accreditation
KAIMRC	King Abdullah International Medical Research Centre
KCL	King's College London
KSA	Kingdom of Saudi Arabia
KSA	Knowledge, Skills and Attitude domains
KSAU-HS	King Saud bin Abdulaziz University for Health Science
KSU	King Saud University
LASA	Look-alike and Sound-alike
MMAT	Mixed methods appraisal tool
MSE	Medication safety education
MOH	Ministry of Health
NHS	National Health System
NICE	The National Institute for Health and Care Excellence
NMC	Nursing and Midwifery Council

OSCE	Objective Structured Clinical *Examination*
PBL	Problem based learning
PGD	Post Graduate Diploma
PharmD	Doctor of Pharmacy
PNU	Princess Norah University
QSEN	Quality and Safety Education for Nurses
QSO	Quality and Safety Officer
RCA	Root Cause Analysis
RCDP	Riyadh College of Dentistry and Pharmacy
SBITT	Simulation-based Inter-professional Team-training
SCHS	Saudi Commission for Health Specialities
SDL	Self-directed learning
SFDA	Saudi Food and Drug Authority
SOS	Science of Safety
UCL	University College London.
UK	United Kingdom
UOD	University of Dammam (Imam Faisal bin Abdulrahman University currently).
UPL	Uni-professional learning
USA	United States of America
WHO	World Health Organization

Chapter 1: Introduction to Patient and Medication Safety Education

1.1 Overview of Chapter One

Chapter 1 introduces this study of patient and medication safety education in undergraduate pharmacy and nursing programmes, justifies the selection of the topic and explains the importance of the topic for researchers, public, healthcare service authorities, healthcare profession students in general and pharmacy and nursing students. In particular, pharmacy and nursing students are at the core of this thesis.

The concept and definition of medication safety and the prevalence of medication error incidents worldwide are discussed, with a specific focus on safety incidents in the UK and Saudi Arabia. Patient safety education and training models are then examined, including patient safety curriculum guides and standards in the UK and Saudi Arabia, educational models, the role of the pharmacist and nurse in improving medication safety and reducing medication errors, and the World Health Organization (WHO) Curriculum Guide for Patient Safety Education as an important international guide for healthcare professionals, especially pharmacy and nursing students. Finally, the specific research questions that drive this study and its aims and objectives are outlined.

1.2 The Rationale for Conducting the Study in the UK and Saudi Arabia

The rationale for completing my study in the UK and KSA is that medication safety education programmes for nursing and pharmacy undergraduates are still in their initial phases, and these academic curricula are still developing. Saudi Arabia was chosen as one component of my study to contribute to the reservoir of knowledge about curriculum development, especially as medication safety education programmes are still evolving. The UK was selected as a point of reference to Saudi Arabia in relation to medication safety education programmes for nursing and pharmacy undergraduates. Thus, I could contribute to the improvement and quality of the medication safety curricula in Saudi Arabia, drawing on my conclusions from studying both countries' curricula in this area. Furthermore, the internationalisation of the curriculum in healthcare transcends international borders meaning it is necessary for

students and healthcare professionals to develop a global perspective on healthcare, with the ultimate aim of both gaining knowledge about healthcare systems and practices in different countries worldwide and helping them recognise the differences and similarities in healthcare practices globally. In this fashion, such knowledge will equip healthcare professionals to deal with the challenges that arise in the healthcare sector when they have exposure to different healthcare systems and practices around the world. For example, when the world was exposed to the COVID-19 pandemic in 2020 and faced the challenge of controlling this contagious disease, healthcare authorities and professionals needed to control the disease by following the same set of standards and guidelines which indicates the importance of internationalising healthcare curricula. Accordingly, I chose to study in the UK and include Saudi Arabia: to obtain both perspectives on patient and medication safety education in different aspects (i.e., content of the curriculum, educational methods, learning outcomes, etc.) and to widen my knowledge and insights.

Andrew Keith Davey, A.K. (2023) highlighted that "internationalisation of the curriculum (IoC) is aimed at incorporating international, intercultural, and global dimensions into the curriculum, including consideration of content, teaching methods, and learning outcomes, and how these are supported at a programme and institutional level." Moreover, Nagarajan, S., McAllister, L. (2015), and Leask, B. (2012) agreed that 'the preparation of globally competent health graduates who have a good understanding of local and international healthcare is an important goal for healthcare education, and internationalisation of the curriculum is a critical component of any university's internationalisation strategy."

1.3 Introduction to Patient Safety

In order to understand the concept of patient safety, it is necessary to provide a definition. Many definitions are used such as the WHO Patient Safety Curriculum Guide Multi-professional edition (2011) definition of patient safety as "the reduction of risk of unnecessary harm associated with health care to an acceptable minimum.", (p 81). The WHO definition will be adopted for this thesis. The World Health Organization/Europe (2008) stated that, "The simplest definition of patient safety is the prevention of errors

and adverse effects to patients associated with healthcare." The NHS in England (2016) defined patient safety as "the avoidance of unintended or unexpected harm to people during the provision of healthcare". Patient safety as defined by Vincent 2006 (as cited by Vincent 2010) may be seen as "The avoidance, prevention and amelioration of adverse outcomes or injuries stemming from the process of healthcare" (Vincent, 2006). Patient safety was defined by the Institute of Medicine (IOM) as "the prevention of harm to patients." and "Emphasis is placed on a system of care delivery that (1) prevents errors; (2) learns from the errors that do occur and (3) is built on a culture of safety that involves healthcare professionals, organisations, and patients.", (Mitchell (2008), cited IOM definition in chapter 1).

This study provides progression on previous studies that call for patient safety and medication safety education evaluation and improvement. The UK Commission on Education and Training for Patient Safety (1990) noted that improving the education and training of students is a priority to create a more integrated National Health System (NHS) and that appropriate consideration should be given to safety in its broadest context. The Commission's report includes 12 recommendations; two recommendations (3 and 10) relate both the importance of developing an evaluation framework for patient safety education and the import of inter-professional learning.

Recommendation 3 states that "The Commission recommends Health Education England (HEE) works with partner organisations to facilitate the development of an evaluation framework to ensure that all education and training for patient safety commissioned in future, is effectively evaluated using robust models."

Recommendation 10 recognises the importance of increased opportunities for inter-professional learning, stating that "There is enthusiasm and a real need for more inter-professional, practical and team-based learning at every level, from first year undergraduates and apprentices through to the existing workforce. The Commission recommends HEE uses its levers to facilitate increased opportunities for inter-professional learning."

Patient and medication safety is an extremely resonant, rich, and sensitive topic that has concerned the public and healthcare services authorities alike for decades. Interest in patient safety has increased and evolved in the US and worldwide after several tragic incidents that led to the harm and death of patients, that shocked the public and authorities such as the death of Betsy Lehman, a journalist at the Boston Globe, due to a drug overdose during chemotherapy. Similarly, the death of Ben Kolb, an eight-year-old child during a minor surgery due to a drug mix-up has provoked much controversy. Moreover, the incorrect operation for the patient, Willie King, which led to the wrong leg being amputated has been a major concern. “These horrific cases that make the headlines are just the tip of the iceberg.”,(Kohn et al., 1999).

This indicates that the incidence of medication safety errors is high and regardless of advancement in patient care there are still a large number of errors and adverse events in hospitals. While healthcare has become more effective it has also become more complex, with greater use of new technologies, medicines and treatments. Unexpected and unwanted events can take place in any setting where healthcare is delivered (WHO/Europe, 2008). Furthermore, patient safety became an important topic after the US Institute of Medicine published a report that captured public, political and government attention. Vincent (2010) stated that” The US Institute of Medicine’s 1999 report ‘To err is human’ is a severe, clear and unarguable plea for action on patient safety at all levels of the healthcare system. Without doubt, the publication of this report was the single most important drive to the development of patient safety.” (p.25.) Moreover, Berwick (2013) mentioned that the patient safety problem that existed then throughout the NHS (referencing the Mid Staffordshire hospital scandal) may be the most significant fall in standards in care in the NHS, this problem indicating that the whole NHS should strengthen patient safety now and into the future. In addition, Berwick (2013) stressed that one of the recommendations to improve safety of patients is that mastery of quality and patient safety sciences and practices should be part of the initial preparation and lifelong education of all healthcare professionals, including managers and executives. Patient safety is the umbrella term relating to several topics including medication safety and medication errors.

The methodological basis of the thesis is the Donabedian structure, process, and outcome conceptual model (Ameh et al., 2017), which has been modified and adapted to the needs of this study (Chapter-4). In particular, the Donabedian model was used to develop a proper quality research design, process, and quality improvement. The Donabedian model is a conceptual model that provides a framework for examining health services and evaluating quality of health care. According to the model, information about quality of care will be derived from three categories: 'structure', 'process' and 'outcomes' (Donabedian, A. 1988).

1.4 Medication Safety and Errors

1.4.1 Introduction to Medication Safety and Errors – Concept and Definition

"Medications are the most common treatment intervention used in healthcare around the world. When used safely and appropriately, they contribute to significant improvements in the health and well-being of patients. In January 2014, the Health Council of Canada reported that more than half of Canadians are regularly using prescription drugs, with 36 per cent taking two or more medications. However, despite the best intentions of healthcare providers and the design of healthcare systems, medications can cause patient safety incidents,", (ISMP Canada, 2007). Moreover, a report estimated that 237 million medication errors occur at some point in the medication process in the NHS in England per year. It is likely that many errors are discovered and prevented before reaching the patient and causing harm. However, the number is still high, (Elliott et al, 2018, p.4). Furthermore, Alsultan et al (2013) reported that in Saudi Arabia hospital pharmacists in the Riyadh region are actively engaged in monitoring medication therapy and providing patient and medication education. However, the medication errors percentage remains high. Adverse drug events (ADEs) and drug-related problems were common in Saudi hospitals, mainly in ICUs and among the hospitalised children, causing major morbidity and mortality. Dosing and drug choice problems are the most frequent problems. (Aljadhey et al. 2016; Rashed et al. 2012). Definitions are presented in this section and will be repeated throughout this study to help the reader understand the concepts under discussion. Medication safety is defined as 'freedom from preventable harm with medication use' (ISMP Canada, 2007). Mohammed Islam (2007), Department of Patient Safety, Long Island University,

USA, stated that “medication safety can describe a project that provides healthcare professionals with a systematic assessment of their clinical practices in relation to the safe use of medications...” (p 2). The National Coordinating Council (2015) defines a "medication error" as follows:

> "*A medication error is any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the healthcare professional, patient, or consumer. Such events may be related to professional practice, healthcare products, procedures, and systems, including prescribing; order communication; product labelling, packaging, and nomenclature; compounding; dispensing; distribution; administration; education; monitoring; and use."*

Similarly, adverse drug events (ADEs) and adverse drug reactions were defined as follows:

> *“An adverse drug event (ADE) is an injury resulting from medical intervention related to a drug. This includes medication errors, adverse drug reactions, allergic reactions, and overdoses” (Health.gov., 2021). Another definition is "an injury from a medicine or lack of an intended medicine. Includes adverse drug reactions and harm from medication incidents" (Bates, 1997). While an adverse drug reaction is defined by WHO (1972) as "a response to a drug that is noxious and unintended and that occurs at doses normally used in man for the prophylaxis, diagnosis, or therapy of disease, or for the modification of physiological function". Furthermore, the National Center for Biotechnology Information (NCBI) definition was "An adverse drug reaction (ADR) can be defined as “an appreciably harmful or unpleasant reaction resulting from an intervention related to the use of a medicinal product; adverse effects usually predict hazard from future administration and warrant prevention, specific treatment, or alteration of the dosage regimen" (NCBI-NIH, 2021).*

1.4.2 Prevalence of Medication Error Incidents Worldwide, in the United Kingdom and Saudi Arabia

The interest regarding medication errors increased from 1995 onwards when several errors led to death and harm to patients and shocked the public and the authorities. A movement for patient safety began in 1995 when serious incidents and errors occurred and led to death or inappropriate surgery were publicised, (Cohen, 2007, p.3). Makary and Daniel (2016) estimated that medical errors including medication errors are the third most common cause of death in the USA, however, medical error is not recorded on US death certificates.

There is evidence from international literature that medication errors occur in all healthcare settings. In the Building Safer Patient Safety report (DOH, 2004) several statistics/figures were provided for medication error incidents and prevalence that led to harm, prolonged hospital stays and increased cost. For example, in the USA, it is estimated that 7,000 deaths each year are caused by medication errors. Similarly, it was reported that medication errors carry human costs for the patient, their family, and friends and for the professionals concerned. This leads to an increase of the financial burden on the NHS. Moreover, it was found in a study, which included more than 4000 admissions in two US tertiary care hospitals, that in almost two per cent of the admissions surveyed, there was a preventable adverse drug event, resulting in a mean increased hospital stay of 4.6 days and additional costs of US$ 5857, (DOH, 2004).

In Saudi Arabia, the prevalence of medication errors is not accurately reported as error reporting is very low due to fear of consequences**.** In addition, many errors are never reported by healthcare professionals due to fear of punishment, that leads to a difficulty in estimating the exact number of medication errors in Saudi Arabia (CBAHI, 2016). Furthermore, it was revealed that reporting of medication error was low due to underreporting in hospitals in Riyadh, (Hemida et al. 2011; Alshaikh et al. 2013). In contrast, Hutchinson et al. (2009) noted that incident reporting rates from acute hospitals in the UK increased since connecting to the national reporting system, and higher rates of error reporting associated with positive safety culture.

1.5 Patient Safety Education and Training Models

1.5.1 Patient and Medication Safety Education Curriculum Guides, Regulatory Bodies and Standards for Pharmacy and Nursing in the UK

The selected UK universities that participated in this study indicated that there is no specific, unified guideline in respect of medication safety education. Each organisation selects their own guidelines and resources, whether international guidelines, such as the WHO Patient Safety Curriculum Guide, or local guidelines (Chapter 4, Table 4.8). In the UK, pharmacists and nurses have a national standard for practice known as the General Pharmaceutical Council (GPhC) for pharmacists that is the regulatory body for

pharmacy practitioners. Similarly, the Nursing and Midwifery Council (NMC), is the regulatory body that sets the standards for nursing education, ensuring that nurses have the necessary skills and qualities to practise.

GPhC standards include three standards relating specifically to safety: Standard 1 "patient and public safety" that includes important details of requirements states "there must be clear procedures to address concerns about patient safety arising from initial pharmacy education and training. Concerns must be addressed immediately."; Standard 5 "curriculum delivery and the students' experience" includes criterion 5.11, that states "patient safety must be paramount in assessment: any evidence of an assessment demonstrating unsafe practice must result in failure."; and Standard 10 "outcomes" includes criterion 10.2.3, that states that practitioners have a responsibility for "ensuring that safe and effective systems are in place to manage the risk inherent in the practice of pharmacy and the delivery of pharmaceutical services.,(GPhC, 2011, p. 8, 18 and 33).

The Standards Framework for Nursing and Midwifery Education applies to all approved education institutions (AEIs) and their practice learning partners that are running NMC approved programmes. These standards aim to provide AEIs and practice learning partners with the flexibility to develop innovative approaches to all education for nurses and midwives, while being accountable for the local delivery and management of approved programmes in line with our standards. These standards for education and training are necessary to achieve the standards of proficiency for admission to the register. Together these are the NMC Standards for Education and Training ('realising professionalism') for the nursing and midwifery professions, (Standards for Nursing and Midwifery Education, 2018, p. 3. "Public safety is central to our standards. Students will be in contact with people throughout their education and it is important that they learn in a safe and effective way." (Standards for Nursing and Midwifery Education, 2018, p. 4).

There are five standards for Nursing and Midwifery Education:(1) Learning culture that inter-professional and teamwork concepts are embedded; (2) Educational governance

and quality which stressed that all learning environments optimise safety and quality, taking account of the diverse needs of, and working in partnership with, service users, students and all other stakeholders; (3) Student empowerment, (4) Educators and assessors and (5) Curricula and assessment. These standards were used to assess the safety and effectiveness of all learning environments. The aforementioned five standards are general and not specific to patient or medication safety education, (Standards for Nursing and Midwifery Education, 2018, p.5).

Although there is a national standard for practice in the UK for both pharmacy and nursing professions, these standards are very general, sometimes vague and have no comprehensive instructions relating to patient and medication safety education and training.

1.5.2 Patient and Medication Safety Education Curriculum Guides, Regulatory Bodies and Standards for Pharmacy and Nursing in Saudi Arabia

In Saudi Arabia, there are no specific unified guidelines relating to medication safety education as each organisation selects their own guidelines and resources, whether international guidelines such as the WHO Patient Safety Curriculum Guide, the Institute for Safe Medication Practice (ISMP) and the Joint Commission International (JCI) Accreditation standards and guidelines or local guidelines, (Chapter 4, Table 4.9).

Furthermore, in Saudi Arabia, there is a Saudi Commission for Health Specialties (SCHS) or "the Saudi Council" that regulates healthcare-related practices for all healthcare professions including pharmacy and nursing. The Saudi Council set general standards for health practice and there are no specific standards for patient or medication safety education and training. (M Bodrick 2017, personal communication, 11 December). The SCHS is the independent authority that regulates healthcare related practices and accreditation at all levels in Saudi Arabia. The SCHS was established in 1992 to set standards for health practice and support and approve training programmes, (SCHS website, 2018).

In Saudi Arabia, the Saudi Central Board for Accreditation of Healthcare Institutions (CBAHI) is the official agency authorised to grant accreditation certificates to all government and private healthcare facilities operating in Saudi Arabia. CBAHI emerged from the Saudi Health Council as a non-profit organisation, its principal function being to set healthcare quality and patient safety standards against which all healthcare facilities are evaluated for evidence of compliance. In 2006, with the help of healthcare quality experts from the public and private sectors, CBAHI developed the first set of national standards for hospitals. The national standards were called the Essential Safety Requirements for Patient Safety (ESR), a list of 20 national standards for hospitals. They are deemed to be basic conditions that must be fully observed to ensure patient safety and protection against healthcare related errors. In the CBAHI standards, there were three standards that explicitly mentioned medication safety related issues, MM.5 “the hospital has a system for safety of high alert medication” MM.6 “the hospital has a system for safety of look-alike and sound-alike (LASA) medication” and MM.41 “the hospital has a process for monitoring, identifying and reporting significant medication errors, including near misses, hazardous conditions, and at-risk behaviours that have a potential to cause patient harm.”,(CBAHI website, 2018).

The Saudi Food and Drug Authorities (SFDA) is a regional regulatory authority for food, drugs and medical devices, which contributes to the protection and advancement of health in Saudi Arabia and aims to ensure the safety of food; the safety, quality and efficacy of drugs; and the safety and effectiveness of medical devices by developing and enforcing an appropriate regulatory system. This body provides instruction and guidelines related to safety issues and distributes safety alerts, circulars, and information to hospitals and the public.

Before the development of CBAHI national standards, each institution, and all hospitals and universities used a range of different standards, mainly those of the Institute for Safe Medication Practice (ISMP), International Patient Safety Goals (IPSG) and Joint Commission International (JCI) Accreditation or they used local policies and procedures including patient and medication safety instruction and guidelines. Moreover, each healthcare organisation (whether hospitals or healthcare colleges) in Saudi Arabia has

its own regulations and its own scope of practice according to local policy, and in that they exclude CBAHI standards, as they are relatively new, there are no unified national standards that control and regulate practice in general or patient and medication safety practice specifically.

1.5.3 WHO Curriculum Guide for Patient Safety Education

1.5.3.1 Importance of Using the WHO Patient Safety Curriculum

The Multi-Professional Edition of the Patient Safety Curriculum Guide is a comprehensive guide to assist the effective development of patient safety education by healthcare academic Institutions. As patient safety teaching is a relatively new field for most healthcare educators, this curriculum guide provides educational frameworks and features a variety of concepts and methods for teaching and assessing patient safety.

The Patient Safety Curriculum Guide seeks to fill the gap in patient safety education by providing a comprehensive curriculum designed to build foundation knowledge and skills for all healthcare students that will better prepare them for clinical practice in a range of environments, (WHO Curriculum Guide, 2009).

The document comprises two parts: Part A: Teacher's Guide; and Part B: 11 Patient Safety Topics. Part A is intended for healthcare educators. It provides them with knowledge and tools, and helps them develop the skills necessary for implementing patient safety education in their institutions. Clear examples of how patient safety might be taught are provided throughout Part A. Part B addresses both healthcare educators and students. It contains 11 ready-to-teach, topic-based patient safety programmes that can be used as a whole or on a per topic basis (see Table 1.1). The topics cover a wide range of contexts in which patient safety can be taught and learned.

The WHO Curriculum Guide was used as a reference source in this thesis and the recommendations and topics provided in the guide were reviewed and consulted. Questions regarding use of the guide as a reference work were included in the topic

guide to assess whether teaching staff were referring to the guide when developing patient safety or medication safety education materials. The guide was used when developing the questionnaire regarding educational interventions and recommendations. The 11 topics included in the WHO Patient Safety Curriculum Guide are very important, but topic 1, what is patient safety and topic 11, improving medication safety are most relevant to this thesis. The following two paragraphs will talk briefly about topics 1 and 11.

Table 1.1 WHO Curriculum Guide Topics (Adapted from WHO, 2011)

	Topics
1	What is patient safety?
2	Why applying human factors is important for patient safety?
3	Understanding systems and the effect of complexity on patient care.
4	Being an effective team player.
5	Learning from errors to prevent harm.
6	Understanding and managing clinical risk.
7	Using quality-improvement methods to improve care.
8	Engaging with patients and carers.
9	Infection prevention and control.
10	Patient safety and invasive procedures.
11	Improving medication safety.

1.5.3.2 What is Patient Safety?

As reported in the WHO curriculum guide (2011), there is now overwhelming evidence that significant numbers of patients are harmed by healthcare, resulting in permanent injury, hospital admissions, increased lengths of stay in hospital and even death. For example, the WHO (2008) reported, during the last 35 years, errors occurred when vincristine (a chemotherapy drug, a member of the vinca alkaloids group) was accidentally applied via a spinal route, and errors concerning this drug have continued to be reported - approximately 55 times in a variety of international settings. In addition, Runciman et al. (2003) found a strong correlation between increasing medication use and rates of adverse drug reaction (ADRs) linked with hospitalisation. Moreover, Kaushal et al. (2001) reviewed 10,778 medication orders in two paediatric inpatient settings and found 616 (5.7 per cent) medication errors, and 115 (1.1 per cent) potential ADEs. These results suggest more efforts are required to reduce them. From the previous examples, we can conclude that medication errors and adverse drug

events were still of great concern and needed more efforts to prevent and improve the service provided to patients.

Over the last decade, there has been increased awareness that adverse events occur not because people intentionally hurt patients, but rather due to the complexity of healthcare systems today, where the successful treatment and outcome for each patient depends on a range of factors, in addition to the competence of the individual healthcare provider.

Certain learning objectives are important in the education of healthcare professionals and students should understand the discipline of patient safety and its role in minimising the incidence and impact of adverse events, as well as maximising recovery from these events.

Patient safety knowledge and skills cover many areas: including effective teamwork, accurate and timely communication, medication safety, hand hygiene and procedural and surgical skills. All these areas affect knowledge and performance. The topics in the WHO Curriculum Guide have been selected based on evidence of their relevance and effectiveness. Furthermore, an overview of patient safety is presented which sets the scene for deeper learning in some of these areas.

In terms of knowledge, according to the WHO (2011) students should discern the harm caused by healthcare errors and system failures; learn about error and system failure from other industries; be familiar with the history of patient safety and the origins of the blame culture; understand the difference between system failures, violations and errors and there should be a model of patient safety accessible to them.

1.5.3.3 Improving Medication Safety

As noted in the WHO curriculum guide (2011), it is necessary to focus on medication safety because although medicines have proven to be very beneficial in treating illness and preventing disease, their success has resulted in a dramatic increase in the use of medication. This in turn has brought with it an increase in hazards, errors and adverse events associated with medication use.

This topic provides an overview of medication safety and is designed to encourage students to continue to learn and practise ways to improve the safety of medication use. To practise safely students should know a range of knowledge requirements such as the scale of medication error; that the use of medications is associated with risks; common sources of error; where in the process errors can occur; the responsibilities associated with prescribing and administering medication; how to recognise common hazardous situations; ways to make medication use safer and the benefits of a multidisciplinary approach to medication safety. In addition, the students should understand that the performance requirements relating to medication safety is a vast topic. A health professional who understands the issues and risks involved in the use of medication will: use generic names; tailor prescribing for each patient; practise taking thorough medication histories; know which medications are high-risk; be very familiar with the medication he/she prescribes and/or dispenses; use memory aids; communicate clearly; develop checking habits; encourage patients to be actively involved in the medication process; report and learn from errors; understand and practise drug calculations, including adjustments based on clinical parameters (e.g. renal clearance) and detect potential/actual drug–drug and drug–food interactions.

1.5.4 Role of Pharmacists and Nurses in Improving Medication and Patient Safety

1.5.4.1 Role of Pharmacists

Pharmacists are medication experts with extensive and specific knowledge of all aspects of medication and play a key role in ensuring medication safety and patient safety. Cavell (2009) noted that all pharmacists, as medicines experts, have a role to play in patient safety, stating that "Over recent years, particularly in acute hospitals, pharmacists have developed specialist roles in medication safety, working with colleagues in pharmacy and other professions to identify problems with medicines' use and prevent errors." Medication safety is a global concern among healthcare professionals. Pharmacists play a major role in identification, prevention, and monitoring of medication errors, (Joint Commission Resources, 2007, p.97).

In Saudi Arabia, until recently, few hospitals employed a medication safety officer which is significant as a medication safety officer has a key role in improving

medication safety and educating hospital staff about medication safety related issues, including tools to identify medication errors and improve safety among different hospital departments. However, a new medication safety officer preparatory course has now been developed in Saudi Arabia to support medication safety awareness, when Aljadhey (2017) noted that a medication safety officer preparatory course was planned using a structured curriculum to equip pharmacists with the knowledge and skills to begin medication safety officer duties.

In Saudi Arabia, the topic of medication safety is discussed and considered at practitioner level, but not at undergraduate level. Medication safety practices were assessed in Saudi Arabian hospitals and Aljadhey (2013) concluded that core practices to improve medication safety were not implemented in many hospitals in Saudi Arabia and that an effort should be made at national level to increase the adoption of such practices in developing countries.

Most studies relating to medication safety and medication errors are conducted in hospitals and focus on prescribing errors. Aljeraisy (2011) noted, in a study in paediatric inpatient tertiary care setting in Saudi Arabia, that the incidence of medication prescribing errors was significantly high, and large-scale prospective studies are recommended to determine the extent and outcome of medication errors in paediatric hospitals in Saudi Arabia. Aldhawailie (2011) found that the main cause of inpatient prescribing errors in a teaching hospital in Saudi Arabia is the lack of prescribing skills, and that use of technology in the prescribing process would support the practitioner in reducing the incidence of prescribing errors. Aljadhey (2014) found that the major factors contributing to medication safety problems in Saudi Arabian hospitals were: unrestricted public access to medications from various hospitals and community pharmacies, communication gaps between healthcare institutions, limited use of important technologies such as computerised provider order entry, and the lack of medication safety programmes in hospitals. In the same study, challenges to current medication safety practice identified by participants included: underreporting of medication errors and adverse drug reactions, multilingualism and differing backgrounds of healthcare professionals, lack of communication between healthcare

providers and patients and high workloads. Suggestions for improving medication safety practices in Saudi Arabia included: continuous education for healthcare professionals and competency assessment focusing on medication safety, development of a culture that encourages medication error and adverse drug reactions reporting, use of technology proven to decrease medication errors and promotion and implementation of national patient safety initiatives.

1.5.4.2 Role of Nurses

> "*Nurses play a significant role in improving patient and medication safety. Of all the members of the health care team, nurses play a critically important role in ensuring patient safety by monitoring patients for clinical deterioration, detecting errors and near misses, understanding care processes and weaknesses inherent in some systems, and performing countless other tasks to ensure patients receive high-quality care." , (Opening statement in Nursing and Patient Safety, 2018).*

Durham (2015) noted that nurses must recognise their own role in preventing medication errors by reporting errors and having proper knowledge of pharmacology that allows them to integrate pharmacokinetics and pharmacodynamics' principles into clinical practice that are essential for patient safety and recognising that perceptual factors as misperceptions are at the root of many medication errors as well as recognising human factors. According to the Joint Commission's (2004) analysis of root causes by event type, human factors account for 73 per cent of all medication errors. Finally, by understanding system and environmental factors, such as the medication administration process, involves multiple decision points that increase the potential for error.

Hughes (2008) noted that nurses are primarily involved in the administration of medications across settings. Nurses can also be involved in both the dispensing and preparation of medications (in a similar role to pharmacists), such as crushing pills and drawing up a measured amount for injection. Accordingly, nurses play a pivotal role in recognising and reporting medication administration errors.

1.5.5 Some Educational and Training Models

This thesis focuses on the fields of undergraduate pharmacy and nursing education. It is essential to apply some of the educational and training theories to assess and measure any potential educational intervention. A range of theories and frameworks have been identified (see Table 1.2), such as the Kirkpatrick model (1959), Kolb's cycles of experiential learning (1984), Bloom's taxonomy (1956), Miller's pyramid of assessment for clinical competence (1990) and O'Malley's training evaluation framework (2013). Miller's pyramid will also be considered later when discussing intervention development.

In the systematic literature review (chapter 3), studies that discussed educational theory or framework are reviewed. In addition, an interview study (chapter 4) was used to establish if teaching staff referred to any educational or learning theories at any stage in their teaching and training process, and how applicable and practical these theories are in enabling better medication safety understanding and medication safety education.

Table 1.2 Educational and Training Frameworks (Models)

	Kolb (Kolb and Fry, 1975)	**Bloom (Crowe et al. 2008)**	**Kirkpatrick (Bates, 2004)**	**Miller (Okuyama et al. 2011 and Kamarudin et al. 2013)**	**O'Malley (O'Malley et al. 2013)**
Definition	Experiential learning is the process of learning through experience, "*learning through reflection on doing.*"	Bloom's taxonomy is a multi-tiered model of classifying learning according to six cognitive levels of complexity. Revised versions of Bloom's taxonomy were developed which included affective and psychomotor domains. This model or framework became a taxonomy of three domains: 1-The cognitive-knowledge based domain (consisting of six levels). 2-The affective- attitudinal based domain (consisting of five levels). 3-The psychomotor-skills based domain (consisting of six levels).	Kirkpatrick evaluation model consist of four levels which are designed as a sequence of ways to evaluate training programmes. Consist of four levels: reactions, learning, behaviour and results.	Miller's Pyramid of Assessment provides a framework for assessing clinical competence in medical education and can assist clinical teachers in matching learning outcomes (clinical competencies) with expectations of what the learner should be able to do at any stage. This model or framework consists of 4 domains: 1-Knows 2-Knows how 3-Shows how 4- Does	Training evaluation framework: Designed to serve as a practical tool for evaluation efforts that seek to link training interventions to their intended outcomes.
Key themes	Four steps Experiential Learning Model (ELM): Concrete experience Reflective experience Abstracts conceptualisation Active experience	Cognitive domain: Knowledge, comprehension and application (lower levels). Analysis, synthesis and evaluation (higher levels). Affective domain: Receiving phenomena, responding to phenomena, evaluating, organisation and internalising values.	The four steps of evaluation consist of: Step 1: Reaction - How well did the learners like the learning process? Step 2: Learning - What did they learn? (The extent to which learners gain	The 4 domains or themes are: 1-Knows: knowledge tested by written exams (cognition). 2-Knows how: application of knowledge: tested by clinical problem solving (cognition).	Evaluation levels (individual, organisational and health systems/population).

	Kolb (Kolb and Fry, 1975)	Bloom (Crowe et al. 2008)	Kirkpatrick (Bates, 2004)	Miller (Okuyama et al. 2011 and Kamarudin et al. 2013)	O'Malley (O'Malley et al. 2013)
		Psychomotor domain: Limitation, manipulation, precision, articulation, naturalisation.	knowledge and skills.) Step 3: Behaviour - (What changes in job performance resulted from the learning process? (Capability to perform the newly learned skills while on the job) Step 4: Results - What are the tangible results of the learning process in terms of reduced cost, improved quality, increased production, efficiency, etc.?	3-Shows how: demonstration of clinical skills: tested by OSCE, standardised patients, clinical exams, etc. (Competency and behaviour). 4- Does: daily patient care: assessed by direct observation in clinical settings (performance and behaviour).	
Key articles/ books (from which the framework or model was quoted)	Toward an applied theory of experiential learning.	Biology in Bloom: Implementing Bloom's Taxonomy to Enhance Student Learning in Biology.	A critical analysis of evaluation practice: The Kirkpatrick model and the Principle of Beneficence.	1-Assessing the Patient Safety Competencies of Healthcare Professionals: a systematic review. 2-Educational Interventions to Improve Prescribing Competency: a systematic review.	A Framework for Outcome Level Evaluation of In-service, Training of Healthcare Workers.

The main purpose of Table 1.2. is to provide a critical overview of current learning models. In particular, Kolb uses the concept of experiential learning to combine its different styles on the basis of the theory that the learning process is different for each person, (Morris, 2019). It is a kind of cycle that includes the accumulation of personal life experience in the chosen profession, along with its analysis, comprehension, and development, then replenishment of the theoretical foundations of knowledge, and, eventually, practical actions. Accordingly, the circle closes, and the learners acquire a new but already professional experience. In this regard, the advantage of Kolb's model is the fact that it allows a student to choose one's own comfortable learning style. It could also probably be used to educate about medication and patient safety, as students would be more accepting of this approach, (Boggu & Sundarsingh, 2019). However, although Kolb's learning model is widely used, the results of various studies indicate the presence of serious shortcomings in it, (Manolis et al., 2013). Some other scholars, such as Pashler et al. (2008), doubt the existence of such a concept as a "learning style." The researchers argue that no matter what a person thinks about learning styles, other factors, such as internal cognitive and emotional skills, also affect the effectiveness of the process.

In turn, Bloom's model allows students to develop critical thinking, which is also an important element in the process of learning medication and patient safety (Kim et al., 2012). Bloom's taxonomy is not just a classification scheme but an organisation of thought processes along a hierarchy. However, this approach is also subject to criticism. For example, one of the key complaints is that the sequence itself does not work in taxonomy. According to Edirisinghe et al. (2022), in modern learning, the process must be reversed; that is, students begin to understand and remember the necessary information through the creation of something. In this regard, this model is not optimal for use in medication and patient safety education.

Another model that could be considered promising is Kirkpatrick's model. It is assumed that without assessing the effectiveness of the learning process, it is impossible to build a learning and development system that would provide the necessary outcomes, (Alsalamah & Callinan, 2021). The experts argue that the four-

level learning cycle has many advantages, such as ease of understanding, good elaboration, and widespread use. However, at the same time, critics consider Kirkpatrick's approach overly simplistic, as there are no proven causal relationships between levels, and assessment levels do not go beyond learning, (Verzat et al., 2009). Accordingly, this approach does not include measures to improve the productivity and effectiveness of learning, which means that it is poorly suited as a basic structure within the thesis.

The next learning model, O'Malley's learning assessment model, which its author characterises as one of the most effective tools for assessing results, (O'Malley et al., 2013), involves assessing learning at three levels: individual, organisational, and the health system level. This approach can be considered optimal since it covers various types of results while considering additional factors that could affect the educational process. However, to date, this model is one of the least studied, as confirmed in the study by O'Donovan et al. (2018). For this reason, it was decided not to use it in the structure of the thesis.

Finally, the last model considered is the Miller pyramid. This structure is not new, but it has already proven its effectiveness in practice. The pyramid has four levels, which reflect the staging of the formation of a medical worker's professional competence. The assessment of the first level of the Miller pyramid is aimed at confirming that a medical specialist has received the knowledge necessary to perform professional duties. The second level involves confirming that the specialist can apply existing knowledge to solve clinical problems. In turn, the third level corresponds to practical skills, abilities and competencies in a simulation environment. Finally, the last level characterises the possibility of independent practice in real clinical settings. Some critics believe that Miller's model is not sufficiently adapted to the requirements of today's medical education since only the last two of its levels are informative, (Rethans et al., 2002). However, according to Thampy et al. (2019), the Miller Pyramid allows educators to measure student growth adequately and incrementally and has a high level of confidence in the results. In addition, it is one of the best approaches for the development of learners' clinical thinking, which results in future diagnostic

accuracy and a high quality of medical care. This reason determines the choice of Miller's model as the basis for organising medication and patient safety education.

In 1990, psychologist George Miller proposed a framework for assessing levels of clinical competence or methods of assessment in medical education, where he produced a pyramid with the following four levels (see Figure 1.1). 'Knows' (knowledge) is at the lowest level of the pyramid followed by 'knows how' (competence), 'shows how' (performance), and 'does' (action). The two lowest levels 'know 'and 'know how' represent the knowledge domain, and the highest levels 'show how' and 'does' represent the skills and attitudes domains. The use of Miller's pyramid for assessment of clinical skills will combine with the WHO Patient Safety Curriculum Guide's instructions.

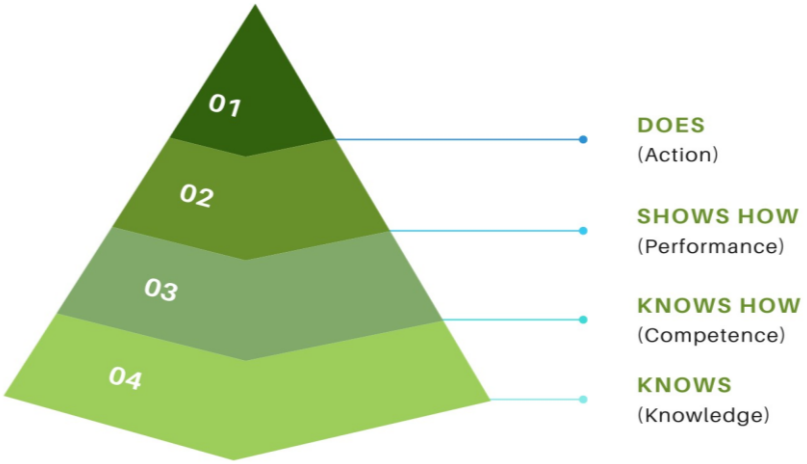


Figure 1. 1 Miller's Pyramid of Assessment of Clinical Skills (Adapted from Miller 1990)

Miller's pyramid, representing four levels of clinical assessment. is discussed in Chapter 6 and is consisted of Level 1 – 'Knows' (knowledge): This includes knowledge about medication safety and medication errors, definitions, types of errors, causes of errors, strategies to reduce medication errors, how to manage the situation after medication errors happen and quality tools to investigate errors. Teaching methods include using lectures, case-based studies and videos about errors. Assessment may include essays, oral examinations, traditional true/false and multiple-choice questions (MCQs). Level 2 – 'Knows how' (competence): At this level, the student knows how to apply knowledge through case-based study, presentations, self-directed learning

(research), and workshops. Assessment may include essays, oral examinations and multiple-choice questions. (Levels 1 and 2 represent the knowledge domain.) Level 3 – 'Shows how' (performance): At this level, students show how to apply knowledge and skills through demonstration in a simulated environment (i.e., simulation sessions and OSCE's) or in a real-life situation (hospital training). Assessment may include objective structured clinical examinations (OSCEs), simulated patient assessment, medication dispensing and administration tests, taking a patient history, error reporting forms and use of root cause analysis (RCA) tool. Level 4 – 'Does' (action): the student applies that knowledge and skills in a clinical setting or in pre-registration assessment (by direct observation when performing specific tasks). The student needs to be observed by their trainer. Assessment may include OSCEs, taking a patient history, direct observation by trainer and workplace-based assessment. (Level 3 & 4 represent skills and attitudes domains.)

1.6 Aims and Objectives

The aim of the studies reported in this thesis was to identify and describe current medication and patient safety education in the UK and Saudi Arabia, and to analyse the factors that affect medication safety teaching. Furthermore, the studies were conducted to recommend using an existing framework to organise or improve medication safety education (Miller). The objectives were as follows:

1. To describe the current content of medication safety in the curriculum of pharmacy and nursing programmes.
2. To identify the current methods used to deliver medication safety education and their effectiveness.
3. To identify the guidelines and educational frameworks currently used in medication and patient safety teaching.
4. To understand the barriers and challenges to improving medication safety education.
5. To understand the degree of confidence that students feel in learning about medication and patient safety in classroom and clinical settings.

Any project to improve patient and medication safety should include teaching staff and students as key factors in the success of the project and sustainability of results. Students and teaching staff are the stakeholders in medication and patient safety education. Recognising them, listening to their voices, and exploring their thoughts, views and concerns is the first step towards the repair of medication and patient safety education. Knowing what is failing in the current medication and patient safety education and curriculum provides an opportunity to set things right and plan for improvement and development of a framework that organises the curriculum and teaching process to achieve the desired learning outcomes.

1.7 Summary

This chapter has outlined the basis of the thesis by providing an introduction to patient safety and medication safety and giving some figures on the prevalence of medical errors including medication errors - the topic of concern. An outline of patient and medication safety education specifically in relation to curriculum guides or guidelines was used and specific standards relating to teaching and training regarding medication safety was presented. The importance of the WHO Patient Safety Curriculum Guide was also discussed, together with some of the educational models used for teaching and training, including Miller's pyramid for assessment of clinical skills as a potential educational model. In the following chapter, I identified the research methods and thesis structure and provided the rationale for selecting the mixed-methods design.

Chapter 2: Overview of Research Methods and Thesis Structure

2.1 Chapter Overview

This chapter outlines the research design and methods used followed by the rationale for selecting a mixed method approach and the exploratory sequential mixed methods' design. The research components are described as well as brief descriptions of two empirical studies. The descriptions include the philosophy underpinning each study, the approach selected and strategy and research design. Finally, an overview of the thesis structure and summary of the chapter are provided.

2.2 Research Design: A Mixed Methods Approach

In the past, a quantitative approach was preferred by healthcare researchers as it is measurable and tangible compared to a qualitative approach that, some argue, is less measurable and depends on views, feelings, and emotional components obtained from interviewees that are difficult to measure and quantify, (Hadi et al., 2016). However, in recent years, a combination of the two approaches has been used by researchers. This is known as the mixed method approach that includes several designs as proposed by Creswell and Plano-Clark (2011). Tashakkori and Creswell (2007) defined mixed methods as "research in which the investigator collects and analyses data, integrates the findings, and draws inferences using both qualitative and quantitative approaches or methods in a single study or a programme of inquiry." The purpose of selecting a mixed method approach was to triangulate the findings and give it more credibility. Hadi (2016) defined triangulation as "a way of confirming new information over the course of data collection. It usually includes seeking multiple and different information sources or using different data collection techniques to obtain the information about the same phenomenon,"

In this thesis, both positivist (quantitative study) and Interpretative (qualitative study) approaches are used. Henn (2006) noted that the positivist approach is based on application of the scientific method used in natural sciences. This approach deals with phenomena that are tangible and measurable. Positivism is associated with the

quantitative approach (for example questionnaires). The purpose of social research is to establish the scientific laws of society that are arrived at by testing research hypotheses. Henn (2006) noted that Interpretativism holds that to explain human behaviour, social researchers need to understand the meanings and interpretations that people attach to phenomena in the social world. Interpretativism is associated with qualitative methods (e.g., such as in-depth interviews). The purpose of social research is to build an understanding of the motives and intentions that underpin social behaviour.

2.2.1 Rationale of the Research Design

A qualitative study using the interview and document review methods were used to gain information based on the experiences of teaching staff and students regarding the subject matter. It is a rich study as it includes the diverse and unique experiences of two groups. One group is the teaching staff in both pharmacy and nursing schools that have different backgrounds and practices. Some of the teaching staff are purely academic staff, others are clinicians working in clinical settings, and some have a combination of academic affiliation and practising clinician skills. This diversity in experience reflects positively on the results of this study and enriches its datasets. Moreover, there is a variation in the number of years' experience which ranges from one year for junior teaching staff to 30 years for senior teaching staff. This may reflect the experience and knowledge of the teaching staff and in turn may reflect their ability to teach patient and medication safety. In addition, the educational background varies between teaching staff as most obtain a bachelor or diploma certificate while some have advanced master and doctorate degrees. Similarly, a second group consisted of students in both pharmacy and nursing schools in both the UK and Saudi Arabia. Students came from different years of study and were selected from different schools and universities, providing different experiences and perceptions on patient and medication safety education and training.

Quantitative study using structured questionnaires (including both quantitative and qualitative components) build on the interview, document review and systematic literature review study's findings and looked for the perceptions of pharmacy and

nursing students on their current medication safety and patient safety education in the classroom, simulation lab and clinical settings. Details of the two approaches are provided in chapters 4 and 5.

Wisdom et al. (2013) stated that one of many advantages of conducting a mixed methods approach is reflecting participants' point of view. Mixed methods give a voice to study participants and ensure that study findings are grounded in participants' experiences. Moreover, Wisdom added that the basic premise of this methodology is that such integration permits a completer and more synergistic utilisation of data than do separate quantitative and qualitative data collection and analysis. However, selecting an appropriate mixed method design is challenging and should be guided by the research question, (Hadi, 2016). Therefore, an exploratory sequential mixed method design was selected to answer the study questions. Hadi (2012) is of the opinion that the exploratory sequential design "prioritises qualitative data collection and analysis that occur in the first phase. The quantitative phase builds on the results of qualitative data analysis to test or generalise its findings."

Creswell and Plano Clark (2011) explained that the researcher who selects an exploratory sequential design first collects qualitative data and then quantitative data. The purpose of an exploratory sequential mixed method design involves the procedure of first gathering qualitative data to explore a phenomenon and then collecting quantitative data to explain relationships found in the qualitative data. Hadi (2016) noted in reference to the exploratory sequential design that "this design also consists of two sequential phases. In this design, qualitative data are collected and analysed in the first phase and are given priority in answering the research question. The findings of the qualitative phase shape the construction of the quantitative phase. It is best suited to situations where quantitative methods are required to test or generalise the findings of the qualitative phase."

This series of studies was intended to explore perceptions of teaching staff and students in pharmacy and nursing schools regarding medication safety education and assess current patient and medication safety education. In the first phase, a document

review, semi-structured interview and focus groups were conducted with teaching staff and students to identify issues related to medication safety education. Based on the findings from the qualitative data analysis, a structured questionnaire was developed to assess students' satisfaction with current patient and medication safety education and their levels of confidence in learning about patient safety domains in classroom and clinical settings. This enabled the testing and generalising of qualitative study findings.

Figure 2.1 Illustrates the phases, procedures and products developed from using of exploratory sequential mixed methods design adapted from Berman (2017).

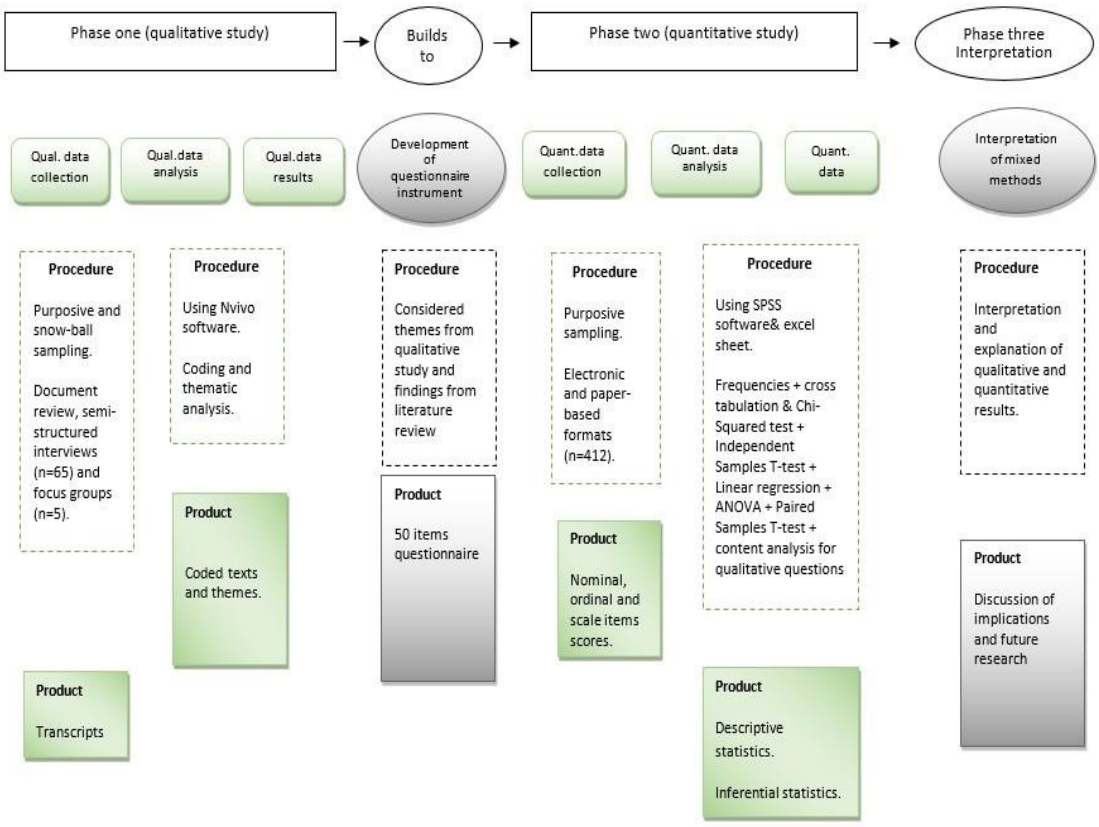


Figure 2. 1 Exploratory Sequential Mixed methods Design (Adapted from Berman, 2017)

When integrating mixed methods designs, Fetters, Curry, and Creswell (2013) indicated that qualitative research methodology is used to explore why and how a phenomenon occurs, to develop a theory, or describe the experience of an individual, while quantitative research methodology concentrates on questions about causality,

generalisability, or magnitude of effect. Therefore, document review and interview data were first collected and analysed, and emerging themes were used to guide the development of a quantitative instrument (questionnaire) to further explore the research problem, (Creswell and Plano Clark, 2011; Teddlie and Tashakkori, 2008). Three stages of analysis were conducted using this design: phase one (qualitative study), phase two (quantitative study), and phase three (interpretation/integration study) which connects the two strands of data and extends the initial qualitative exploratory finding, (Creswell and Plano Clark, 2011).

2.2.2 Aspects of the Research

This research used a number of aspects: descriptive, interpretative and exploratory. In the following section each aspect will be defined together with how it relates to the research.

Descriptive

The descriptive aspect of the research design of this study was intended to collect accurate data on current medication and patient safety education in pharmacy and nursing schools in the UK and Saudi Arabia, this data being collected from teaching staff and students participating in qualitative and quantitative studies. The descriptive aspects were based on relating what its subject is really like, rather than on developing theories about it, (Cambridge Dictionary, 2018).

Interpretative

The thesis included an interpretative aspect of research design related to explaining or understanding the *meaning* of medication safety and the concept of patient safety as perceived by teaching staff and students in the qualitative study and the qualitative part in the quantitative study (open-ended questions in the questionnaire study). The term interpretative may be defined as" explaining and understanding the meaning", (Cambridge Dictionary, 2018).

Exploratory

This thesis is exploratory in research design because it investigates unknown or disparate aspects of medication and patient safety education such as content of the medication safety component, methods used in delivering medication safety education, educational guidelines and frameworks and confidence in learning in different sites. The term exploratory may be defined as" intended to learn more about something", (Cambridge Dictionary, 2018).

2.3 Qualitative Study

The philosophy that underpins this qualitative study including document review and interviews is an interpretative approach. This study was designed to answer the following research questions:

1. What does the current medication safety curriculum include (content, medication safety theories, curriculum guides, guidelines, learning outcomes and target knowledge, skills and desired attitudes to be achieved)?
2. What the current teaching process include (underlying learning theories, teaching style, time allocated for medication safety teaching, mode of integration, mode of supervision and methods used to deliver medication safety)?
3. How is the medication safety component evaluated in pharmacy and nursing curricula, (outcomes barriers, improvement strategies and adequacy of current education)?

A cross-sectional study design was used, document review, semi-structured interviews and focus groups were conducted to collect qualitative data. Participants were teaching staff and students from pharmacy and nursing schools in the UK and Saudi Arabia.

Purposive and snowball sampling approaches were applied throughout this study to identify and recruit the participants. The participants selected have good knowledge and rich experience regarding medication and patient safety education in general. It

was indicated that purposive sampling includes identifying and choosing people or groups of people that are especially knowledgeable about or experienced in a phenomenon of interest, (Cresswell & Plano Clark, 2011; Palinkas, 2013). Purposeful sampling technique was defined by Patton (2002, p. 230) as:

> *"The logic and power of purposeful sampling lie in selecting information-rich cases for study in depth. Information-rich cases are those from which one can learn a great deal about issues of central importance to the purpose of the inquiry, thus the term purposeful sampling. Studying information-rich cases yields insights and in-depth understanding rather than empirical generalisations."*

As mentioned above, the snowball sampling technique was used to recruit participants who are difficult to identify and to ease data collection, Naderifar (2017) stated that "snowball sampling is applied when samples with the target characteristic are not easily accessible." After conducting the interviews, some of the participants were asked if they could recommend colleagues who have knowledge about medication safety education and might be interested in the study. Elfil (2017) indicated that:

> *"This method is used when the population cannot be located in a specific place and therefore, it is different to access this population. In this method, the investigator asks each subject to give him access to his colleagues from the same population,"*

Teddlie & Tashakkori (2008) stated that snowball sampling or chain sampling" is a sampling strategy that involves using informants or participants to identify additional cases for inclusion in the study."

This method was able to answer the qualitative study research questions and provided a clear understanding of current medication safety education and provided us with an opportunity to explore deeply and discover new area of interest. Some of the principles of validity in qualitative research reported by Cohen (2011) such as: (1) the data are descriptive (2) data were analysed inductively (3) data are presented in terms of the respondents rather than the researchers (4) seeing and reporting the situation through the eyes of participants and (5) the natural setting is the principal source of data - were achieved in this study.

2.4 Quantitative Study

The philosophy that underpins this quantitative questionnaire study is a positivism approach. This study was designed to answer the following research questions:

1. How is medication safety education delivered in the UK and Saudi Arabia?
2. What are the most effective methods of teaching according to students? Do preferences vary by country, year of study or profession?
3. Do perceptions of the adequacy of patient safety education vary across classroom and clinical settings? Do these perceptions vary according to year of study, profession, or country?

This study is a cross-sectional survey. A questionnaire was used to collect quantitative and qualitative data which was developed based on a systematic literature review and qualitative studies (document review and interviews). Participants were students from pharmacy and nursing schools in the UK and Saudi Arabia. The purposive sampling approach was applied throughout this study to identify and recruit the participants.

Several parametric and non-parametric statistical techniques were used to analyse research questions: i) simple descriptive statistics (e.g., frequency and percentage, mean, median, range and standard deviation) and ii) inferential statistics (e.g. differences between groups such as Chi-Square test and Independent sample T-test).

This method was able to answer the quantitative study research questions and provide a clear understanding of current medication safety education and was able to test and generalise the findings/results obtained from interview study. Some of the principles of validity in quantitative research reported by Cohen (2011) such as: (1) controllability, (2) replicability and (3) predictability - were all explored in these studies.

2.5 Thesis Structure

This thesis consists of six chapters including this chapter and the introduction to patient safety chapter. The chapters to follow are:

Chapter 3: Patient and Medication Safety Education – Narrative Synthesis Review

Chapter 4 : Interview Study to Explore Teaching Staff and Student Perspectives on Medication and Patient Safety Education

Chapter 5 : Questionnaire Study on the Perceptions of Nursing and Pharmacy Students on Medication and Patient Safety Education

Chapter 6 : Research Findings and Discussion

Exploratory synthesis of findings will be presented in Chapters 3, 4 and 5, an argument synthesis and overall discussion will be presented in Chapter 6. Please see table of contents.

2.6 Summary

This chapter provided justification for the research design, described the chosen method and outlined the different aspects of a mixed methods design. The philosophy underpinning the chosen research design was discussed together with the research questions each method answered. Chapters 4 and 5 will detail the application of the research methods used, the analysis of collected data, as well as the results. In Chapter 3, I explore health sector literature for research on patient and medication safety education released globally between 1994 and 2021. A systematic narrative review approach was used in the design to summarise the findings of the selected studies, using an inductive reasoning approach to identify patterns and relationships in the data set collected from the studies.

3.1 Studies on the Problem of Medication Safety

The prevalence of medication error is increasing worldwide. An article 'Exploring the Causes of Adverse Events in the UK NHS Health Practice', published by Neale et al. (2001), stated that "nearly 10,000 people experienced serious preventable adverse reactions to drugs which cost the NHS £1 billion per year". Furthermore, the NHS wastes up to £2.5billion per year on preventable errors in the UK, many of which are related to the improper use of medications, (DOH, 2014).

Various articles have been published in recent years on the relationship between medication error and the lack of knowledge and training of healthcare practitioners. Coombes et al., (2005) found that providing practical medication risk awareness training improved the ability of nurses to detect medication errors. Moreover, it is still the case regarding medication administration errors due to luck or inappropriate training. A study by Tsegaye et al. (2020) concluded that medication administration errors were high and that it was better to develop guidelines, provide training, and develop strategies to minimise distributions and reduce administration errors.

Developing strategies to improve medication safety education for pharmacy and nursing undergraduates is likely to improve their understanding of medication safety. It would also provide new pharmacists and nurses with a guide to best practice when they start their careers. In turn, this would lead to improved accuracy in the dispensing and administration of medication. Cresswell et al (2013) found evidence of gaps in knowledge and lack of educational capacity and sophistication in some instances. This could mean that students graduate without a clear understanding of how evidence can be used for safe practice.

Integrating patient safety in the healthcare curriculum is now becoming an international area of interest and one of the strategies to improve patient safety education is to introduce a module on medication safety at undergraduate training

level (DOH, 2004). The authors of the WHO Multi-professional Patient Safety Curriculum Guide (2011) stressed that its aim is to raise awareness of the need to integrate patient safety into the curriculum of all professional health programmes. Furthermore, since 2000 a considerable number of publications have discussed the need for change in healthcare and healthcare education, (Holdford et al, 2011). Preparing future healthcare practitioners is an essential foundation for advancing and sustaining a culture of safety and this critical need of introducing healthcare students to the fundamentals of patient safety has been promoted on a global level (WHO, 2009). The WHO guide states that the strengthening of patient safety education in pharmacy and nursing undergraduate curricula could further enhance their capability to contribute to patient safety (WHO, 2011). Berwick (2013) recommends that the mastery of quality and patient safety sciences and practices should be part of initial preparation and lifelong education of all healthcare professionals, including managers and executives.

Anecdotal evidence suggests that there is considerable variation in educational practice for medication safety across institutions. The purpose of this review is to gain a clearer understanding of the current international studies on medication safety. A few years ago, there were limited studies of medication safety education in pharmacy and nursing undergraduate programmes. In contrast, there were many studies in medical education programmes. Kirkman (2015) reviewed the latest evidence for patient safety education for medical students and concluded that there is an increasing trend for developing educational interventions in patient safety delivered to medical students. However, significant methodological shortcomings continue to exist and additional evidence of impact on patient outcomes is needed. Alper (2009) described current patient safety curricula at US and Canadian medical schools and identified factors associated with adoption of these programmes. Moreover, the WHO Patient Safety Curriculum Guide for Medical Schools published in 2009 aims to encourage and facilitate the teaching of patient safety topics to medical students. Similarly, the WHO Patient Safety Curriculum Guide Multi-Professional Edition, published in 2011, aimed to teach patient safety topics to healthcare professional students, including pharmacy and nursing.

Previous review studies (Wakefield et al., 2005; Tella et al., 2014; Shearer et al., 2013; Kiersma et al., 2011; Mansour, 2012) looked at one or more aspects of medication and patient safety such as: the extent in which patient safety is addressed in nursing curriculum, the content, educational methods of medication safety, how obvious or clear is patient safety in nursing curricula, and how integration of patient safety education in nursing training were perceived by nursing students and faculty members. This literature review looked more in-depth into these aspects and extended the search to cover new areas such as curriculum guides and frameworks used when designing and teaching medication and patient safety curricula. In addition, this review included both the nursing and pharmacy professions.

3.2 Aim and Objectives

This systematic narrative review aimed to identify, describe and appraise published studies on patient and medication safety education for undergraduate pharmacy and nursing students. Accordingly, the objectives were as follows:

1. To evaluate the evidence for the effectiveness of current educational practice in relation to patient and medication safety.
2. To describe the content, teaching methods, guidelines and curriculum frameworks used in patient and medication safety education.

3.3 Method

3.3.1 Study Design

A systematic review with a narrative synthesis approach was used to summarise the findings from multiple studies. This approach was used as these studies used a range of designs including: qualitative, quantitative, mixed methods study, description of effective approach, curriculum review, commentary, proposal for change, and evaluation studies, (Popay et al, 2006).

An inductive approach was used as a research strategy in this study to construct a logic, perform reasoning, and analyse the data of the selected studies obtained from systematic searching for the literature. Jebreen (2012) stressed the value of the inductive approach as a credible and rigorous research approach to explore the

literature, interpret the study findings, and make conclusions. Bhandari, P. (2022), stated that inductive reasoning is a method of drawing conclusions by going from the specific to the general. You start by making observations or gathering data. Then, you take a broad view of your data and search for patterns. Finally, you draw general conclusions that you might incorporate into theories. Similarly, Jebreen (2012) noted that using an inductive approach can be treated as both an underlying philosophy and a specific mode of analysis. As a philosophical approach to human understanding, it provides the philosophical grounding for interpretivism. As a mode of analysis, it suggests a way of understanding textual data.

3.3.2 Databases

Medline, Embase, Web of Science, Cochrane library database, International Pharmaceutical Abstracts (IPA) and Cumulative Index to Nursing and Allied Health Literature (CINAHL) databases were searched.

A manual search was conducted for relevant papers from the following journals: '*American Journal of Pharmaceutical Education'*, '*Nurse Education Today'*, '*Nurse Education in Practice'*, '*Journal of Nursing Education'*, and '*BMJ Quality & Safety'*.

In addition, the following resources were consulted: recommendations of experts in the field, and reference lists of relevant articles including previous systematic reviews (Kiersma et al. 2011, Shearer et al. 2013, Tella et al. 2014, Mansour, 2012 and Wakefield et al. 2005).

3.3.3 Search Strategy

The search was grouped into three facets: (a) patient safety or medication safety; (b) pharmacy and/or nursing; and (c) education (List of free-text words and MeSH used in search strategy is presented in a table in Appendix 1). In searching databases, a combination of free-text words and medical subject headings (MeSH) were used to ensure a comprehensive search of the literature, synonyms, additional terms, and truncation symbols such as asterisks (*) were also used. Boolean terms OR and AND

were used to broaden and refine the search respectively. Inclusion and exclusion criteria are presented in Table 3.1.

Table 3. 1 Inclusion and Exclusion Criteria

The inclusion Criteria were Papers Including One or More of the Following Which:	The exclusion Criteria were Papers which:
1. Included a description of medication safety in undergraduate pharmacy and/or nursing education.	1. Provided a description of medication safety courses / training for postgraduate student pharmacists and nurses who are already qualified (for example independent prescribing courses).
2. Included case studies and commentary that describe medication safety in undergraduate education.	2. Opinion pieces, editorials, notes, letters or conference abstracts.
3. Included a description of medication safety education content and/or methods.	3. Preview of dissertation and thesis.
4. Explored students' and teaching staff's perceptions of medication safety education.	4. Literature reviews.
5. Included a description of educational interventions e.g., using simulation and/or inter-professional learning as methods to deliver medication safety education.	5. Written in a language other than English.

The year 1994 was selected as the starting point for the search as this was the year in which medication safety received much international attention after two tragic medication errors occurred in one of the world's best cancer hospitals, Dana-Farber Cancer Institute (DFCI) in Boston. These errors led to considerable re-evaluation and ultimately a major change in institutional practices and culture, (Conway & Weingart, 2005).

3.3.4 Data Extraction and Synthesis

Thematic analysis was used to synthesise the data extracted from all the articles. Data was extracted using a form and then the results were tabulated (three data extraction tables being presented in Appendix 2). A summary of the data extraction tables was presented in the result section. In addition, a table that identified articles that explicitly used a curriculum guide or framework was presented, (see table 3.5).

As shown in figure 3.1, 104 articles were selected and identified. Eighty-two articles were empirical, (see table 3.2). The remaining 22 articles, which were non-empirical, were categorised based on the study design presented in the paper as follows: eight

articles described the teaching process, four evaluated the teaching, three were commentaries, two were proposals for change, two articles described and evaluated the methods used to deliver medication safety, one was a pilot study on teaching strategy, another article explored the opportunities and challenges for integrating patient safety, and the final article was on designing online instructions for a course on medication safety. These 22 articles were selected for their relevance to the research being conducted and met the inclusion criteria, even though there was no critical appraisal tool available to assess their quality.

Including non-empirical studies can be biased as can be descriptive, provide commentaries, offer proposals for change, represent pilots or e-learning studies, and, understandably, they can lack the scientific rigour of empirical studies. However, I took the decision to include non-empirical studies as the topic of medication and patient safety is broad, and by including the non-empirical students, I can also provide a more comprehensive and diverse range of perspectives and more insights, which could lead to a richer understanding of the topic. Dan (2017) noted that due to differences between empirical and non-empirical methods, scholars are likely to have a clear preference for either empirical or non-empirical methods. However, it seems that the hostility between these two "camps" is slowly subsiding, and more scholars are willing to employ both empirical and non-empirical methods when needed. Accordingly, I have incorporated both empirical and non-empirical methods in this thesis.

3.3.5 Quality Check for Empirical Articles

A quality check was performed on the 82 empirical articles (see Table 3.2). Table 3.2 shows the number of articles for each study design and the quality check tool used to assess the quality of the article.

Table 3. 2 Quality Check for the 82 Articles

Number of Articles	Study Design	Quality Check Tool
24	Qualitative	Critical Appraisal Skills Programme (CASP)
50	Quantitative	Assessment list of questions from Guyatt et al (1993)
8	Mixed methods	Mixed Methods Appraisal Tool (MMAT) developed by Pluya (2013)
Total = 82		

Twenty six (31.7 per cent) articles of the 82 mentioned above were considered high quality papers as they fully addressed all critical appraisal questions. The remaining 56 (68.3 per cent) articles were considered to be lower quality papers, as they partially addressed the critical appraisal questions (i.e., unable to answer any of the critical appraisal questions). However, those "low quality" studies were included in the review as they were very important and relevant to the research. Moreover, quality of studies was not used as an exclusion criterion.

All 82 empirical studies met the criteria of the two screening questions for inclusion. The two screening questions are: (1) Did the study address a clearly research question? And: (2) Do the collected data allow addressing the research question?

The Critical Appraisal Skills Programme (CASP), which consists of ten questions, was used to assess the quality of the 24 qualitative studies. Questions from Guyatt et al. (1993) Users' Guides to Medical Literature, consisting of 12 questions, were used to assess the quality of 50 quantitative studies. A Mixed Method Appraisal Tool (MMAT), developed by Pluye (2013), which consists of 13 questions, was used to assess the quality of eight mixed design studies (the questions for each tool are presented in Appendix 4). There were 42 studies from nursing, 20 studies from pharmacy, and 20 studies from mixed professions.

Accordingly, the quality of 82 empirical studies from 1994 to 2021 were checked/assessed using three quality check tools: the CASP, Guyatt and MMAT. The rationale for performing quality checks for these studies was to ensure the validity and reliability of the selected studies. These tools help identify potential biases, weaknesses, and limitations in the study, which may affect the accuracy and validity of the findings.

The 82 empirical studies were first entered into Excel, then transferred to Word, (see Appendix 3). The assessed papers were given a score for their quality, whether they were high or low, which means articles that answered all questions or partially answered questions. The 26 papers that answered all quality check tool questions

were 15 qualitative studies, ten quantitative studies, and one mixed method study. The 26 papers that answered all quality check tool questions were considered high quality. These papers were used in the following chapters and were prioritised in the assessment of the available evidence.

3.4 Results of a Literature Search Review

The search process is summarised in Figure 3.1 below.

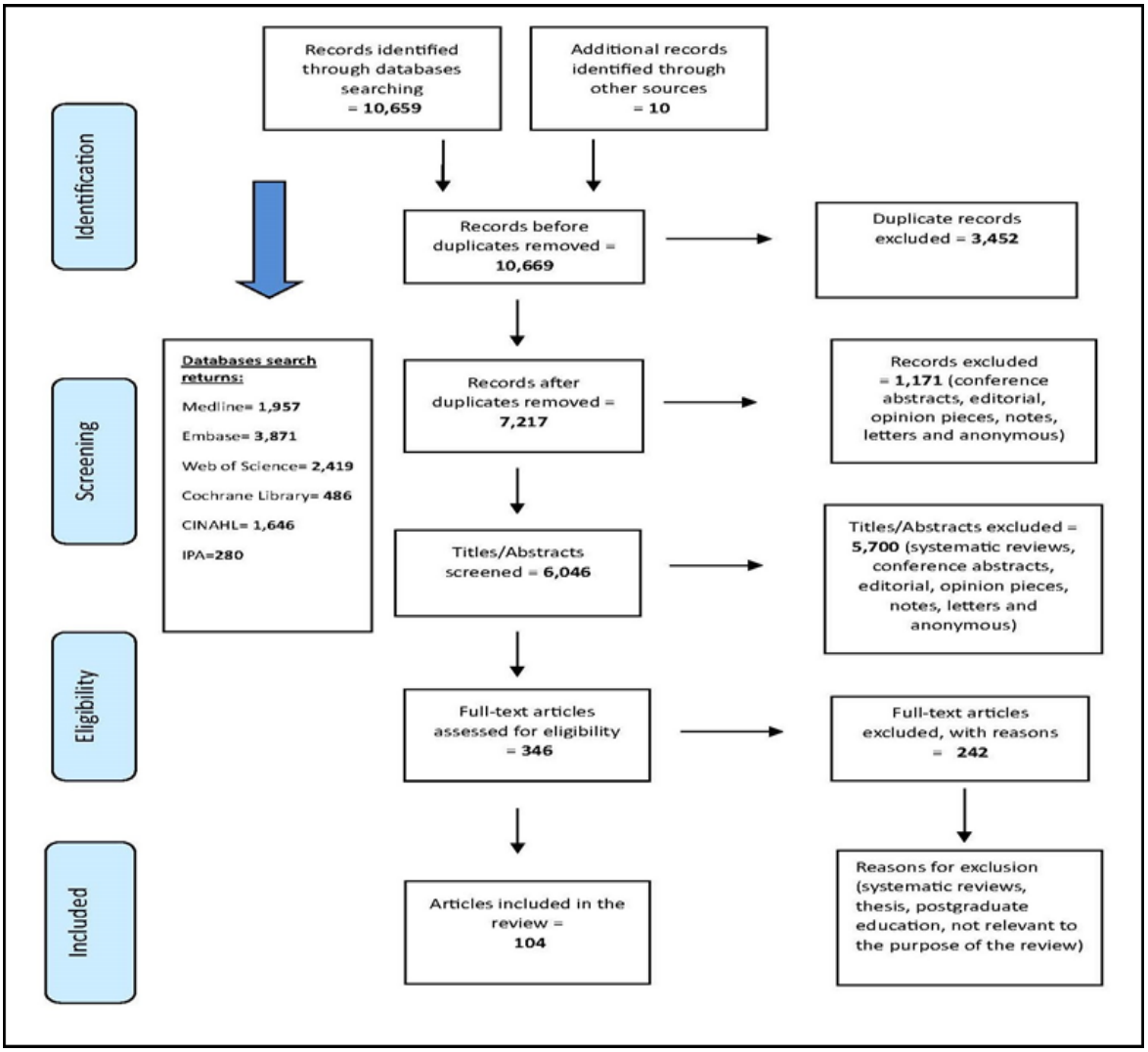


Figure 3. 1 Flow Diagram Illustrating the Search Strategy

Results from the six databases were exported to Endnote, duplicates removed (using both reference software and a manual search as recommended by Brown et al., 2012). Then the process of screening titles, abstracts and full text was performed. A second check by second researcher was performed for 16 (20 per cent) of selected papers.

3.4.1 Description of Data Extracted

A summary of the data extracted is presented in the following paragraph (see Appendix 2 for full data extraction tables).

There are 59 nursing studies from 2006 to 2021. Twenty-four (41 per cent) studies the USA, six (10 per cent) studies in the UK, four (7 per cent) in Canada, four (7 per cent) in Australia, three (5 per cent) studies in Iran, two (3 per cent) in Italy, and one each (2 per cent) in Ireland, Scotland, Turkey, Japan, South Korea, Taiwan and Oman. In addition, three (5 per cent) studies in Korea, and one each (2 per cent) in Brazil, European Countries, Saudi Arabia, Jordan, Kenya and Australia. There is a wide range of study designs including: qualitative, quantitative, mixed methods studies, descriptive studies, evaluation studies, piloting studies, curriculum revision, discussion paper, curriculum development and commentaries.

There are 24 pharmacy studies from 2002 to 2020: sixteen (67 per cent) studies were conducted in the USA, three (12.5 per cent) studies were conducted in the Saudi Arabia, and one (4 per cent) study each in the UK, Australia, Malaysia, the Middle East and Ethiopia. The types of studies are qualitative, quantitative, mixed studies, multi-method design, course evaluation, course development, and description of training model.

There are 21 multi-professional studies which included pharmacy, nursing, and other healthcare professions from 2010 to 2021: Seven (33 per cent) studies were conducted in the USA, three (14 per cent) in the UK, two (9.5 per cent) in Australia, two (9.5 per cent) in Korea, and one (5 per cent) study each in Norway, Canada, Brazil, Indonesia, New Zealand, Australia and Serbia. These studies used qualitative, quantitative, mixed studies, multi design methods and description of educational intervention.

3.4.1.1 Empirical studies

Qualitative Studies

This review included 24 qualitative studies; 14 were on undergraduate nursing education, four on undergraduate pharmacy education and six studies included mixed health care professions such as pharmacy, nursing and medical students and faculty members.

Of the 14 studies on undergraduate nursing education, four examined medication errors covering the following categories: medication errors identified by nursing students (Cooper, 2014), perceptions of nursing students on the causes of medication errors (Vaismoradi et al., 2014b), medication errors and the application of root cause analysis (RCA); (Dolansky et al., 2013), and finally those which assess the ability of nursing students to identify prescribing errors (Whitehair et al., 2014). Seven studies explored views on medication safety education in the following areas:

- Patient safety education in pre-registration nursing curriculum in relation to the WHO Curriculum Guide (Mansour, 2013)
- Nursing students' perspectives on developing patient safety aspects of the curriculum (Vaismoradi et al., 2014a), and the role of nursing education in developing their capabilities to provide safe care (Vaismoradi et al., 2011), and understanding the formal and informal ways nursing students learn about patient safety (Steven et al., 2014)
- The current content of pharmacology education and the extent to which this content can equip nurses to prevent medication errors (Page et al., 2006).
- Aspects of medication safety practices that have been produced from action research studies (Adhikari et al., 2014).
- A case study about understanding students' perceptions of the use of high-fidelity simulation as a learning strategy in undergraduate intensive care courses, (Badir et al., 2015).

Finally, three studies, which examined patient safety education and the curriculum, covered the following:

- The first study identified contents related to Patient Safety (PS) contemplated in the curricular units and aims to know the teaching methodologies and evaluation strategies used in the Patient Safety Education of the Graduation in Nursing from a Teaching Perspective, (Bohomol, E. 2019),
- the second study identified contents related to Patient Safety (PS) contemplated in the curricular units and aims to know the teaching methodologies and evaluation strategies used in the Developing an integrated curriculum that incorporates PS factors for existing patient safety curriculum to increase competencies in an undergraduate nursing programme, (Ji, Y., et al., 2021).
- Finally, a third study that assesses the perspectives on patient safety education in the pre registration nursing curriculum, identifies explicit PS concepts in the Kenyan nursing curriculum and explores the perspectives of nursing faculty members and clinical nurses on the integration of PS in the curriculum, (Mbuthia, N. N., and M. M. Moleki, 2018).

Regarding undergraduate pharmacy education studies, one was related to the communication of pharmacy students concerning medication errors (Noland et al., 2009), another highlighted opinions about pharmacy students' science of safety educational needs (Warholak et al., 2011), while the other two examined how hidden and informal curricula shaped pharmacy student learning about patient safety and provided baseline information on integrating the science of safety into the pharmacy curriculum, (Bradly et al., 2011; Holdford et al., 2011).

Finally, the six combined professions studies investigated formal and informal ways students learn about patient safety and presented the teaching faculty's perspectives on factors influencing curriculum change in pharmacy, nursing and medical schools (Cresswell et al, 2013; Pearson et al., 2010; Tregunno et al., 2014). In addition, one study described the development and implementation of Inter-Professional Simulation-based Education (IPSE) for students, and their changes in attitudes toward each other's health professions after participating in IPSE. (Lee et al. 2020). Another case study explored pharmacy student-reported reflections from an inter-professional

shadowing experience with nursing students through qualitative content analysis of reflective statements, (Rotz, M. E., and D. D. O'Neill, 2021). Finally, an interview study was to investigate how quality and patient safety methods are being taught in the pre-registration curricula of health profession education programmes in New Zealand, (Robb, G., et al. 2017).

This review includes 50 quantitative studies as follows:

a. Thirteen studies concerning with undergraduate nursing education (Hewitt et al., 2015; Mansour, 2015; Smith et al., 2007; Sullivan et al., 2009; Hanson, 2016; Chenot et al., 2010; Lee et al., 2016; Debourgh, 2012; Cooper, 2013; Usher, 2018; Kirwan, 2019; Lee et al., 2020a; Lee et al., 2020b).

Of the thirteen quantitative studies in undergraduate nursing education, six were evaluative in nature. They explored the following areas: students' perceived effectiveness of educational intervention (Hewitt et al., 2015), investigating of the factor structure of a survey completed by a group of nursing students in one of the UK universities (Mansour, 2015), an assessment of current levels of integration of quality and safety content in nursing curricula (Smith et al., 2007), student perspectives of quality and safety contents in their programmes and the perceived importance of the six Quality and Safety Education for Nurses (QSEN) competencies (Sullivan et al., 2009), the impact of using a flipped classroom approach in pharmacology on students' understanding (Hanson, 2016) and finally, an examination of the current patient safety education for nursing students and investigation of nursing student awareness, skills and attitudes about patient safety, (Chenot et al., 2010).

The other three studies addressed the content and methods used for patient safety education as perceived by nursing students and students' self-reported patient safety competency (Lee et al., 2016), the engagement of a nursing school and hospital affiliate in a partnership to increase opportunities for students to acquire the six QSEN competencies (Debourgh, 2012a), and finally a description of the innovative new role of quality and safety officer (QSO) and their use of safety tools, also identifying the

students' perceptions of safety issues, communication, and safety reporting in the clinical setting, (Cooper, 2013).

Finally, four studies, one study was to establish how patient safety teaching is incorporated into pre-registration education of nurses, and how nursing was examined, along with national guidelines related to nurse education. The study concluded that PS as a topic generally remains a hidden element within the curriculum, taught across many subjects, (Kirwan, M., et al., 2019). Two studies by Lee One investigated how PS is currently taught in pre-registration nursing programmes (methods and content) across South Korea and explored nurse educators' perspectives on curriculum change, (Lee, S. E., et al. 2020). The second study, by the same author, examined nursing students' educational experiences based on self-reported perceptions of PS and cultural competence related to curriculum content and learning venues (methods and content),(Lee, S. E., et al., 2020). The final study examined how Australian-nursing curricula addresses patient safety, identified where and how patient safety learning occurs and described who is responsible for facilitating this learning, (Usher, K., et al., 2018).

b. Twelve studies completed in undergraduate pharmacy education (Rickles et al., 2010; Trinkley et al., 2017; Walpola et al., 2015; Vyas et al., 2012a; Johnson et al., 2002; West Strum et al., 2011; Rajiah et al., 2016; Scalese et al., 2015; Al Katheri et al., 2017; Al Whaibi et al., 2020; Naser et al., 2020 and Tegegn et al., 2017).

There are 12 studies in undergraduate pharmacy education. Four of these were evaluative in nature: one described and evaluated pharmacy students' knowledge of and comfort in communicating, managing, and preventing medication errors (Rickles et al., 2010): another assessed the effectiveness of human patient simulation to teach patient safety, team building skills, and the value of inter-professional collaboration to pharmacy students (Vyas et al., 2012a); the third study examined the perceived benefit of integrating patient safety education into a pharmacy curriculum (Trinkley et

al., 2017); and the fourth evaluated the effectiveness of a peer-led patient safety education programme for pharmacy students, (Walpola et al., 2015).

Four studies were: an assessment of the manner and extent to which the topic of medication error is included in the curricula of schools of pharmacy in the USA(Johnson et al., 2002); a description of the integration of science of safety (SOS) topics in Doctor of Pharmacy (PharmD) curricula of US colleges and schools of pharmacy (West Strum et al., 2011); an investigation of the knowledge and perception of pharmacy students about adverse drug reaction reporting and pharmacovigilance (Rajiah et al., 2016); and finally determination of the effectiveness of a three hour interactive case-based laboratory experience to improve attitudes about medication errors and systematic approaches to improve medication safety in third year pharmacy students, (Scalese et al., 2015).

The remaining four studies, one of which assessed pharmacy educators' knowledge of medication safety and their perception toward its integration into the PharmD curriculum in Saudi Arabia, (Alkatheri, A. M., et al., 2017). The other three studies explored the attitudes toward patient safety among pharmacy students, (Alwhaibi, M., et al., 2020; Tegegn, H. G., et al., 2017; Naser, A. Y., et al., 2020).

c. Seven studies were looked at which used the Health Professional Education in Patient Safety Survey (H-PEPSS) tool: six related to undergraduate nursing (Bressan et al., 2016; Duhn et al., 2012; Lukewich et al., 2015; Stevanin et al., 2015; Weatherford et al., 2015; Suliman, 2019), and one to nursing and medicine undergraduates, (Hwang et al., 2016).

Seven studies used the H-PEPSS tool, six of which were conducted in undergraduate nursing and one in nursing and medicine undergraduates. These studies covered the following areas: an assessment of the validity and the reliability of the H-PEPSS tool in nursing education (Bressan et al., 2016) ,perspectives on patient safety and the extent to which this is addressed in classroom and clinical settings (Duhn et al., 2012), an exploration of nursing students self-reported confidence in learning about patient

safety (Lukewich et al., 2015); a description of the perception of nursing students regarding their own patient safety knowledge and competence, including the difference in perceptions of first, second and third year nursing students and the adverse events that students have experienced in clinical placements (Stevanin et al., 2015), understanding students' attitudes regarding safety competencies and determining if curriculum changes related to safety were achieved in both classroom and clinical settings, (Weatherford et al., 2015). Another study was an assessment of the patient safety competencies of final-year health professional students and the effect of a one-day patient safety education programme on these competencies, (Hwang et al., 2016). And lastly, a study examined nursing students' perceptions of patient safety knowledge and competencies in the classroom and clinical settings using the H-PEPSS, (Suliman, M. 2019).

d. Eight studies using the simulation method (House et al., 2016; Mariani et al., 2015; Sears et al., 2008; Atayee et al., 2016; Vyas et al., 2012b; East et al., 2015; Komperda & Lempicki, 2019; Skoy et al., 2018;).

There are eight studies using simulation methods. Three studies focused on undergraduate nursing. The first study identified patient safety knowledge and explored perceptions of a safety simulation strategy, (House et al., 2016) and the second determined if perceptions and comfort level regarding safety principles and practices increased after simulation, (Mariani et al., 2015). The third study is an examination of whether the use of clinical simulation in nursing education could help reduce medication errors, (Sears et al., 2008). Another four studies which were conducted on undergraduate pharmacy used the simulation method to evaluate the first year pharmacy students' ability to identify medication errors in the top 100 prescription medications (Atayee et al., 2016), and implemented a simulation-based introductory pharmacy practice experience (IPPE) and determined its effectiveness in assessing pharmacy students' core domain abilities prior to beginning advanced pharmacy practice experience (APPE) (Vyas et al., 2012b). A study also evaluated the effectiveness of a simulated learning exercise on pharmacy students' ability and perception of their ability to perform medication reconciliation (Komperda, K., and K.

Lempicki 2019). Another study focused on designing and evaluating the use of simulations in preparing students to identify and reduce medication errors and promote patient safety, (Skoy, E. T., et al., 2018). Finally, one study in combined professions (undergraduate nursing and midwifery) evaluated a filmed simulated pharmacological clinical scenario, (East et al., 2015).

e. Eight studies using the Inter-Professional Learning (IPL) method (Omura et al., 2015; Ernawati et al., 2015; Lapkin et al., 2012; Thom et al., 2016; Ragucci et al., 2016; Ottis et al., 2016; Bridgeman et al., 2018 and Seaman et al., 2018).

Eight studies used the inter-professional learning (IPL) method, one study in undergraduate nursing evaluated the impact of an inter-professional learning resources on the intentions of nursing students to practise in an approach promoting medication safety (Omura et al., 2015). The remaining seven studies were from combined professions. One study assessed the attitudinal changes toward inter-professional education (IPE) among undergraduate health students after attending an IPE workshop on medication safety (Ernawati et al., 2015); while the second study examined inter-professional learning in relation to:(1) the extent to which IPE is currently used in Australian and New Zealand nursing, pharmacy and medical programs, (2) the extent to which IPE is currently used to teach medication safety and (3) identifying barriers and facilitators to curriculum integration of IPE (Lapkin et al., 2012. The third study described the development and implementation of an inter-professional course intended for medical, nursing and pharmacy students during clinical training (Thom et al., 2016). A fourth study evaluated the impact of an inter-professional communication skills workshop on pharmacy, nursing, medicine and health profession students' confidence and proficiency in disclosing medical errors to patients (Ragucci et al., 2016). A fifth study chosen emphasised patient safety and changing the attitudes toward inter-professional learning, enabling students to appreciate the role of different professions (Ottis et al., 2016. The sixth study aimed to describe the results of the impact of a large-scale inter-professional medication error prevention workshop on student perceptions of team-based patient care in the prevention of medication errors (Bridgeman, M. B., et al., 2018). –Finally, a seventh

study examined nursing and medical students' beliefs, behaviours, and attitudes in relation to inter-professional socialisation and their expectations and experiences before and after a two-week clinical placement in ambulatory care, (Seaman, K., et al., 2018).

f. Two studies which included mixed health care professions (Yoshikawa et al., 2013; Svitlica et al., 2021).

Finally, two studies included mixed healthcare professions, one study identifying the understanding of human error and patient safety of graduate students in nursing and medicine at a public university in São Paulo (Yoshikawa et al., 2013) and the other study investigating medical and nursing students' level of knowledge of patient safety, (Svitlica, B. B., et al., 2021).

Mixed Method Studies (qualitative and quantitative approaches)

This review includes eight qualitative and quantitative mixed studies (approaches). Of these, five were carried out on undergraduate nursing education, two on mixed healthcare professions and one on undergraduate pharmacy education - exploring the attitudes of pharmacy students toward an elective patient safety course, (Fuji et al., 2010).

The five undergraduate nursing studies focused on the perceptions of nursing students, educators and stakeholders regarding patient safety in the English pre-registration curriculum (Attree et al., 2008); testing the effects of structured classroom and clinical content related to safety and quality of health care systems (Miller et al., 2009), evaluation of the effectiveness of an e-learning programme on improving paediatric medication management (Lee et al., 2013), the use of an integrated clinical model (dedicated education unit) to improve nursing students' knowledge of quality and safety using a mixed method evaluation (Masters, 2016), and finally understanding how student learning and perceptions of patient safety changed over time using a simulation-based medication event reporting to study trends in a medication related event, (Sanko et al., 2015).

The two mixed studies addressed the development of undergraduate inter-professional training in medication safety (Hardisty et al., 2014) and investigated the experiences of nursing and medical students who participated in simulation-based inter-professional team training (Reime et al., 2016).

3.4.1.2 Non-Empirical Studies

The following table 3.3 represents the 22 non-empirical studies that were included in this chapter as they were relevant to the research (as was discussed previously: evaluative studies, descriptive studies, commentaries, change proposal studies, pilot studies and e-learning module design studies).

Table 3. 3 Non-Empirical Studies

Type of study	Findings or description of the study
Evaluative Studies	Four evaluative studies were considered in this review. These included an evaluation of the integration of patient safety instructions (i.e., adherence to hand washing and patient identification requirements) within undergraduate nursing education, (Gantt et al., 2009). Two studies were undertaken in undergraduate pharmacy education related to evaluating medication errors using root cause analysis (RCA) projects to assess students' performance (Schafer et al., 2012), and evaluating the patient safety course within the school of pharmacy (Sukkari et al., 2008), and the final one was a mixed evaluation quality and safety initiative which combined nursing and medical students, (Headrick et al., 2012).
Descriptive Studies	Eleven descriptive studies were undertaken in undergraduate nursing education, five of which examined the application of QSEN and Institute of Medicine (IOM) competencies to the undergraduate nursing curriculum (Armstrong et al., 2013; Day et al., 2007; Jarzemsky et al., 2010; Hickey et al., 2010; Sherwood et al., 2007). One described the integration of a clinical reasoning and reflection framework for undergraduate nursing students (Russell et al., 2013), another described a patient safety improvement agenda which included human factors theory (Milligan et al., 2006), and a third study highlighted a simulated role-play experience developed to enable undergraduate nursing students to reflect on and analyse their responses to interruption during medication administration (Hayes et al., 2015). Another was a training model study from pharmacy that evaluated the impact of integrating simulation-based education (SBE) into advanced pharmacy practice experience (APPE) on students' learning outcomes, training costs, and satisfaction (Korayem, G. B., and A. M. Alboghdadly, 2020). Yet another study described and evaluated an inter-professional simulation training for medical error disclosure, including dental medicine, nursing, and pharmacy students, (Popkess, A., et al., 2017). The last study from nursing explored the opportunities and challenges for integrating PS education in the undergraduate nursing curriculum, (Mansour, M. J., et al., 2018).
Commentaries	Three commentary studies were conducted in undergraduate nursing education. The first study looked at the need to shift to a culture of safety and to focus on system errors rather than individual errors in nursing education, (Gregory et al., 2007). The second study highlighted educational challenges in nursing education and compared it with challenges taking place in medical education, (Ruth-Sahd, 2014). Finally, the third study commented on patient safety in nursing education and highlighted strategies to enhance patient safety such as evidence-based education and practice, interdisciplinary collaboration in nursing education, simulation training and use of informatics to reduce errors and enhance communication, (Madhavanpraphakaran, 2012).
Change Studies	There were two proposals for change studies undertaken in undergraduate nursing education. The first study proposed reviewing pre-licensure curricula including teaching and learning activities focused on patient safety (Debourgh et al., 2012b), while the second study highlighted the importance of education in preparing nursing students for their role in medication management, (Holdforth et al., 2013).
Pilot and E-learning Module Design Studies	There was one pilot study in undergraduate nursing about piloting a simulation game session (teaching strategy) to decrease students' fears about unexpected patient events (Mawhirter et al., 2016). In addition, there was only one study in undergraduate nursing about designing an online module that increases knowledge, skills and attitudes about medication safety, (Bush et al., 2015).

3.4.2 Description of Quality Checked Studies

As mentioned in 3.3.5 that three quality checks were performed as follows:

1. CASP was used to assess the quality of the 24 qualitative studies. The results were as follows: fifteen (62.5 per cent) studies fully met the criteria of the CASP tool, included information that answered all ten questions; six (25 per

cent) studies had enough information to answer nine questions; and finally, three (12.5 per cent) studies partially met the CASP tool and had information which could answer or partially answer seven or more questions.

2. Guyatt users' guides to medical literature were used to assess the quality of 50 quantitative studies. The results were: ten (20 per cent) studies fully met the requirements of the tool and answered all 12 questions; 27 (54 per cent) were able to answer 11 questions of the Guyatt tool; and 13 (26 per cent) studies partially met the requirements of the Guyatt tool and included information to answer or partially answer nine or more questions.

3. MMAT was used to assess the quality of eight mixed design studies. The results were: one (12.5 per cent) study fully met the criteria of the tool and answered all 13 questions, another study (12.5 per cent) was able to answer 12 questions of the MMAT, and six (75 per cent) studies partially met the requirements of the Pluye tool and included information to answer or partially answer ten or more questions.

3.4.3 Themes Emerging from the Study

Presented below are the three themes which emerged from the inductive analysis performed on the published works. These three themes were produced based on the research questions presented earlier in the chapter. The findings extracted from the selected papers were grouped under these three themes:

- Verification for current educational practice in medication safety in the nursing and pharmacy,
- Subject matter and teaching and training approaches used in teaching medication safety,
- Guiding principles and curriculum compositional frameworks employed in medication safety education.

3.4.3.1 The first theme focused on verification for current educational practice in medication safety in the nursing and pharmacy as presented in the literature. In addition, it includes a section relating to outcome measures used to evaluate educational interventions.

A) Verification for Current Medication and Patient Safety Education in Nursing Studies

Attree et al. (2008) argued that patient safety was not explicitly addressed in the undergraduate nursing curriculum. Similarly, Steven et al. (2014) reported that within the academic context, patient safety was not visible as a curricula theme, and programme leaders struggled to define it whilst some felt labelling to be problematic. Similarly, in a study that examined current nursing programmes in South Korea, Lee et al. (2016) reported results that confirm the need to revise the nursing curriculum. Moreover, Mbuthia, N. N. et al. (2018) indicated that the curriculum content of patient safety was implicit within the curriculum as a series of statements and inferences to patient safety. Similarly, Usher, K., et al. (2018) highlighted those approaches to teaching patient safety varies considerably between universities, where patient safety tended to be integrated within undergraduate nursing course subjects rather than explicitly taught in separate, stand-alone subjects.

In addition, Kirwan, M., et al. (2019) highlighted that the topic of patient safety generally remains a hidden element within the curriculum taught across many subjects. Moreover, Milligan et al. (2006) mentioned that there is a significant need to improve patient safety education and to include the human factors theory in healthcare education with specific mention being made of the Human Factors Analysis and Classification System. Similarly, in a descriptive study regarding integrating patient safety instruction into simulation experiences for undergraduate nursing students, Gantt et al. (2010) reported that students in the first semester did not demonstrate satisfactory performance of either hand hygiene or patient identification for 61 per cent of the time. Furthermore, even after patient safety instruction, students still did not perform these procedures consistently for 38 per cent of the time.

Another concerning fact, was highlighted by Gregory et al. (2007) in that the exclusive focus on individual errors and not on system errors, is of concern regarding nursing education and patient safety. Therefore, educators need to engage in a culture shift whereby student error is considered from an education systems perspective (Gregory, 2007).

Additionally, in a study exploring the formal and informal ways in which pre-registration nursing students learn about patient safety, Steven et al. (2014) noted that in practice, students learned by observing staff who acted as role models; challenging practice was problematic, since they needed to 'fit in' and mentors were viewed as deciding whether they passed or failed their placements.

Another finding by Page et al. (2007) is that both lecturers and students expressed dissatisfaction with current pharmacology education and strongly indicated that there is a need for further educational initiatives. Moreover, Vaismoradi et al. (2011) reported that nursing students discovered that they lacked knowledge and experience regarding patient safety. Furthermore, Vaismoradi et al. (2014b) identified two causes of medication errors: under-developed caring skills in medication management and incomplete learning of safe medication management. In addition, Vaismoradi and colleagues reported that all respondents felt that their education programmes left them vulnerable to "drug errors". Similarly, Ruth-Sahd (2014) emphasised that the Baccalaureate nursing curriculum requires revision due to the gap between education and practice, and stressed that there is a need for creative teaching strategies to foster critical thinking, critical analysis and reasoning skills. Additionally, Debourgh (2012) in a pilot study using the IOM six competencies approach, reported that survey data reveals moderate to large gains in safety and quality knowledge, and students' increased confidence had an impact on patient care outcomes.

Another positive finding by Mansour (2015) is that patient safety education is contextualised in the undergraduate pre-registration nursing curriculum, and identified four factors relating to patient safety: willingness to disclose errors, recognition and management of medical errors, perceived inter-professional context of patient safety and perceived support and understanding for improving patient safety. However, Mansour (2013) believes that the power imbalance between

students and staff in clinical placements appeared to have rendered many students reluctant to challenge unsafe practice. Furthermore, Whitehair et al. (2014) pointed out that student nurses had difficulty identifying the prescribing errors built into a prescription medication quiz, and they recommended using a simulation approach to educate students about medication safety.

Bressan et al. (2016), Duhn et al. (2012), Lukewich et al. (2015), Stevanin et al. (2015), Weatherford et al. (2015) and Suliman, M. (2019), used the Health Professional Education in Patient Safety Survey (H-PEPSS) to assess the perceptions and confidence of undergraduate nursing students regarding their own patient safety knowledge, competence and attitudes. These studies revealed different findings. Among these findings were that H-PEPSS is a valid tool which is capable of evaluating the self-perception of nursing students regarding patient safety knowledge and competence, (Bressan, 2016). Nursing students' responses were favourable, with students reporting confidence in learning about a variety of patient safety competencies. However, third and fourth year students reported decreasing levels of confidence. There were low to moderate correlations between classroom and clinical responses, (Duhn, 2012). In addition, Duhn et al. (2012) strongly suggested that it is important to engage students consistently in safety principles early and throughout their health care education programmes. Moreover, nursing students were relatively confident about what they were learning about the clinical aspects of patient safety (i.e. safe clinical practice, hand hygiene, infection control and safe medication practice) while they were less confident about socio-cultural aspects of patient safety, (Lukewich, 2015). Furthermore, nursing students reported having experienced an adverse event or near miss during their clinical experience, noting that the learning setting was unsafe and there was a significant difference in perception of nursing students in different academic years, (Stevanin, 2015).

In contrast to the above studies, nursing students were also found to be satisfied as regards their safety competencies in both classroom and clinical experience settings, (Weatherford, 2005). Finally, a study by Suliman, M. (2019) advised developing a comprehensive framework that incorporates patient safety knowledge and

competencies in order to close the gap between theory and practise in the nursing curriculum.

Furthermore, patient safety can be "institutionalised" by becoming a requirement for programme certification, according to Mansour, M. J., et al. (2018). Additionally, Ji, Y., et al. (2021) confirmed that, in accordance with the continuity and sequence of education principles, patient safety topics should be covered in both theoretical and practical settings throughout the whole nursing programme. It was noted in the study by Lee, S. E., et al. (2020a) that the majority of respondents said that further supports are required, including a national standardised curriculum for patient safety education, although there was some consistency in approaches to teaching patient safety. Lee, S. E., et al.'s (2020b) study was another that supported the need for curriculum development to encompass all aspects of patient safety. Similarly, Kirwan, M., et al. (2019) noted variation in how nursing is regulated across countries, and regulatory bodies have not yet advocated criteria on the subject. Moreover, Mbuthia et al. (2018) suggested integrating patient safety concepts into nursing education, equipping academic and clinical faculties, creating a conducive patient safety culture in clinical placement sites, and fostering collaboration between academic and clinical settings. Furthermore, Usher, K., et al. (2018) reported there were differences in the amount of time allocated, who was responsible for the teaching and learning, and in which setting the learning occurred and was assessed. There was little indication of the existence of a systematic approach to learning patient safety, with most participants reporting an emphasis on learning applied to medication safety.

In a study which aimed to design online instructions for medication safety courses Bush et al. (2015) found that using Quality and Safety Education for Nurses (QSEN) competency as a guide, could ensure that students are given an opportunity for knowledge acquisition, skills practice, and the development of appropriate attitudes. Similarly, in a study by Masters (2016), aimed to integrate QSEN into clinical nursing education through development of a dedicated education unit, Masters found that students who participated in the dedicated education unit had higher scores than those with traditional clinical rotations.

B) Verification for Current Medication and Patient Safety Education in Pharmacy Studies

Bradly et al. (2011) reported that informal learning allocated high levels of credibility by students and elements of patient safety were not adequately addressed in the formal curriculum such as safe systems, errors and professionalism. Another positive finding by Fuji et al. (2010) is that data from patient safety course evaluation showed that students placed high value on receiving patient safety education, and felt that the course should continue to be offered. In contrast, Noland et al. (2009) reported that study results indicate that pharmacy students experience both incomplete and inconsistent learning for the role of communication in medication errors and their prevention. However, it was found that the majority of students felt they had adequate training related to communication issues that cause medication errors (this finding is in contrast with the finding of Noland, 2009 and Rickles, 2010). However, fewer students believed that they knew how to report such an error to a patient or within a health system (this finding supports the finding of Rajiah, 2016). Furthermore, West-Strum et al. (2011) stated that the majority of the colleges and schools responding indicated that they had integrated Science of Safety (SoS) topics into their curriculum. However, some gaps (for example teaching students about communicating risk, Food and Drug Administration (FDA) Sentinel Initiative and utilising patient databases) were identified and these needs have to be addressed. Similarly, Warholak et al. (2011) reported that newly graduated pharmacists should meet minimum SoS requirements, and that pharmacy schools are preparing students well in some areas of medication safety but not in others and SoS education should be "hands on" or interactive. Moreover, Rickles et al. (2010) outlined three factors associated with knowledge and comfort in communication of medication errors; the majority of respondents received little or no formal didactic or on-the-job training in how to handle communication of medication errors, other students reported having learned by observing how others handled medication errors and those students who reported receiving formal training felt it was insufficient or inadequate. Similarly, Rajiah et al. (2016) reported that pharmacy students had sufficient knowledge, but

that there were significant differences in perception among students on adverse drug reaction reporting.

In addition, Scales et al. (2015) reported that there was a significant improvement in students' attitude to medication safety related to their confidence in understanding and preventing medication error. However, there was no significant change in students' attitudes regarding reporting of medication errors. Another positive finding by Trinkley et al. (2017) is that pharmacy students in their second year (P2) were more confident

to describe patient safety, describe factors that influence it, and conduct a root cause analysis (RCA). Walpola et al. (2015) also found that first-year students' attitudes significantly improved as a result of the peer-led education programme, particularly in relation to internalising errors, questioning behaviours and open disclosure, which indicates that peer-led education is an effective method that can be adapted to improve first year pharmacy students' attitudes towards patient safety. Tegegn, H. G., et al. (2017) outlined that standardised patient safety courses should be considered in the curriculum for junior pharmacy students to improve their attitude toward patient safety. Similarly, Alwhaibi, M., et al. (2020) highlighted the need for including patient safety courses in the curricula of the different pharmacy programmes given the patient safety training importance in improving the quality of patient care. It is notable that around one-half of the surveyed pharmacy students did not receive any courses on patient safety. Moreover, Naser, A. Y., et al. (2020) stressed that patient safety content should be covered comprehensively in pharmacy curricula and reinforced in each year of study. This should be more focused on students in their final year of study and who have started their training. This will ensure that the next generation of pharmacists is equipped with the requisite knowledge, core competencies and attitudes to ensure optimal patient safety when they practise. Furthermore, Alkatheri, A. M., et al. (2017) noted the curriculum varied significantly by general discipline, academic degree, years of experience and gender, with more than 50 per cent of respondents indicating that medication safety should be covered within selected courses, and 65 per cent indicating that such courses should be mandatory.

These findings identified a clear gap in the curriculum and a possible gap experienced by other schools and colleges of pharmacy.

C) Verification for Current Medication and Patient Safety Education in Combined Healthcare Professions' Studies

Yoshika et al. (2013) reported that most students received formal training on human error and patient safety and had attitudes that demonstrated uncertainty about what would be correct in some practices. However, Cresswell et al. (2013) stated that patient safety tended to be either implicit in curricula or explicitly identified in a limited number of discrete topic areas. Students were predominantly taught about safety-related issues in isolation, with the consequence of only limited opportunities for inter-professional learning. Furthermore, Svitlica et al. (2021) found that students' knowledge and attitudes towards patient safety significantly influence the necessity of incorporating a patient safety course into healthcare curricula.

3.4.3.2 The second theme as mentioned earlier focused on subject matter (content), teaching and training approaches (methods) used in medication safety education as reported in the nursing, pharmacy and combined healthcare professions studies.

A) Medication Safety Curriculum Content, Teaching and Training Methods used in Nursing Studies:

Nurses need to have sufficient knowledge of pharmacology and medication safety, and there is a need to integrate more content and dedicate more time to the whole area of pharmacology and medication management in the nursing curriculum (Adhikari et al., 2014; Holdforth et al., 2013). Furthermore, Adhikari et al. (2014) reported that the Five Rights of medication administration are not enough for holistic medication safety, and there is a need to strengthen multi-disciplinary team-work to achieve greater patient safety. In addition, Armstrong et al. (2013) suggested that providing pre-licensure students a strong foundation in quality and safety in an introductory clinical course facilitates early adoption of quality and safety

competencies as core practice values. Moreover, Debourgh et al. (2012) suggest revising pre-licensure curricula to include practical teaching activities on nursing care-sensitive patient outcomes, focusing on situational awareness, clinical reasoning, and judgement.

Additionally, according to Bohomol, E. (2019), the undergraduate course's patient safety content is lacking in three crucial areas, including "What is patient safety?;" Why is it crucial for patient safety to consider human factors?" and "Learn from mistakes to avoid harm." Similarly, Lee, S. E., et al. (2020a) noted that patient safety topics are addressed throughout various nursing courses, and patient safety education is limited in hours of instruction and breadth of content. A finding by Smith et al. (2007), who described the current levels of integration of quality and safety content in pre-licensure nursing curricula, was that there were opportunities for improvement in many nursing schools, particularly with respect to informatics, quality improvement and evidence-based practice. Additionally, Day et al. (2007) described an innovative approach to integrating medication safety, (see Table 3.4).

Table 3. 4 Three Innovative Approaches as Described by Day et al. (2007):

Exercise 1	Data Mining and Interpretation (Informatics, Quality Improvement, and Evidence-Based Practice) uses a known process such as "Plan-Do-Study-Act" cycles
Exercise 2	Web-Site Evaluation (Informatics, Patient-Centred Care)
Exercise 3	Evaluation of Staff Work-Arounds (Evidence-Based-Practice, Safety, Teamwork and Collaboration, Quality Improvement).

In this section, there are many educational methods used as reported in nursing studies: simulation, inter-professional learning, critical thinking, problem-based learning and problem-solving skills. Scholars have indicated the lack of uniformity in the delivery of medication safety in nursing education. There is strong evidence of this in the literature (Adhikari et al., 2014; Holdforth et al., 2013; Dobourgh et al., 2012b

and Lee et al., 2016). Generally, the literature highlights some broad categories of teaching methods. These include teaching simulations, problem-based learning, critical thinking and problem-solving, teaching strategies, root cause analysis and a combination of various classroom and clinical learning activities including e-learning, (Sears et al., 2010; Badir et al., 2015; Hayes et al., 2015; Mariani et al., 2015; Lee et al., 2016; Miller et al., 2009; Hewitt et al., 2015; Chenot et al., 2010; Jarzemsky et al., 2010; Russell et al., 2013; Madhavanpraphakaran, 2012; Cooper, 2014; Lee et al., 2013; Dolansky et al., 2013).

Moreover, Hanson (2016) obtained undergraduate nursing students' responses to a flipped classroom approach in pharmacology lectures and found that nursing students who engaged with e-lectures before face-to-face workshops had a greater understanding of the subject and enhanced critical thinking skills. Furthermore, Mawhirter et al. (2016) on using simulation games as a teaching strategy, pointed out that the gamification of patient safety simulation scenarios was found to be a creative innovation which increased student enthusiasm for learning and self-reflection. Similarly, in a study by Sanko et al. (2015), on the use of simulation-based medication event reporting as a learning strategy, a decreasing trend of reported medication events across courses was found. However, in a study by House et al. (2016) exploring nursing students' perceptions of a safety simulation strategy, the results demonstrated that participants struggled to identify patient safety issues. In addition, Omura et al. (2015) reported that results demonstrate the potential for inter-professional multimedia learning resources to positively impact the behaviours of Japanese registered nurses in relation to safe medication practices.

Researchers have made the case for the use of various simulation exercises in patient safety education. Sears et al (2010); Badir et al (2015); Hayes et al (2015) and Mariani et al (2015), all indicated the need for and effectiveness of simulation-related teaching activities, although from different perspectives. The group led by Sears reported that students in clinical placement made fewer medication errors if they had prior exposure to a related, simulation-based experience, while Badir's group found that high-fidelity simulation was an ideal method of promoting learning by helping

students transfer theory into practice, build confidence and teamwork, and raise professional awareness. These perspectives are supported by Hayes et al. (2015) and Mariani et al. (2015). Hayes pointed out that using simulation technologies has been shown to create a positive learning experience and improve deductive reasoning and analysis skills of students through exposure to clinical experience in a safe environment, whereas Mariani argued that simulation is a teaching strategy that may contribute to increasing undergraduate nursing students' comfort with reporting or investigating errors. In contrast to these was the perspective of Lee et al. (2016) who concluded, based on students' reports, that patient safety education during coursework was delivered primarily by lecture rather than during laboratory or simulation sessions. Additionally, Bohomol, E. (2019) identified that different teaching methodologies and evaluation strategies, both traditional and innovative, were used in teaching medication safety.

Hewitt et al. (2015) reported that the use of problem-based learning as an educational intervention offers nursing students the opportunity to engage with system factors that contribute to medication errors, while Chenot et al. (2010) noted that including critical thinking and problem solving skills is necessary to identify and reduce errors. She also noted that at least three of the six QSEN competencies (i.e., include patient-centred care, teamwork and collaboration, evidence-based practice, quality improvement and informatics, and safety) were included in the curriculum of participating academic institutions. In contrast, Jarzemsky et al. (2010) described a strategy for the efficient planning of simulation-based training which incorporates knowledge, skills and attitudes as defined by QSEN initiatives. Russell et al. (2013) also supported the strategy approach by stating that a safety framework has been shown to be a useful tool for integration of content knowledge, clinical reasoning and reflection on essential professional practice issues for nursing students. Similarly, Madhavanpraphakaran (2012) argued that patient safety can be enhanced through strategies as outlined in table3.5 below. However, Cooper (2014) highlighted using the medication error reporting method to identify three categories of medication errors: administration rights, system issues, and knowledge and understanding. Moreover, Lee et al. (2013) reported using an e-learning programme on medication management

as an effective learning method in addition to attending lectures, whereas Dolansky et al. (2013) pointed out that using RCA to evaluate and identify the causes of medication error incidents can be an effective learning tool for nursing students, as it will also allow them to identify factors which contribute to medication errors.

Table 3. 5 Strategies Identified by Madhavanpraphakaran (2012)

1) Evidence based education and practice,
2) Interdisciplinary collaboration in nursing education,
3) Simulation training,
4) Use of informatics in education and health care to reduce errors and enhance communications,
5) Faculty involvement with inter-professional teams on patient care units.

B) Medication Safety Curriculum Content, Teaching and Training Methods used in Pharmacy Studies

Researchers in pharmacy studies have reported some educational methods used in patient and medication safety education. Holdford et al. (2011) mentioned that undergraduate pharmacy education should include the following general topic areas related to medication safety: educating students in inter-professional teams, teaching communication skills, providing the chance for students to practise research in medication safety and promoting a culture of safety in students' minds. Furthermore, Schafer et al. (2012) reported that using team-based RCA projects led to the successful introduction of medication error evaluation and prevention in a medication safety course. In addition, Sukkari et al. (2008) mentioned that major improvements in students' knowledge and skills, readiness for knowledge application, and commitment to improving patient safety were due to developing a patient safety course that included didactic lectures, case studies, in-class activities and reading assignments. Another positive finding by Vyes et al. (2012) is that simulation training provided an opportunity to improve pharmacy students' ability to recognise and react to patient safety concerns and enhanced their inter-professional collaboration and communication skills. Moreover, Atayee et al. (2016) reported that using simulation-based methods to improve first year pharmacy students' ability to identify medication

errors was successful at improving students' knowledge, confidence and application of these skills.

Similarly, Komperda & Lempicki (2019) stressed that simulated learning exercises should continue to be incorporated in pharmacy education as they significantly improved students' ability to perform medication reconciliation, including obtaining an accurate medication list, correctly identifying medication discrepancies and proposing appropriate resolutions. Furthermore, Korayem & Alboghdadly (2020) agreed that integrating simulation into Advance Pharmacy Practise Experience (APPE) can supplement hospital-based experiential training to achieve the best learning outcomes with improved student satisfaction. Additionally, Skoy et al. (2018) noted that using the root cause analysis (RCA) method to discover medication errors in three simulated pharmacy settings improved students' knowledge, skills, and attitudes regarding medication errors.

C) Medication Safety Curriculum Content, Teaching and Training Methods used in Combined Healthcare Professions Studies

Pearson et al. (2010) reported that incident reporting was a key feature of the patient safety programme, and anticipated that patient safety had become a higher priority for health trusts in recent years. In addition, East et al. (2015) evaluated a filmed clinical scenario as a teaching resource for an introductory pharmacology unit and reported that the nursing and midwifery students found the filmed clinical scenario more useful than lectures, although less useful than tutorials. Additionally, Ottis et al. (2016) reported a positive shift among all students in attitudes from pre-to post-simulation and differences in confidence levels between pharmacy and nursing students.

Another positive finding was made by Reime et al. (2016) found that nursing and medical students who participated in a simulation-based inter-professional team-training course improved team performance and patient care quality after returning to clinical practice, emphasising the importance of speaking up. Additionally, Lee, W.,

et al. (2020) and Popkess, A., et al. (2017) found that the use of simulation in inter-professional education or training is effective in practising and developing undergraduate nursing and medical students' inter-professional collaboration through hands-on experience, and error disclosure as a simulation training programme appeared to be successful in enhancing student knowledge and attitudes about error disclosure as an inter-professional team. Overall, students perceived the training as a positive experience.

Researchers reported the effectiveness of interprofessional learning methods in delivering patient and medication safety education. Headrick et al. (2012) addressed the need for inter-professional education as a required learning goal and in being to create clinically based improvement learning for all students. In addition, group of researchers have made the case for the use of inter-professional learning methods in patient safety education. Ernawati et al. (2015); Hwang et al. (2016); Lapkin et al., 2012; Thom et al. (2016); and Ragucci et al. (2016), all indicated the need for and effectiveness of inter-professional learning method, although from different perspectives. A positive finding by Ernawati et al. (2015) was that learning with other healthcare students through an inter-professional education (IPE) workshop improved medical, nursing and pharmacy students' attitudes towards the importance of shared learning, teamwork and communication in healthcare services. Similarly, Hwang et al. (2016) evaluated patient safety competencies using the H-PEPSS, and indicated that the inter-professional education strategy was significant in improving H-PEPSS and knowledge test scores. Additionally, Lapkin et al. (2012) investigated the utilisation of inter-professional education in teaching nursing, pharmacy, and medical students. Moreover, Thom et al. (2016) described the development and implementation of an inter-professional course for medical, nursing and pharmacy students, and pointed out that all students reported a high level of readiness for engaging with inter-professional learning and indicated an interest in inter-professional opportunities as well. In addition, Ragucci et al. (2016) evaluated the impact of an inter-professional communication skills workshop on pharmacy student confidence and proficiency in disclosing medical errors to patients. Moreover, Seaman, K., et al. (2018) pointed out the relevance to clinical practice of inter-professional clinical placements, which are

essential for students to understand inter-professional practice for better patient outcomes and developing their own perspective of future work within an inter-professional team. A clinical placement in an ambulatory setting for nursing and medical students resulted in an increase in self- perceived ability to work with others and in valuing working with others too. Accordingly, ambulatory care is an ideal environment for nursing and other health professional students to engage in inter-professional clinical placements.

These perspectives are supported by Robb et al. (2017), who noted that inter-professional shadowing combined with reflection can enhance learning. In addition, Bridgeman et al. (2018) highlighted the impact of an inter-professional medication error workshop on healthcare student perceptions. Differences in the responses of pharmacy, medical and physician-assistant students were found, highlighting the areas where healthcare education can be targeted to bridge the gap in opinion.

Finally, researchers have made the attempt and presented some outcome measures used to evaluate educational interventions such as using simulation for assessment and use of emerging views on quality and safety competencies to redesign nursing education programmes. Vyes et al. (2012) emphasised that simulation is an effective method for assessing student's competency in core domain abilities before beginning the advanced pharmacy practice experience (APPE), preparing them for real clinical encounters and making them more aware of medication errors and other patient safety issues. Whitehair et al. (2014) recommended using a simulation approach to educate students about medication safety and Sherwood et al. (2007) reported that emerging views of quality and safety and related competencies, as applied in practice, have corresponding implications for the redesign of nursing education programmes.

3.4.3.3 The Third Theme Focused on Guiding Principles and Curriculum Compositional Frameworks Employed in Medication Safety Education.

This theme focused on curriculum guides and educational frameworks used in medication safety education as presented in the reported literature. Table 3.6 shows

the 43 articles (representing nearly half, of the 104 papers examined (44.7 per cent)) which mentioned the use of curriculum guides or educational frameworks in the three professional groups.

Table 3. 6 Articles that Describe use of a Curriculum Guide or Framework

#	Authors & Year	Country	Title	Curriculum Guide or Educational Framework Used
1	Alwhaibi, M., et al. (2020)	Saudi Arabia	Pharmacy Students' Attitudes toward Patient Safety in Saudi Arabia: a Cross-Sectional Study.	The Attitudes to Patient Safety Questionnaire III (APSQ-III)
2	Armstrong et al. (2013)	USA	Fundamentally Updating Fundamentals	US Quality & Safety Education for Nurses (QSEN) six competencies
3	Attree et al. (2008)	UK	Patient safety in English Pre-registration Nursing Curriculum	UK Nursing and Midwifery Council (NMC) guide
4	Bohomol, E. (2019)	Brazil	Patient Safety Education of the Graduation in Nursing from the Teaching Perspective	WHO CG
5	Bridgeman, M. B., et al. (2018)	USA	Impact of an Inter-professional Medication Error Workshop on Healthcare Student Perceptions	Kirkpatrick's evaluation framework used for this workshop
6	Bush et al. (2015)	USA	Cultivating a Culture of Medication Safety in Pre-licensure Nursing Students	QSEN
7	Chenot et al. (2010)	USA	Frameworks for Patient Safety in the Nursing Curriculum	QSEN
8	Cooper et al. (2013)	USA	From the School of Nursing Quality and Safety Officer: Nursing Students' Use of Safety Reporting Tools and their Perception of Safety Issues in Clinical Settings	QSEN
9	Cresswell et al. (2013)	UK	Patient Safety in Healthcare Pre-registration Educational Curricula: Multiple Case Study-Based Investigations to Eight Medicine, Nursing, Pharmacy and Physiotherapy University Courses	Eraut's learning in the workplace framework
10	Day et al. (2007)	USA	Integrating Quality and Safety Content into Clinical Teaching in the Acute Care Setting	QSEN
11	Debourgh et al. (2012b)	USA	Patient Safety Manifesto: A Professional Imperative for Pre-licensure Nursing Education	QSEN
12	Debourgh (2012a)	USA	Synergy for Patient Safety and Quality: Academic and Service Partnerships to Promote Effective Nurse Education and Clinical Practice	QSEN
13	Dolansky et al. (2013)	USA	Nursing Student Medication Errors: A Case Study using Root Cause Analysis	QSEN

#	Authors & Year	Country	Title	Curriculum Guide or Educational Framework Used
14	East et al. (2015)	Australia	Evaluation of a Filmed Clinical Scenario as a Teaching Resource for an Introductory Pharmacology Unit for Undergraduate Health Students: A pilot study	Bloom's Taxonomy of cognitive processes
15	Hayes et al. (2015)	Australia	Nurse interrupted: Development of a Realistic Medication Administration Simulation for Undergraduate Nurses	Jeffries Simulation Framework (2005) + educational theorists including; Benner's novice to expert, Tanner's model of clinical judgement, and Kolb's theory of experiential learning (Benner, 2001; Kolb, 1984; Tanner, 2006)
16	Hewitt et al. (2015)	Australia	An Education Intervention to Improve Nursing Students' Understanding of Medication Safety	Experiential learning concepts = Kolb Framework
17	Hickey et al. (2010)	USA	Integrating the Institute of Medicine Competencies in a Baccalaureate Curricular Revision: Process and Strategies	Institute of Medicine (IOM) competencies
18	Hold forth et al. (2013)	Ireland	The Strategic Role of Education in the Prevention of Medication Errors in Nursing (Part 2)	NMC guide - essential skills cluster for medicines management
19	Hwang et al. (2016)	South Korea	Patient Safety Competence for Final-Year Health Professional Students: Perceptions of Effectiveness of an Inter-professional Education Course	WHO CG
20	Jarzemsky et al. (2010)	USA	Incorporating Quality and Safety Education for Nurses' Competencies in Simulation Scenario Design	QSEN
21	Kirwan, M., et al. (2019).	countries from Europe	Regulation and Current Status of Patient Safety Content in Pre-registration Nurse Education in 27 Countries: Findings from the Rationing - Missed Nursing Care (RANCARE) COST Action Project	WHO CG
22	Lee et al. (2016)	South Korea	Patient Safety Education and Baccalaureate Nursing Students' Patient Safety Competency: A Cross-sectional Study	QSEN
23	Lukewich et al. (2015)	Canada	Undergraduate Baccalaureate Nursing Students' Self-Reported Confidence in Learning about Patient Safety in the Classroom and Clinical Settings: An Annual Cross-sectional Study (2010–2013)	The six dimensions of the Canadian Patient Safety Institute Safety Competencies Framework
24	Madhavanpraphakaran	India	Patient safety and Nursing Education	QSEN

#	Authors & Year	Country	Title	Curriculum Guide or Educational Framework Used
	(2012)			
25	Mansour (2013)	UK	Examining Patient Safety Education in Pre-registration Nursing Curriculum: Qualitative Study	WHO CG
26	Mansour, M. J., et al. (2018).	Saudi Arabia	Integrating Patient Safety Education in the Undergraduate Nursing Curriculum: A Discussion Paper.	QSEN + WHO CG
27	Masters (2016)	USA	Integrating Quality and Safety Education into Clinical Nursing Education through a Dedicated Education Unit	QSEN
28	Mawhirter et al. (2016)	USA	Expect the Unexpected: Simulation Games as a Teaching Strategy	QSEN + constructivist learning theory
29	Miller et al. (2009)	USA	Students Learning Outcomes after Integrating of Quality and Safety Education Competencies into a Senior Level Critical Care Course	Knowledge, Skills and Attitude (KSA) framework
30	Omura et al. (2015)	Japan	Measuring the Impact of an Inter-professional Multimedia Learning Resource on Japanese Nurses and Nursing Students using the Theory of Planned Behaviour Medication Safety Questionnaire	Theory of Planned Behaviour: Medication Safety Questionnaire
31	Ottis et al. (2016)	USA	An inter-Professional Nursing and Pharmacy Student Simulation in Acute Pain Management	KSA framework
32	Russell et al. (2014)	USA	Safety: an Integrated Clinical Reasoning and Reflection Framework for Undergraduate Nursing Students	Safety/clinical reasoning and reflection framework
33	Schafer et al. (2012)	USA	A Root Cause Analysis Project in a Medication Safety Course	The Institute for Safe Medication Practice (ISMP) approach was used in this course
34	Sherwood et al. (2007)	USA	Quality and Safety Curricula in Nursing Education: Matching Practice Realities	QSEN
35	Smith et al. (2007)	USA	Current Assessments of Quality and Safety Education in Nursing	QSEN
36	Stevanin et al.(2015)	Italy	Knowledge and Competence with Patient Safety as Perceived by Nursing Students: The Findings of a Cross-sectional Study	The six dimensions of the Canadian Patient Safety Institute Safety Competencies' Framework
37	Steven et al. (2014)	UK	Patient Safety in Nursing Education: Context, Tensions and Feeling Safe to Learn	KSA framework

#	Authors & Year	Country	Title	Curriculum Guide or Educational Framework Used
38	Sukkari et al. (2008)	USA	Development and Evaluation of a Required Patient Safety Course	Reports published by IOM was used when outlining the course
39	Sullivan et al. (2009)	USA	Assessing Quality and Safety Competencies of Graduating Pre-licensure Nursing Students	QSEN
40	Svitlica et al. (2021)	Serbia	Patient safety: Knowledge and Attitudes of Medical and Nursing Students: Cross-sectional Study.	WHO CG
41	Warholak et al. (2011)	USA	Perspectives on Educating Pharmacy Students about the Science of Safety	US Food & Drug Administration (FDA)/Science of safety (SOS) framework/IOM
42	Weatherford et al. (2015)	USA	Senior Nursing Students' Perspectives on Safety Competencies: An End-of-Program Outcome Evaluation	The survey based on Kirkpatrick's evaluation framework and the six dimensions of the Canadian Patient Safety Institute Safety Competencies Framework
43	West-strum et al. (2011)	USA	The Science of Safety Curriculum in US Colleges and Schools of Pharmacy	FDA/ SOS framework

WHO CG = WHO patient safety curriculum guide for multi-professional education (2011) used in programme design, KSA = Knowledge, Skills and Attitudes, QSEN = Quality and Safety Education for Nursing, FDA = Food and Drug Administration, IOM = Canadian Patient Safety Competencies Framework = The six dimensions of the Canadian Patient Safety Competencies Framework by institute of medicine. NMC = UK Nursing and Midwifery Council guide

The table 3.6 above presents studies which used curriculum guides such as the WHO Patient Safety Curriculum Guide for Multi-Professional Edition.

Six studies used the WHO Curriculum Guide explicitly (Hwang et al., 2016; Mansour 2013; Bohomol, E. 2019; Kirwan et al. 2019; Mansour et al. 2018; Svitlica et al. 2021) and a further 37 studies used other guides and frameworks (see table 3.6). This shows that the WHO Curriculum Guide was rarely used or not used explicitly. However, some items which are similar to the WHO Curriculum Guide items were used such as the QSEN six competencies which include: patient-centred care, teamwork and collaboration, evidence-based practice, quality improvement and informatics and safety. Moreover, many educational frameworks were reported, such as KSA, Kolb Experiential learning concepts, Kirkpatrick's evaluation frameworks and others.

Quality of Studies in This Review

As mentioned in the method section, a quality check was performed for the 82 empirical studies using CASP, Guyatt quantitative quality check tool and MMAT. Table 3.7 presents the 26 high quality studies selected as a result.

Table 3. 7 High Quality Studies

#	Author, Year and Country	Article Title	Profession	Type of Study	Method	Framework/ Theory	Quality Check/ Tool Used
1	Badir et al. (2015), Turkey	Using High-fidelity Simulation as a Learning Strategy in an Undergraduate Intensive Care Course	Nursing	Qualitative	Case study, focus groups and 3 simulation scenarios	None	CASP
2	Bradly et al. (2011), UK	The Role of Hidden Curriculum in Teaching Pharmacy Students about Patient Safety	Pharmacy	Qualitative	Case study, focus groups, observations	None	CASP
3	Bohomol, E. (2019), Brazil	Patient Safety Education of the Graduation in Nursing from the Teaching Perspective	Nursing	Qualitative	A descriptive case study was carried out	World Health Organization (WHO) Patient Safety Curriculum Guide.	CASP
4	Holdford et al. (2011), USA	Teaching the Science of Safety in US Colleges and Schools of Pharmacy	Pharmacy	Qualitative	Interviews, case study	None	CASP
5	Lee, W., et al. (2020), Korea	Nursing and Medical Students' Perceptions of an Inter-professional Simulation-Based Education: A Qualitative Descriptive Study	Nursing and medical	Qualitative	Qualitative descriptive design with reflective journal	None	CASP
6	Mansour (2013), UK	Examining Patient Safety Education in Pre-registration Nursing Curriculum: Qualitative Study	Nursing	Qualitative	Semi-structured interviews	WHO Patient Safety Curriculum Guide	CASP
7	Mbuthia, N. N. and M. M. Moleki (2018), Kenya	Perspectives on Patient Safety Education in the Kenyan Preregistration Nursing Curriculum.	Nursing	Qualitative: document	A qualitative content analysis on the relevant curriculum documents, and in-depth, semi-structured interviews	None	CASP
8	Noland et al. (2009), USA	Reflection and Analysis of how Pharmacy Students Learn to Communicate about Medication Errors	Pharmacy	Qualitative	Interviews	None	CASP

#	Author, Year and Country	Article Title	Profession	Type of Study	Method	Framework/ Theory	Quality Check/ Tool Used
9	Robb, G., et al. (2017), New Zealand	The State of Quality Improvement and Patient Safety Teaching in Health Professional Education in New Zealand.	Medicine, nursing, midwifery, dentistry, pharmacy, physiotherapy , dietetics	Qualitative	Semi-structured interview	None	CASP
10	Rotz, M. E. and D. D. O'Neill (2021), USA	Exploring Second Professional Year Pharmacy Student Reflections after an Inter-professional Shadowing Experience with Nursing Students in Critical Care Units: A Qualitative Study	pharmacy & nursing student	Qualitative	Case study using conventional qualitative content analysis.	None	CASP
11	Steven et al. (2014), UK	Patient Safety in Nursing Education: Contexts, Tensions and Feeling Safe to Learn	Nursing	Qualitative	A multi-method design: curriculum review, in-depth case studies, interviews, focus groups, observation	KSA	CASP
12	Warholak et al. (2011), USA	Perspectives on Educating Pharmacy Students about the Science of Safety	Pharmacy	Qualitative	Semi-structured interviews	Canadian Patient Safety Competencies Framework	CASP
13	Vaismoradi et al. (2011), Iran	Patient Safety: Nursing Students Perspectives and the Role of Nursing Education to Provide Safe Care	Nursing	Qualitative	Semi-structured interviews	None	CASP
14	Vaismoradi et al. (2014a), Iran	Nursing Students Perspectives and Suggestions on Patient Safety-Implications for Developing the Nursing Education Curriculum in Iran	Nursing	Qualitative	Focus groups	None	CASP

#	Author, Year and Country	Article Title	Profession	Type of Study	Method	Framework/ Theory	Quality Check/ Tool Used
15	Vaismoradi et al. (2014b), Iran	Nursing Students' Perspectives of the Cause of Medication Errors	Nursing	Qualitative	Focus groups	None	CASP
16	Alkatheri, A. M., et al. (2017), Saudi Arabia	Pharmacy Educators' Knowledge of Medication Safety and Their Perception Toward Its Integration into the Doctor of Pharmacy Curriculum in Saudi Arabia.	Pharmacy	Quantitative	A survey was administered to evaluate Knowledge, training, and perception.	None	Guyatt
17	Bressan et al. (2016), Italy	Measuring Patient Safety Knowledge and Competences as Perceived by Nursing Students: An Italian Validation Study	Nursing	Quantitative	H-PEPSS	None	Guyatt
18	Chenot et al. (2010), USA	Frameworks for Patient Safety in the Nursing Curriculum	Nursing	Quantitative	HPPSACS	QSEN	Guyatt
19	Duhn et al. (2012), Canada	Perspective on Patient Safety among Undergraduate Nursing Students	Nursing	Quantitative	H-PEPSS	None	Guyatt
20	Hwang et al. (2016), South Korea	Patient Safety Competence for Final-Year Health Professional Students: Perceptions of Effectiveness of an Inter-professional Education Course	Nursing, medicine and traditional medicine	Quantitative	H-PEPSS	WHO Patient Safety Curriculum Guide	Guyatt
21	Lapkin et al. (2012), Australia and New Zealand	A Cross-Sectional Survey Examining the Extent to which Inter-professional Education is Used to teach Nursing, Pharmacy and Medical Students in Australian and New Zealand Universities	Nursing, Pharmacy and Medical Students	Quantitative	Survey	None	Guyatt

#	Author, Year and Country	Article Title	Profession	Type of Study	Method	Framework/ Theory	Quality Check/ Tool Used
22	Lukewich et al. (2015), Canada	Undergraduate Baccalaureate Nursing Students' Self-Reported Confidence in Learning about Patient Safety in the Classroom and Clinical Settings: An Annual Cross-Sectional Study (2010–2013)	Nursing	Quantitative	H-PEPSS	Canadian Patient Safety Competencies Framework	Guyatt
23	Mansour (2015), UK	Factors Analysis of Nursing Student's Perception of Patient Safety Education	Nursing	Quantitative	HPPSACS	None	Guyatt
24	Rickles et al. (2010), USA	Pharmacy Student Knowledge and Communication of Medication Errors	Pharmacy	Quantitative	Questionnaire	FDA and SOS	Guyatt
25	Stevanin et al. (2015), Italy	Knowledge and Competence with Patient Safety as Perceived by Nursing Students: The Findings of a Cross-sectional Study	Nursing	Quantitative	H-PEPSS	Canadian Patient Safety Competencies Framework	Guyatt
26	Fuji et al. (2010), USA	Pharmacy Student Attitudes toward an Inter-professional Patient Safety Course: an Exploratory Mixed Methods Study	Pharmacy	Mixed Method	Quantitative data were collected from course evaluation, case study and final examination performance. Qualitative date (interviews)	None	MMAT

KSA = Knowledge, Skills and Attitudes, H-PEPSS = Health Professional Education Patient Safety Survey, HPPSACS = Healthcare Professionals Patient Safety Assessment Curriculum Survey, QSEN = Quality and Safety Education for Nursing, MMAT = Mixed Methods Appraisal Tool, FDA = Food and Drug Administration, SOS = Science of Safety framework , Canadian Patient Safety Competencies Framework = The six dimensions of the Canadian Patient Safety Competencies Framework by institute of medicine (IOM).

As indicated in Table 3.7, there are fifteen qualitative studies, ten quantitative studies and one mixed study. Of the 26 studies, 14 are from the nursing education profession, seven from the pharmacy profession and three studies are combined professional studies.

Nine of the 26 studies used a framework or theory, three studies used the World Health Organisation Patient Safety Curriculum Guide and six studies used a variety of different frameworks or theories such as Knowledge, Skills and Attitudes (KSA), the six dimensions of the Canadian Patient Safety Institute Safety Competencies Framework, QSEN and the FDA/SOS framework. Of the fifteen- qualitative high quality studies ten focussed on content of medication or patient safety education in the curriculum of pharmacy and nursing students (Bradly et al., 2011; Holdford et al., 2011; Noland et al., 2009; Steven et al., 2014; Warholak et al., 2011; Vaismoradi et al., 2011; Vaismoradi et al., 2014a; Vaismoradi et al., 2014b; Mbuthia & Moleki 2018; and Robb et al., 2017), three studies focused on integrating simulation and inter-professional learning as a strategy to teach medication safety(Badir et al., 2015; Lee et al., 2020; and Rotz & Neill 2021), and two studies discussed current patient safety education in relation to WHO Patient Safety Curriculum Guide themes, (Mansour, 2013; Bohomol, 2019) . Of the ten quantitative high quality studies, five used the Health Professional Education in Patient Safety Survey (H-PEPSS) to evaluate students' perception of patient safety education (Bressan et al., 2016; Duhn et al., 2012; Hwang et al., 2016 ; Lukewich et al., 2015; Stevanin et al., 2015), one study used the Healthcare Professionals Patient Safety Assessment Curriculum Survey (HPPSACS) to explore themes emerging from the students' responses (Mansour, 2015), another study examined current patient safety education including the six competencies of QSEN framework and used the HPPSACS (Chenot et al., 2010), a further study described and evaluated pharmacy students' knowledge of and comfort with communicating and managing medication errors (Rickles et al., 2010) and one study evaluated the extent to which inter-professional education is currently used to teach medication safety (Lapkin et al., 2012). Another study by Alkatheri et al. (2017) examined the perception of pharmacy educators in Saudi Arabia regarding the integration of medication safety into their curriculum. Finally, one mixed method, high quality study explored the

attitude of pharmacy students toward inter-professional patient safety elective course, (Fuji et al., 2010).

3.5 Discussion

In this review, 104 studies were identified that met the inclusion criteria. This review revealed that there is limited evidence that the current medication and patient safety educational practice provided to pharmacy and nursing students are effective and sufficient and there are different views and perceptive regarding the subject matter. Furthermore, this review revealed that the content of patient and medication safety taught to pharmacy and nursing students is diverse, there are a range of educational methods used to deliver patient and medication safety education, that no unified curriculum guides were referred to and there a number of educational frameworks are used. Based on the review results, we can see the different types of studies and the variation in medication and/or patient safety content in the current curricula. There are considerable variations in methods used to deliver medication and patient safety components and different opinions on medication safety education and evaluations of the effectiveness of tools used to deliver medication safety. In addition, there are several different educational frameworks used. Altogether, most of the studies proposed changes to the current undergraduate pharmacy and nursing curricula as it relates to patient and medication safety. These studies (Bohomol, E. 2019; Kirwan, M., et al. 2019; Mansour, M. J., et al. 2018; Svitlica, B. B., et al. 2021; Hwang et al. 2016; Mansour. 2013) have shown that using a unified comprehensive curriculum guide which covers medication safety components, such as the WHO Curriculum Guide might improve medication safety education in undergraduate pharmacy and nursing professions. In addition, using a unified well-defined educational framework such as Kolb's Experiential Learning Framework and Kirkpatrick's Evaluation Framework might improve medication safety education. The following section will present the discussion under five themes:

The Reported Evidence for the Effectiveness of Current Educational Practice

Studies indicate that nursing students were not satisfied with their depth of knowledge relating to patient safety education, which lacked common definition for

the terms ‘medication safety’ or ‘patient safety’. Since 2015, there have been six nursing studies and one combined study, including nursing and medical students, using the H-PEPSS to assess the perceptions and confidence of undergraduate nursing students regarding their own patient safety knowledge, competence and attitudes. These studies indicated that students have different perceptions and confidence regarding patient safety competencies in the classroom versus clinical settings among different years of study. However, no pharmacy study used the Health Professional Education in Patient Safety Survey (H-PEPSS). Furthermore, simulation and inter-professional learning were effective methods of delivering patient safety education to undergraduate nursing students. Another interesting fact, highlighted in the review by Mansour (2012), was that there is a mismatch between the student perception and educator conceptualisation of patient safety, which may impact the effectiveness of current educational practice. Moreover, the review by Tella et al., (2014) revealed that patient safety component in nursing curricula was not necessarily explicit. However, patient safety was taught within both academic settings and clinical environments.

This review reveals that greater attention should be given to the teaching of pharmacology and medication safety. There were variations in the degree of student satisfaction with the quality of safety teaching provided in the classroom and clinical learning and skills simulation settings. These variations should be investigated. There was also an issue relating to early exposure to medication safety education and how it impacted student confidence.

Pharmacy studies indicate that although the majority of pharmacy colleges and schools in the USA integrate Science of Safety topics into the curriculum, there are still some gaps that need to be addressed, such as lack of teaching about risk communication, the FDA Sentinel initiative and how to utilise patient databases. There was also variation in the education of students in all medication safety areas. In fact, these gaps and variations were indicated in other pharmacy studies from different countries that were included in this review. For instance, (Alkatheri et al., 2017) stressed that perceptions towards medication safety integration into the curriculum varied significantly by general discipline, academic degree, and years of experience,

with more than 50 per cent of respondents indicating that medication safety should be covered within selected courses and 65 per cent indicating that such courses should be mandatory.

Combined healthcare professions studies indicated that students were not certain about correct practices. This review reveals that there is a need to review learning outcomes and determine effective strategies to achieve them. Robb, G., et al. (2017) identified teaching gaps in patient safety and improved science methods and tools, and he stressed that if these gaps are not filled, new graduates' ability to successfully implement and maintain improvements would be compromised. Moreover, Svitlica, B. B., et al. (2021) reported that a patient safety course must be developed and added to the existing curricula and syllabi of all colleges and universities with a focus on healthcare, as evidenced by the knowledge and attitudes towards patient safety displayed by the students in this survey. Similarly, Bradly et al (2011) highlighted that patient and medication safety portion was not adequately addressed in the formal curriculum.

The Content of Contemporary Reporting of Medication Safety Curricula

This review described the current medication safety curriculum content in reported practice. Studies indicate the need for explicit integration of medication safety in the curriculum for nursing undergraduates and the need to include topics such as human factors, theories and skill development, and providing a strong foundation in quality and safety. Additional content and time are also needed for pharmacology and medication management, (Holdforth, 2013; Adhikari, 2014). There is a prerequisite to include new teaching and learning activities focused on nursing care-sensitive patient outcomes and patient safety. There is also an urgent need to improve the three QSEN competencies of evidence-based practice, quality improvement and informatics. Similarly, Wakefield et al.'s (2005) review found that health professionals receive limited education on harm reduction, error management techniques, and organizational cultures, leading to unsatisfactory implementation of simple measures. In addition, the review by Tella et al. (2014) identified that the content of patient safety was learning from errors, responsible individual and interprofessional team

working, anticipatory action in complex environments, and patient safety–centered nursing. Dejene (2020) agreed with the previous reviews that patient safety training still needs to be improved and guidelines and strategies still need to be developed to minimise errors that can harm the patient.

Pharmacy studies indicate that elements of medication safety such as safe systems, error and professionalism are not addressed adequately in the undergraduate curriculum. Medication safety education should allow students to be educated in inter-professional teams. Furthermore, students should learn about communication skills and practise research in safety fields. There was a substantial variation in the quality and quantity of medication error instruction in the pharmacy curriculum. In addition, the review by Kiersma et al., (2011) pointed out that the majority of pharmacy schools had embedded medication error instruction in pharmacy administration, therapeutics or law courses. Similarly, Kiersma stressed that the majority of instruction was lecture based, with content in human error, medical errors, medication errors, quality or process improvement, root cause analysis and failure mode and effects analysis.

Combined healthcare professions studies indicate that patient safety had recently become a high priority in UK NHS trusts and incident reporting was a key feature of the patient safety agenda. Patient safety was either implicit in the curriculum or explicit in a limited number of topic areas, such as prescribing and administration of drugs, communication skills, infection control, risk assessment and moving and handling, (Cresswell et al., 2013).

Educational Methods That Used to Teach Medication Safety

This review identified several educational methods (i.e., as simulation, critical thinking, PBL, problem solving skills, RCA, e-learning, inter-professional learning, and combing didactic and experiential learning methods), which were used as reported in the literature, and suggested and recommended a number of effective methods to improve medication safety education in undergraduate pharmacy, nursing and other healthcare professions.

Nursing studies indicate the need to include methods such as problem-based learning (PBL) (Attree et al., 2008), simulation-based learning (Badir et al., 2015; Gantt et al., 2009; Hayes et al., 2015; House et al., 2016; Jarzemsky et al., 2010; Mariani et al., 2015; Mawhirter et al., 2016; Sanko et al., 2015; Sears et al., 2008) and a combination of didactic and experiential learning activates which ideally will have a greater impact on student knowledge, skills and attitudes, (KSA) (Bush et al., 2015; Hanson, 2016; Miller et al., 2009). Additionally, they showed the importance of using educational frameworks such as QSEN on student KSA (Armstrong et al., 2013; Bush et al., 2015; Chenot et al., 2010; Cooper, 2013; Day et al., 2007; Debourgh et al., 2012a and 2012b; Dolansky et al., 2013; Jarzemsky et al., 2010; Lee et al., 2016; Masters, 2016; Mawhirter et al., 2016; Sherwood et al., 2007; Smith et al., 2007; Sullivan et al., 2009). There was also a need to include incident reporting as a method to help students recognise, identify and prevent medication errors. Moreover, there is a prerequisite to expand medication safety education methods such as including simulation, root cause analysis and e-learning. After 2015, there was an increase in the number of studies indicating that simulation is a teaching and learning method which is very effective in delivering medication safety teaching to undergraduate nursing students. Similar to the above discussion, the review by Shearer (2013) revealed that simulation-enhanced clinical experiences and may reduce medication errors. In addition, Shearer believes that knowledge and attitudes of safety may be improved with simulation experience, depending on the students' educational levels. Moreover, on teaching and learning methods, Tella et al. (2014) included combining multiple methods such as structured patient safety lectures in academic settings, a Web-based hazard and near-miss reporting system in clinical practice, and conducting a root cause analysis of patient safety incidents, and inter-professional simulation scenarios, followed by debriefing sessions.

Pharmacy studies indicate that using methods such as team-based learning (Fuji et al., 2010; Vyas et al., 2012a), root cause analysis projects (Schafer et al., 2012), and a self-assessment course survey (Sukkari et al., 2008) improved student knowledge, skills and commitment to improving patient safety, and using simulation method

(Komperda & Lempicki 2019; Korayem & Alboghdadly 2020, and Skoy et al., 2018). Komperda & Lempiki (2019), Korayem (2020), and Skoy (2018) emphasised the value of simulation techniques in enhancing students' proficiency in medication conciliation, achieving the best learning outcomes, and enhancing knowledge, skills, and attitudes regarding medication errors. These stress the need to increase the proportion of methods used to teach medication safety such as simulation, inter-professional learning and communication skills. Similarly, Kiersma et al., (2011) noted a variety of educational methods and strategies such as plenary, small-group learning, experiential learning, simulation, role-plays with standardised patients, case-based learning, individual and team-based learning, and supportive audio-visual materials.

Combined healthcare professions studies indicate the need for inter-professional education and clinically based improvement learning. This supports the recommendations in the nursing and pharmacy studies to include more methods and revisit the current methods used to teach medication safety. In addition, since 2015 several combined professional studies have reported using inter-professional learning as an effective strategy to educate health profession students, to help them adopt a positive attitude, and to improve their communication and teamwork skills. However, there were limited opportunities for inter-professional learning with increasing demands.

Curriculum Guides and Educational Frameworks Currently Available for Medication Safety

This review indicates that most of the studies, excluding Mansour (2013), Hwang (2016), Bohomol (2019), Kirwan et al. (2019), Mansour et al. (2018) and Svitlica et al. (2021), did not show explicitly that they used or consulted the WHO Curriculum Guide as a patient safety education reference. 37 studies, mostly from the USA, mentioned using a range of guides and frameworks such as the QSEN, IOM competencies, NMC, Kolb's Experiential Learning Framework, Educational Theories (Benner, 2001; Kolb, 1984; Tanner, 2006),Kirkpatrick's Evaluation Framework, the Theory of Planned Behaviour, the Constructivist Learning Theory, Jeffries Simulation Framework, Bloom's Taxonomy of Cognitive Process, the KSA framework, safety/clinical reasoning and

reflection framework, FDA/Science of Safety Framework, ISMP and Eraut's Learning Framework. There is a need to incorporate and use a comprehensive curriculum guide to patient safety, such as the WHO Curriculum Guide, which provides insights on how to teach patient safety topics including medication safety. Similar to the above discussion, a review by the group of Wakefield et al., (2005) outlined that the NMC 2002 had only four recommendations explicitly referring to issues of patient safety, which explained the low degree of emphasis on patient safety and which was exemplified by the Nursing and Midwifery Council's 21-page document outlining the Requirements for Pre-Registration Nursing Programmes Protecting the Public through Professional Standards. Furthermore, Wakefield et al., (2005) stressed the need to incorporate methods for learning from adverse event via application of human factor engineering framework into healthcare programmes, in order for the students to develop the necessary constructive thinking skills needed for patient safety analysis, which may lead to reduction in patient risk. However, the review of Mansour (2012) pointed out the missing of several aspects of non-technical skills from the QSEN framework such as the lack of any teaching materials to address the importance of human factors and the contributions of system complexities toward unsafe practice, or acknowledgement that serious safety problems may occur in the hands of highly dedicated and competent health professionals.

Medication Safety Opportunities and Challenges to Curriculum Change

In nursing studies, a number of promising opportunities, described by Hickey et al. (2010), were using the Institute of Medicine competencies as part of an innovative framework to create a new curriculum (see table3.8)**.** In addition, in a study for developing the nursing education curriculum, Vaismoradi et al. (2014a) identified two opportunities: involving students fully in-patient care and structuring patient safety education. Furthermore, Page et al, (2007) reported that one initiative was the development of a "medication safety day" which explored the causes of medication errors, highlighted drugs and situations that carry particular risks and provided recommendations to promote good practice. However, Chenot et al. (2010) mentioned that barriers to changing the nursing curriculum include an already maximised curriculum, a growing faculty shortage, the need for faculty development

in the competency content area and the slow pace of curriculum change. Moreover, Cooper (2013) highlighted the barriers or reasons students identify for not reporting errors and near misses mirror the reasons nurses and physicians identify for not reporting. Additionally, Mansour et al. (2018) noted that a key challenge remains building faculty capacity who are experts in both patient safety teaching and research to enable a shift in the patient safety "mind-set" for the future nursing workforce. These reasons included being worry of punishment, time consuming, concern it will affect their job, fear of shame, and feeling guilty, (Buerhaus, 2007; Paterick et al., 2009; Wachter and Pronovost, 2009).

Table 3. 8 Opportunities to Curriculum Change Described by Hickey et al. (2010)

1) Provide patient-centred care,
2) Work as members of an interdisciplinary team,
3) Employ evidence-based practice,
4) Apply quality improvement approaches and,
5) Utilise informatics.

In pharmacy studies, the group of Johnson et al. (2002) reported that the quality and quantity of medication error instruction in pharmacy curricula varied notably. They also stated that pharmacy schools need to articulate and standardise a minimum level of medication error instruction in pharmacy curricula and provide a sample curriculum that could be used. Without a clear instruction, medication errors and medication safety education will not be unified. Naser et al. (2020) emphasised the importance of comprehensive patient safety content in pharmacy curricula, which should be reinforced annually during each study year. A supporting point was made by the review of Kiersma et al. (2011), who emphasised that research is needed to guide curricular change, specifically focusing on instructional methods and interdisciplinary collaborations.

In the combined healthcare professions studies, Tregunno et al. (2014) stated that faculty perspectives on key challenges to safe practice vary across the medicine, pharmacy and nursing disciplines and these different perspectives lead to different

priorities for curriculum innovation. Additionally, accreditation and regulatory requirements are driving curricular change in medicine and pharmacy. Key challenges exist for health professional students in clinical teaching environments where the culture of patient safety may hinder the development of safe practice. Moreover, Lapkin et al. (2012) noted that timetabling restrictions and lack of appropriate teaching and learning resources were identified as the main barriers to implementation of inter-professional education (IPE). In addition to what was mentioned above, Hardisty et al. (2014) stressed that firstly, there are considerable organisational challenges in arranging inter-professional groups when students come from different organisations with different placement arrangements in practice, secondly it is clear that the scenarios that are set for groups need to be developed by inter-professional groups and specifically provide tasks that engage and challenge all professions involved, and finally, facilitators need to represent each profession involved, as well as being trained and confident in facilitating inter-professional groups.

The indication is that there are various perspectives on key challenges to safe practice in different disciplines, which lead to different priorities for curricular innovation. The issues need to be addressed and the medication and patient safety element of nursing education needs to be revised. In addition, accreditation and regulatory requirements are a motive for curriculum change. Furthermore, previous research stresses that greater focus must be placed on opportunities to improve medication safety in the nursing, pharmacy and other healthcare professions curricula. Challenges must be identified, addressed and strategies to overcome the challenges must be developed.

The results of this systematic literature review revealed that the evidence for the effectiveness of current educational practice, as reported in the literature, is still not enough to decide which educational practices are most effective in delivering medication and patient safety education. Content of medication safety training varies within pharmacy and nursing education settings, and that there is no explicit clarity in pharmacy and nursing curricula. Many different teaching and training methods are used to educate pharmacy and nursing students about medication safety. Similarly,

the review by Mansour 2012 supports the above statement as it highlights the limitation of research on patient safety education in undergraduate/preregistration nursing training.

The 26 high quality studies reviewed show very similar results; that medication safety content varied among different schools and professions, different methods were used with more focus on simulation and inter-professional learning as potential effective strategies to deliver medication safety education. There were also different curriculum guides and educational frameworks used which need to be reviewed and investigated to select and unify one or a few guides and frameworks, in order to standardise medication safety education.

Generally, the above evidence points to the need for medication safety education to be labelled explicitly and for medication safety topics to be addressed adequately. Teaching and learning methods need to be reviewed, evaluated and include methods such as PBL and simulation more frequent. Medication safety learning outcomes must be identified and evaluated.

These results support the need for educators to consider alternative approaches to educating students about medication safety. Recommendations with the potential to address this gap in education through the use of simulation are proposed by the reviewed papers which were cited previously in this chapter.

The review indicates that most of the nursing studies, which were published relating to medication safety, originate from the USA which means that the USA has taken advanced steps in integrating medication safety education at undergraduate nursing level compared to other countries. In addition, pharmacy studies about medication safety appears in the USA, which suggests that the USA have taken advanced steps in integrating medication safety education at undergraduate pharmacy level compared to other countries such as Saudi Arabia, UK, Australia and Malaysia. Furthermore, most of the combined healthcare studies about medication safety appear in the USA compared with studies undertaken in the UK, Norway, Canada, Brazil, Indonesia,

South Korea, Serbia and Australia. In conclusion most of the studies about patient safety education originated from the USA comparing to other countries including UK. This finding supports those of Tella et al., (2014) and Mansour, (2012) which indicated that most of the nursing studies in their reviews originated from the USA.

This literature review reveals that there are a high number of nursing studies (59) compared with the number of pharmacy studies (24). In addition, there are four literature review papers specifically about nursing education (Mansour, 2012; Tella et al., 2014; Shearer, 2013; Wakefield et al., 2005), and one paper about pharmacy students, which also includes medical and dentistry students, (Kiersma et al., 2011). It is not clear if this difference is due to the number of pharmacy schools versus nursing schools or if authors are more interested in medication safety education at undergraduate nursing level, or maybe because all the pharmacy degree is about medication safety, but this fact may need further investigation to explore more explanations.

Further interview and questionnaire studies are needed to assess medication safety education and pre- and post-educational interventions studies are needed to determine the degree of improvement in medication safety education in the undergraduate pharmacy and nursing curricula. Research is also needed in pharmacy, nursing and other healthcare professional education.

3.5.1 Strengths and Limitations

The strengths of this review include combining undergraduate pharmacy and nursing education studies selected from all over the world. The review sample size was large relative to other published systematic reviews on patient and medication safety education. It covers topics of medication safety content, methods and considered evidence of the effectiveness of current educational practice. It is possible that this is one of the few studies that examines curriculum guides and educational frameworks used in patient or medication safety education as reported in the literature. There are many studies relating to the training of medical undergraduates. However, there has been limited studies of medication safety education for pharmacy and nursing

undergraduates. This review is one of the few studies which has addressed both professions. The quality of experimental studies was checked using CASP, Guyatt et al. (1993) Uusers' Guides to Medical Literature and the MMAT developed by Pluye (2013).

This review also has some limitations. For example, only papers published between 1994 and 2021 were included, with an explicit focus on medication safety education at undergraduate pharmacy and nursing levels. Papers published before 1994 were not included. Only papers with a clear focus on medication safety education at undergraduate pharmacy and nursing levels, including perceptions of students and recently graduated and teaching staff, were included. This approach may have resulted in the exclusion of important papers that address medication and patient safety from different perspectives, including papers published in English only and papers where the full text was not obtainable were excluded. Furthermore, the concept of medication safety is more explicit in pharmacy education, while in nursing education the medication safety concept was always underlying or embedded in the concept of patient safety which was more comprehensive and included many aspects such as hand hygiene, infection control and safe clinical practice. This made it difficult to compare the concept of medication safety in the publications of these two professions.

3.5.2 Implications for Educational Practice and Future Research

Medical education leaders should take action in promoting the change toward integration of explicit medication safety education at undergraduate pharmacy and nursing levels. International and national regulatory bodies such as GPhC and NMC in the UK should review their standards/curriculum guides and include an explicit section on medication safety education (including aim and objectives, content, methods and particular approach recommended to deliver medication safety and adapt sections from the WHO Patient Safety Curriculum Guide to their standard or guidelines).Universities' curriculum advisory bodies should carefully evaluate their current curricula, select medication safety topics to be included, determine effective methods to deliver medication safety and evaluate the effectiveness of educational

interventions. College deans and teaching staff should advocate the change in the curriculum and provide support to improve medication safety education and unify medication safety content among pharmacy and nursing schools. Additional research is needed to assess the KSA domains pre and post medication safety interventions.

3.5.3 Summary

In this review, a narrative synthesis approach was used to summarise the findings from multiple studies, due to the wide range of designs presented in the selected studies. This review focused on medication safety education in the nursing and pharmacy health sectors. It looked primarily at evaluated evidence for the effectiveness of current educational practice, and secondly at content, methods used to deliver medication and patient safety as presented in the literature. In addition, it provided an overview of the current curriculum guides used when teaching, learning and teaching theories underpinning medication and patient safety education. Finally, it provided a section on medication safety education opportunities and challenges to change curricula as reported in the literature. Medication safety education needs to be addressed explicitly in pharmacy and nursing undergraduate curricula. Evidence for the effectiveness of current educational practice as reported in the literature is not sufficient to decide and measure their effectiveness in delivering the desired medication safety education outcomes. The content of medication safety education needs to be reviewed, including current and new teaching methods. The learning outcomes must be clearly defined and evaluated. Opportunities and challenges to innovative teaching should be addressed. These factors would help to improve patient and medication safety education at undergraduate pharmacy and nursing level. There is a need to use a comprehensive curriculum guide for patient safety such as the WHO Curriculum Guide, which provides insights on how to teach patient safety topics including medication safety. In addition, it is important to examine the frameworks used when teaching medication safety. This would help to maximise their role in delivering safe care to patients in the future. In the following chapter, I explore how medication safety is taught to pharmacy and nursing students in the UK and KSA, as perceived by teaching staff

Chapter 4: Interview Study to Explore Teaching Staff and Student Perspectives on Medication and Patient Safety Education

4.1 Introduction

The previous chapter revealed that there is limited evidence to suggest that the current medication and patient safety educational practice, provided to pharmacy and nursing students, are effective and efficient, and that there are different views and perceptions regarding their practices and experiences. Similarly, it was determined that the patient and medication safety content taught to pharmacy and nursing students is diverse, that a range of educational methods are used to deliver patient and medication safety education to pharmacy and nursing students, that a number of educational frameworks are used and that no unified curriculum guides were referred to. Furthermore, there was no explicit clarity in pharmacy and nursing curricula. In addition, many challenges and opportunities to improve patient and medication safety education were identified. Mansour et al (2018) highlighted that the opportunities and challenges for integrating and building faculty capacity, who are experts in patient safety teaching, remain a key challenge.

It is significant that various researchers, including Coombers et al. (2005) and Taxis (2003), have only suggested that changes to the nursing and pharmacy education are urgently required. However, Creswell et al. (2013) have also explained that there are various gaps in nursing and pharmacy education, including its lack of educational capacity and sophistication in certain areas. Furthermore, the majority of students, who pursue pharmacy or nursing programmes, ended up graduating without even clearly understanding patient safety. Moreover, Neale et al. (2001) mentioned the increasing number of medication errors resulting from a lack of patient safety education in pharmacy programmes. Similarly, Coombers et al. (2005) expressed concerns over the need to provide practical medication risk education and improving the ability of nursing students to minimise these medication risks. Besides, Vosper et al., (2018) found that there is a lack of properly articulated patient safety education in pharmacy curricula and recommended developing a model including the human factor

as a topic. Likewise, Kirwan, M., et al. (2019) highlighted that patient safety as a topic generally remains a hidden element within the nursing curriculum, taught across many subjects. Alwhaibi, M., et al. (2020) also stressed the need for including patient safety courses in the curricula of the different pharmacy programmes - given the importance of patient safety training in improving the quality of patient care. Furthermore, Robson et al. (2013) reported that the awareness of the World Health Organization's multi-professional patient safety curriculum guide was poor in nursing students' programmes. Moreover, Alkatheri et al. (2017) noted that more than 50 per cent of the pharmacy educators indicated that medication safety should be integrated within existing courses such as pharmacy practice, and they stressed that medication safety should be mandatory. Accordingly, this limitation in information and gap in the literature was the impetus to conduct this study.

4.2 Aims and Objectives

The following Table 4.1 shows the aims and objectives for conducting the interview study with the teaching staff and the students from pharmacy and nursing schools.

Table 4. 1 Aims and Objectives

Profession	Aim	Objectives
Teaching staff	The aim of this study was to explore how medication safety is taught to pharmacy and nursing students in the UK and Saudi Arabia as perceived by teaching staff & students.	1. To identify the current medication safety curriculum including: content, medication safety theories, curriculum guides, guidelines, learning outcomes and target knowledge, skills and attitudes which need to be achieved. 2. To describe the current teaching process including underlying learning theories, teaching style, time allocated for medication safety teaching, mode of integration, mode of supervision, methods used to deliver medication safety, applied medication safety practices and feedback on medication safety. 3. To evaluate the medication safety component in pharmacy and nursing curricula including outcomes, barriers, improvement strategies, adequacy of current education and lessons learned.
Students		1. To identify the current medication safety curriculum including; content, guidelines and references, medication errors related issues and target knowledge and skills and attitudes which need to be achieved. 2. To describe the current teaching process including: time allocated for medication safety teaching, mode of integration, mode of supervision and training and methods used to deliver medication safety and experience in different sites. 3. To evaluate the medication safety component including: adequacy of current education, barriers and improvement strategies.

4.3 Method

4.3.1 Design

A cross-sectional study design was chosen, using document review, semi-structured individual interviews and focus groups (for KSAU-HS site) to collect qualitative data. Thematic analysis techniques were used to analyse the data. Document review, or the document analysis approach, is a qualitative research method in which documents are reviewed and interpreted by the researcher to provide voice and meaning around a studied topic (Bowen, 2009). Moreover, Bowen (2009) defined document analysis as "a systematic procedure for reviewing or evaluating documents". In addition, the rationale for using a document review approach, in combination with other qualitative research approaches in this thesis, was to triangulate data (Bowen, 2009). Accordingly, a qualitative method approach was used in this study to explore current medication safety education which was relatively new, and teaching staff and students' perception about medication safety were listened to. A semi-structured interview method was used (also called in-depth interviews), to capture powerful stories that explore the subjective experiences of the interviewees one-on-one with the interviewer (CRICH Survey Research Unit Methodology Bites, 2015). However, the focus group method was used for students at one site in Saudi Arabia, as it was not possible to use semi-structured interviews for reasons mentioned in 4.4.3.

The following table 4.2, about the three methods used in collecting qualitative data, shows the definition, the rationale for using each method and the justification for using three qualitative methods in a study.

Table 4. 2 The Methods used in Collecting Qualitative Data

Qualitative method	Semi-structured interview	Focus group	Document review
Definition	Semi-structured interviews are one-on-one encounters between the researcher and the interviewee that aim to gather in-depth information about the interviewee's experiences. The interviewer guides the conversation with a pre-determined list of questions, while allowing the interviewee some freedom to move in different directions. (CRICH Survey Research Unit Methodology Bites, 2015).	Focus group is a form of group interview that capitalise3 on communication between research participants to generate data (Pope C & Mays N, 2006)	Document review analysis is a form of qualitative research in which documents are interpreted by the researcher to give voice and meaning around an assessment topic (Bowen, 2009).
Rationale for including the method	The overall purpose of using semi-structured interviews for data collection is to gather information from key informants who have personal experiences, attitudes, perceptions and beliefs related to the topic of interest. (DeJonckheere, M. & Vaughn, L.M. 2019)	The main purpose is to listen and gather information. It is a way to better understand how people feel or think about an issue, product or service. Participants are selected because they have certain characteristics in common that relate to the topic of the focus group (Krueger & Casey. 2015, p. 4).	Document analysis is often used in combination with other qualitative research methods as a means of triangulation 'the combination of methodologies in the study of the same phenomenon' (Denzin, 1970, p. 291).
Rationale for using three qualitative methods in this study	In conclusion, the use of different qualitative methods in a single study enriches the data collection, analysis, and interpretation processes which allows researchers to develop a deeper understanding of the medication safety education topic under investigation. This improves the credibility and reliability of the results and makes the research more comprehensive and informative. The qualitative researcher is expected to draw upon multiple (at least two) sources of evidence, i.e., to seek convergence and corroboration through the use of different data sources and methods. (Bowen, G.A., 2009).		

4.3.2 Setting

This study was conducted in universities in the UK and Saudi Arabia that agreed to participate. In the UK, the pharmacy programmes lead to a Master of Pharmacy (MPharm), while the nursing programme leads to a Bachelor of Science in Nursing or a

Post Graduate Diploma (BSN or PGD). However, in Saudi Arabia the pharmacy programme leads to a Bachelor of Science in Pharmacy (BSc Pharm) or a Doctor of Pharmacy (PharmD), while the nursing programme leads to a Bachelor of Science in Nursing (BSN). Teaching staff and students were invited from governmental sector universities in both countries. However, one pharmacy school in Saudi Arabia was a private sector university. Several universities were contacted to recruit teaching staff and students, as both groups were recruited at the same time. Universities that agreed to participate in the UK and Saudi Arabia are shown in the table 4.3.

Table 4. 3 Universities which participated in the document review and interview studies in the UK and Saudi Arabia

#	University name	College of Pharmacy	College of Nursing
1	University of Bedfordshire (UK)		participated
2	University of Birmingham (UK)	participated	
3	Buckinghamshire New University (UK)		participated
4	Durham University (UK)	participated	
5	University of East Anglia (UK)	participated	
6	University of Hertfordshire (UK)	participated	
7	Kings College London (UK)	participated	participated
8	Manchester University (UK)	participated	
9	University of Portsmouth (UK)	participated	
10	University College London (UK)	participated	
11	University of West London (UK)		participated
12	King Saud bin Abdulaziz University for Health Science (KSAU-HS)	participated	participated
13	King Saud University (KSU)	participated	
14	Princess Norah University (PNU)	participated	
15	Riyadh College of Dentistry and Pharmacy (RCDP) in Riyadh city	participated	
16	Imam Abdurrahman bin Faisal University in Dammam (previously University of Dammam).	participated	participated

The inclusion criterion for teaching staff was: (1) teaching staff in the pharmacy and nursing schools who teach patient or medication safety, while the exclusion criterion was; (2) teaching staff with no experience in teaching or training on patient and medication safety topics. Whereas, the inclusion criterion for students was; (1) pharmacy and nursing undergraduate students, while the exclusion criteria were; (2) newly graduated pharmacy and nursing students with more than 12 months' working experience, and (3) postgraduate students.

4.3.3 Participants and Sampling

Pharmacy and nursing schools that agreed to participate in the study were sent an invitation e-mail to participants who matched the inclusion criteria. The email incorporated a participant information sheet and consent form (see Appendices 5, 6 and 7), which were sent via the administration staff who were asked to invite pharmacy and nursing teaching staff and students to participate. Participants from both pharmacy and nursing schools were teaching staff with different experience and years of practice and students in different years of study.

Purposive and snowball sampling approaches were applied to recruit further participants. These approaches were selected so that inclusion criteria are met to enable participants to provide their views on medication safety education.

In addition to the primary method of recruitment used (contacting universities officially), the researcher used additional strategies to recruit students from the UK such as posting an advertisement on the student room web page (https://www.thestudentroom.co.uk/) and Twitter was accessed to recruit students (i.e. nurses' and pharmacists' accounts on Twitter). A request was also posted on the Royal Pharmaceutical Society RPS forum to recruit pharmacy students. Unfortunately, few responses were received from participants despite these attempts.

4.3.3 *Research* Materials

For the document review method, a table was used to arrange extracted data from the universities' webpage and course description handbook and four themes

emerged: medication safety as a stand-alone course, medication safety as a component of other courses, the type of integration into the curriculum and whether a curriculum guide was used when teaching medication safety.

A topic guide was used to guide individual semi-structured and focus groups (particularly in the KSAU-HS site). The questions were developed based on a review of the literature and the recommendations presented in the *Improving Medication Safety* chapter in the WHO Patient Safety Curriculum Guide for multi-professionals (WHO, 2011), as indicated in chapter (1) of this thesis. The questions were tested with teaching staff and students in both specialties for clarity and amended when necessary. In addition, the questions were discussed with a panel of experts in patient and medication safety education.

The main areas of questioning for teaching staff included in the topic guide were as follows: staff profession and background, importance of medication safety, identification of medication safety aspects (content), medication safety teaching methods, integration type (mode of delivery), WHO curriculum guide, and other guides or educational frameworks, teaching and learning theories, expected outcomes, feedback on medication safety education and identification of obstacles. (See Appendix 8 for full topic guide.) Whereas, the main areas of questioning for students included in the topic guide were as follows: student's level of education, medication safety concept and medication error incidents, contents of medication safety component, medication safety practice seen in different educational and training settings, medication safety teaching methods, medication safety skills and knowledge and attitudes and identification of integration type. (See Appendix 9 for full topic guide.)

4.3.4 Data Collection

A document review was conducted, and the data was reviewed and extracted from the universities' websites and course description handbooks were indicated in the table. The extracted information was arranged into themes: the profession, the title of the programme, the number of years of the programme, status of the medication safety component as a stand-alone course or as part of existing courses, whether the

source of information is from the university webpage or course description handbook, mode of integration and the standard curriculum guides used in pharmacy and nursing schools in the UK and Saudi Arabia. (See tables 4.8 and 4.9.)

In addition, in the UK, the data collection for teaching staff and students commenced after ethical approval was obtained from the Imperial College Ethics Committee. An invitation e-mail was sent to participants who met the inclusion criteria, along with a participant information sheet and consent form. (See Appendices 5, 6 and 7) The consent form was signed and returned via email prior to conducting the interview. Two reminder invitation emails were sent after the initial invitation message with the co-operation of the administrators at each site. Pharmacy and nursing teaching staff and students individual semi-structured interviews were conducted using topic guides. (See Appendix 8 and 9) Telephone interviews were used. The researcher introduced herself to the participants and explained the aim and objectives of the interview study, making sure that participants signed the consent form having read and understood all information presented in the participant information sheet (PIS). It was also emphasised that participants' views would be strictly confidential and that there were no right or wrong answers. Participants were also invited to ask for clarification if any question was not clear. Each individual semi-structured interview lasted between 40 and 90 minutes. Interviews were recorded using a digital recorder. No further interviews were conducted once data saturation was reached.

In Saudi Arabia, the data collection for teaching staff and students commenced after ethical approvals were obtained from relevant Ethics Committees. The same processes were followed to recruit participants as mentioned in the paragraph above. Individual semi-structured interviews were conducted with teaching staff in pharmacy and nursing schools. While, Individual semi-structured interviews were conducted with pharmacy and nursing students in both sites (KSAU-HS and Imam Abdulrahman bin Faisal University), and focus groups were conducted in the KSAU-HS site only. The same topic guide was used in both interview formats (see Appendix 9). Telephone interviews or face-to-face methods were used, and each individual semi-structured interview lasted between 40 and 90 minutes. Focus groups were used when an

individual interview was not possible, and each focus group lasted between 60 – 120 minutes.

4.3.5 Data Analysis

Interviews were conducted in English and transcribed verbatim by the researcher or by official transcribing services. Transcripts were checked against the original audio recording to ensure accuracy and consistency. Transcripts were read through several times to obtain the sense of the whole. Thematic analysis with an inductive approach was used to analyse interviews as the purpose of the research was exploratory and the thematic coding and grouping were described and interconnection between themes were studied (Pope & Mays, 2006; Hadi et al., 2012, 2016). Furthermore, thematic analysis was used to analyse data extracted from the reviewed documents obtained from universities' webpages and course description handbooks. The extracted data from documents were presented in tables (See table 4.8 and 4.9.) The Interview data was coded, and notes and keywords were reviewed and coded. Interview transcripts were entered into the QSR Nvivo 10 data management programme, and a systematic process of data coding and identification of themes and sub-themes was undertaken, in addition to using axial and selective coding approaches. Qualitative analysis is an iterative and reflexive process (Pope and Mays, 2006). A second researcher read ten per cent of the teaching staff and students' transcripts (seven transcripts) independently. Similarly, the reviewed documents were analysed and the data was coded into themes as mentioned above. Also, experts in patient, medication safety and social science were consulted about the coding process to ensure consistency. They also reviewed the emerging themes and checked data interpretation and interrelations between emerged themes. These experts were supervisors and colleagues at Imperial College London and other universities. Abbreviations were used to identify participants when presenting illustrative quotes (TS = teaching staff, ST = student, P = pharmacy, N = nursing, FG = Focus Group, UK = United Kingdom, SA = Saudi Arabia)

4.3.6 Ethical Issues

In the UK, ethical approval (ICREC 15IC2586 JRCO HOD) was obtained from the Imperial College Ethics Committee. (Presented in Appendix 10) Similarly, ethical approvals (ICF-SP16-043 and IRB -PGS-2016-04-106) were obtained from the Institutional Review Board (IRB) at the King Abdullah International Medical Research Centre (KAIMRC) in King Abdulaziz Medical City (KAMC), which accommodates King Saud bin Abdulaziz University for Health Science (KSAU-HS) in Riyadh and at the University of Dammam (UOD) (recently named as Imam Abdulrahman Bin Faisal University) in Dammam city. (The IRBs are presented in Appendices 11 and 12) However, King Saud University (KSU), Princess Norah University (PNU) and Riyadh College of Dentistry and Pharmacy (RCDP) accepted the approval obtained from Imperial College London.

All participants were asked to sign an explicit consent form, and were assured that confidentiality and anonymity were maintained. In addition, participants were informed that they were free to withdraw at any time. Furthermore, the research team had access to the interview data for the duration of the project.

Measures were taken to ensure confidentiality throughout the study as follows:

1. Data was stored on a password protected computer for the duration for the project and the necessary period afterwards.
2. Interview data and related forms e.g., consent form was kept in a locked cabinet.
3. Participants' information was kept anonymous, participants' names and numbers were kept separate from the data during the study, and they were destroyed after the study.
4. Interviews were recorded and the participants were asked to complete a declaration that they agreed to have the interview recorded (to consider cultural sensitivity).

4.4 Results from the UK and Saudi Arabia

The results were divided into three sections; (1) document review 4.4.1, (2) nursing and pharmacy teaching staff interviews 4.4.2, and (3) nursing and pharmacy students' interviews 4.4.3. A total of 70 interviews were conducted for nursing and pharmacy teaching staff and students in both countries. The following four tables 4.4, 4.5, 4.6 and 4.7 show the type of qualitative method used (semi-structured interviews or focus groups), the composition, and the number of interviewees in each group and category

Table 4. 4 Semi-structured Interviews: Number of Teaching Staff from Universities in the UK and KSA

#	Profession / Country	Number of the Teaching Staff
1	Nursing teaching staff / UK	8
2	Nursing teaching staff / KSA	12
3	Pharmacy teaching staff / UK	13
4	Pharmacy teaching staff / KSA	15
Total = 48 Interviews		

Table 4. 5 Semi-structured Interviews - Composition and Number of Students from KSAU-HS and Imam Abdulrahman bin Faisal Universities in KSA

#	Profession / Gender / University	Year of Study	Number of Students
1	Nursing students / female / KSAU-HS	Second and third year (intern) - after pre-professional years	2
2	Nursing students / female/ Imam Abdulrahman bin Faisal University	First, second and third year (intern)- after pre-professional years	4
3	Pharmacy students / male and female / Imam Abdulrahman bin Faisal University	First, second, third and fourth year (intern) - after pre-professional years	5
Total = 11 Interviews			

Table 4. 6 Semi-structured Interviews - Composition and Number of Students from Universities

#	Profession / Gender	Year of Study	Number of Students
1	Pharmacy students / male and female	Third and fourth year (4 years programme)	2
2	Nursing students / male and female	First and second year of Nursing Postgraduate Diploma (2 years programme)	4
Total = 6 Interviews			

Table 4. 7 : Focus Groups –Composition and Size Number of Students from KSAU-HS in KSA

#	Profession / Gender	Year of Study	Focus Group Size Number
1	Pharmacy students / male	First and Second year - after pre-professional years (5 participants (1st year) + 2 participants (2nd year))	7
2	Pharmacy students / male	Third year - after pre-professional years	4
3	Pharmacy students / male	Fourth year - after pre-professional years	6
4	Pharmacy students / female	First year - after pre-professional years (They were the first female batch of students in the pharmacy college in the KSAU-HS.)	7
5	Nursing students / female	First year - after pre-professional years	6
Total = 5 focus groups (30 students)			

4.4.1 Document Review for Medication Safety Education

As mentioned, the document review was conducted for the universities from which the teaching staff and students were recruited, and the universities' websites and course description handbook were accessed. The results were presented in the following tables (see tables 4.8 and 4.9).

Table 4.8 shows the UK universities from which teaching staff and students participated in the study (all participated universities were located in England), the table presenting the themes obtained on the profession, the title of programme and the number of years of the programme, status of the medication safety component as a stand-alone course and as part of existing courses, whether the source of information was from the university webpage or the course description handbook, mode of integration and the standard curriculum guides used in pharmacy and nursing schools in the UK. In addition, the structure of pharmacy and nursing programmes in the UK or years of programme (presented in table 4.8) indicated that the pharmacy degree is a four-year programme called Master of Pharmacy (MPharm), while there are two paths to a nursing degree: the three-year BSc Nursing or Midwifery programmes or the two-year Postgraduate Diploma (PGD) in Nursing.

In addition, table 4.9 shows the Saudi Arabia universities from which teaching staff and students participated in the study. This table is similar to table 4.8 and shows the

same themes. In addition, the structure of pharmacy and nursing programmes in Saudi Arabia or years of programme, (presented in table 4.9 below), indicated that in Saudi Arabia pharmacy degrees have two tracks: the six-year programme of Bachelor degree and the six-year programme of PharmD (Doctor of clinical pharmacy). While the nursing programme is a five-year programme leading to a Bachelor of Science in Nursing (BSc).

Table 4. 8 Themes Emerged in the Document Review Study from the UK Universities that Participated

University	Profession	Program of study	Source of information	MS stand-alone course	MS component of other courses	Mandatory or optional	Curriculum guide used
Hertfordshire	Pharmacy	M Pharm (4-years)	University webpage	Public health & patient safety	Info. not available	Mandatory	GPhC + WHO CG
UCL	Pharmacy	M Pharm (4-years)	University webpage	MS lectures & workshops	Info. not available	Mandatory	GPhC
Portsmouth	Pharmacy	M Pharm (4-years)	University webpage	Info. not available	Info. not available	Info. not available	GPhC
Manchester	Pharmacy	M Pharm (4-years)	University webpage	No MS stand-alone course	MS integrated in several courses	Mandatory	GPhC
Birmingham	Pharmacy	M Pharm (4-years)	University webpage	Info. not available	Info. not available	Info. not available	GPhC
West London	Nursing	BSc in nursing (3-years) or PGD (2-years)	University webpage	Info. not available	Info. not available	Info. not available	NMC
Buckinghamshire	Nursing	BSc in nursing (3-years) or PGD (2-years)	University webpage	Info. not available	Info. not available	Info. not available	NMC
KCL	Nursing	BSc in nursing (3-years) or PGD (2-years)	University webpage	No MS stand-alone course	Patient safety as part of introductory courses: (1) Professional Knowledge and Skills for Nursing Practice (2) Promoting Patient Safety	Mandatory	NMC
Bedfordshire	Nursing	BSc in nursing (3-years) or PGD (2-years)	University webpage	No MS stand-alone course	Patient safety as part of introductory courses	Mandatory	NMC

Information accessed from universities webpage on May – June 2016, MS = medication safety, GPhC = General Pharmaceutical Council, WHO CG= World Health Organization Curriculum Guide, NMC= Nursing and Midwifery Council, PGD = Post Graduate Diploma.

Table 4. 9 Themes Emerged in the Document Review Study from Saudi Arabian Universities that Participated

University	Organisation type	Profession	Programme of study	Source of information	MS stand-alone course	MS component of other course	Mandatory or optional	Curriculum guide used
KSAU-HS	Government	Pharmacy	Pharm D (6-years)	University webpage and course description handbook	Yes	Yes	Mandatory	University of Tennessee and Michigan, WHO CG and from practice
		Nursing	BSc in nursing (5-years)	University webpage and course description handbook	Yes	Yes	Mandatory	WHO CG and BMS course handbook
UOD	Government	Pharmacy	Pharm D (6-years)	University webpage	No MS stand-alone course	Yes	Mandatory	Handbook of institutional pharmacy practice, Hospital Pharmacy (2nd edition), Clinical skills for pharmacists A patient-focused approach (3rd edition) and Pharmaceutical care practice: the patient-centered approach to medication management (3rd edition)
		Nursing	BSc in nursing (5-years)	University webpage	No MS stand-alone course	Yes	Mandatory	No specific curriculum guide
KSU	Government	Pharmacy	Pharm D (6-years) and Bachelor of pharmacy (6-years)	University webpage	No MS stand-alone course	Yes	Mandatory	Medication errors by Michael Cohen
PNU	Government	Pharmacy	Pharm D (6-years)	Course description handbook	Yes	Yes	Mandatory	Medication errors by Michael Cohen
RCDP	Private	Pharmacy	Bachelor of pharmacy (6-years)	Course description handbook	Yes	Yes	Mandatory	Medication errors by Michael Cohen, ISMP, ASHP basic practice book (MS chapter)

Information accessed from universities' webpages between August – November 2016, , WHO CG= World Health Organization Curriculum Guide, BMC course = Basic Medication Safety course, ISMP = Institute for Safe Medication Practice, KSAU-HS = King Saud bin Abdulaziz University for Healthcare Sciences, UOD = University of Dammam (Currently Emam Faisal bin Abdulrahman University), KSU = King Saud University, PNU = Princess Nora bint Abdulrahman University, RCDP = Riyadh College of Dentistry and Pharmacy.

A document review was performed, documents across the studied universities were examined and course descriptions were accessed from universities' webpages or course description handbooks. As can be ascertained from tables 4.8 and 4.9 of the universities studied or from which participants were recruited, the medication safety component is delivered to nursing and pharmacy students as part of existing courses, this being the case in most universities, while a few universities (e.g. UCL and Hertfordshire, in the UK and KSAU-HS, PNU and RCDP in Saudi Arabia) have a stand-alone module or a course which focusses on medication safety in addition to delivering a medication safety component as part of existing courses. Furthermore, the medication safety component is integrated as mandatory in the two professions and both countries. Moreover, the UK sample indicated using mostly the GPhC and the NMC, which are the national standards, with a rare use of the WHO curriculum guide. However, the Saudi Arabian sample indicated using a number of curriculum guides including a "medication errors book" and the WHO curriculum guide (as shown in table 4.9). These results indicate that each university has its own way of teaching medication safety with different types of integration and where different curriculum guides are used.

4.4.2 Nursing and Pharmacy Teaching Staff Interviews

In the following section, the results of teaching staff interviews in the UK and Saudi Arabia are presented, while the results of students' interviews in both countries are shown in 4.4.3. Twenty-one semi-structured interviews were conducted with pharmacy and nursing teaching staff in the UK. In addition, 27 semi-structured interviews were conducted with pharmacy and nursing teaching staff in Saudi Arabia. It should be noted that there is wide variation in the number of years' experience of teaching staff which ranges from one year for junior teaching staff to 30 years for senior teaching staff as mentioned in chapter 2 of this thesis.

4.4.2.1 Themes Emerging from Teaching Staff Interviews

Thematic data analysis of the pharmacy and nursing teaching staff and student interviews revealed three themes and numerous sub-themes. The three main themes were adapted from the Donabedian model (1966): structure (MS curriculum), process

(teaching process) and outcomes (evaluation of MS education). Figure 4.1 shows the main three themes and sub-themes that emerged. In addition, the sub-themes, shown in bold font, represented those that were recorded from the teaching staff group only (not shown in the students' group).

The Donabedian model of structure, process and outcome was initially an approach that described the main elements of the quality of medical care (Ameh et al., 2017). Donabedian identified three main areas of work to ensure the quality of medical care: improving the structure, process (technology) and outcome (Ameh et al., 2017). The revised version of this idea of an approach to developing quality improvement guidelines is optimal for organising themes and subthemes in a chapter. In particular, according to Ibn El Haj et al. (2013), the quality of the structure describes the conditions of care, or, in other words, its mechanism. In this chapter, this idea has been transformed into a mechanism for creating a logical and consistent connection between the three elements (structure, process and outcomes), their themes and subthemes.

In the context of the chapter, this idea was applied as a guide to the content of themes and subthemes, the sequence of information presented in them and the methodological basis. Finally, such a component as the outcome quality describes the ratio of the achieved outcomes of treatment to the planned outcomes (Sharew et al., 2020). In this regard, this idea is used in the chapter to improve the quality and reliability of the final data, their rationale and conclusion.

According to Tossaint-Schoenmakers et al. (2021), the indicators described by Donabedian can be applied to various types of research. Therefore, Donabedian's conceptual model was adapted to the current chapter, which made it possible to implement the following relationship effectively: the quality of the research structure ensures the quality of the methodological process, which, in turn, contributes to the quality of the thesis findings.

Table 4.10 shows the themes and sub-themes that emerged from teaching staff interviews and provides definitions for the sub-themes under the themes. As

mentioned previously, three main themes emerged, which were divided into sub-themes. The sub-themes were defined and described.

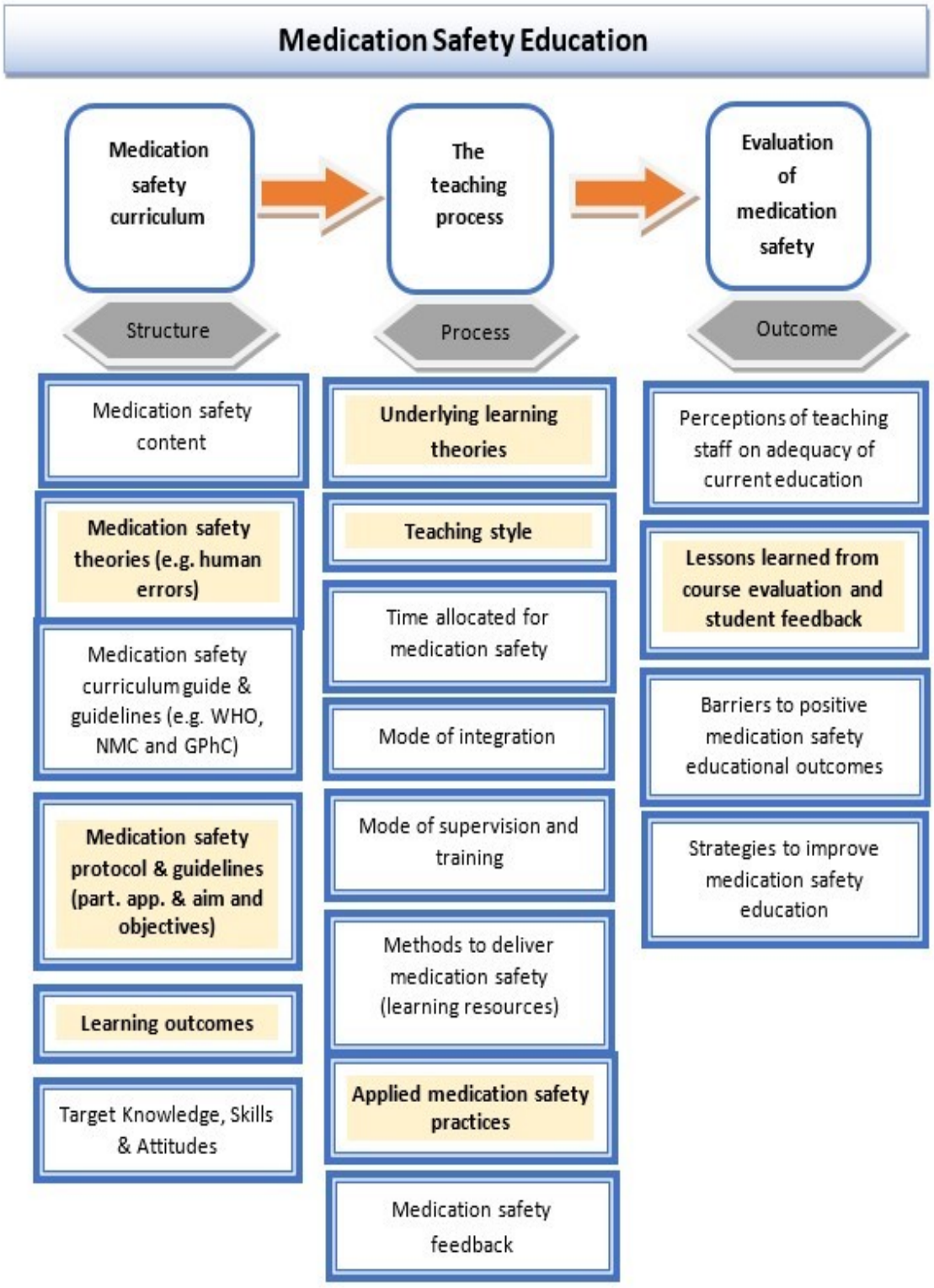


Figure 4. 1 Data Analysis Framework - Pharmacy and Nursing Teaching Staff

Table 4. 10 Definitions of Themes and Sub-themes Emerging from Teaching Staff Interviews

Main Themes	Sub-themes	Definitions/Overview
Medication safety curriculum	A1) Medication safety content	Addresses the constituent, chapters, and sections included in medication safety curriculum. A specific section on this sub-theme deals with pharmacology as a key subject when discussing medication safety concepts with nursing teaching staff.
	A2) Medication safety theories	Discusses theories underlying medication errors such as human factors, Reason's (2000) Model of Accident Causation.
	A3) Medication safety curriculum guide and guidelines	Considers curriculum guides and guidelines used or consulted when designing and preparing medication safety materials as reported by the participants, such as the World Health Organization (WHO) Patient Safety Curriculum Guide, Nursing and Midwifery Council (NMC) and General Pharmaceutical Council (GPhC).
	A4) Medication safety protocol and guidelines	Examines protocol, guidelines, aim and objectives regarding medication safety mentioned in the course description and if there is any specific approach suggested by the school.
	A5) Learning outcomes	Reviews expected outcomes to be achieved by lecturers and the educational board at the school.
	A6) Target knowledge, skills and attitudes (KSA)	Discusses the KSA dominos/model that students need to develop when studying to practise medication safely after graduation.
The teaching process	B1) Underlying learning theories	Discusses teaching and learning theories used when teaching students about medication safety, such as Kolb's cycle, Bloom's taxonomy and Miller's pyramid.
	B2) Teaching style	Discusses the teaching style used by lecturers such as didactic and interactive styles.
	B3) Time allocated for medication safety teaching	Deals with the time allocated for medication safety teaching and whether it is adequate to cover all aspects of the medication safety component.
	B4) Mode of integration	Examines how the medication safety component is integrated in the curriculum, whether as a stand-alone course or part of existing courses or both, which year is optimal for integration of a medication safety component or course and whether medication safety is being taught explicitly or implicitly.
	B5) Mode of supervision	Considers the type of supervision used during clinical placement and training related issues.

Main Themes	Sub-themes	Definitions/Overview
	B6) Methods to deliver medication safety	Reviews current methods or learning resources used to teach the medication safety component and whether additional methods should be used in the future such as inter-professional learning (IPL), simulation and e-learning.
	B7) Applied medication safety practices	Examines how teaching staff are applying and practising medication safety in their professional practice.
	B8) Medication safety feedback	Feedback from the students examining both positive and negative comments on the medication safety component, such as methods used in teaching and difficulties faced during training. In addition to mode of assessment or evaluation of medication safety course or component.
Evaluation of medication safety	C1) Perceptions of teaching staff regarding adequacy of current education	Presents the views and perceptions of teaching staff about the quality and adequacy of current medication safety education. (Is the amount of medication safety education sufficient to satisfy requirements and meet the need for safe medication practice?)
	C2) Lessons learned from course evaluation and student feedback	Discusses the knowledge or understanding of medication safety gained by reviewing course evaluation and student feedback.
	C3) Barriers to positive medication safety educational outcomes	Considers difficulties and obstacles which prevent or block improvement in medication safety education.
	C4) Strategies to improve medication safety education/	Examines ideas, methods and plans suggested by teaching staff or students to improve medication safety education.

In the following section, quotes will be presented and three full-stops (...) are used to indicate omitting of non-essential parts from the original transcriptions of the interviews data. However, the logic and meaning of the original transcripts were maintained. Moreover, a few quotes will be presented as examples under each sub-theme, while a full list of quotes are presented in Appendices 13 and 14.

4.4.2.1.1 Nursing Teaching Staff in the UK and Saudi Arabia Themes

A. The Medication Safety Curriculum Theme

A1) Medication Safety Contents Sub-theme

As an introduction to the medication safety education topic and to set the scene, the teaching staff was asked to define the concept of medication safety before starting to obtain and explore their views on this topic. Accordingly, a range of answers were received from both countries relating to an understanding of the concept of medication safety and its definition.

Some participants were not able to provide a definition of medication safety or thought the topic of medication safety was too broad or related medication safety to medication administration's Five Rights, for example.

> *"I guess … I don't know actually; I've never really thought about it in terms of how I'd actually define it. ...I couldn't answer that." (TS - N 01 – UK)*
>
> *"In what way it is very broad? I think I would define medication safety as ... safe administration of medications..." (TS - N 03 – UK)*
>
> *"So all the rights of medication prescribing: right patient, right time, right type and dose and right patient, so all of these are about medication safety." (TS - N 07 – SA – talking about the Five Rights of medication administration)*
>
> *"Medication safety is a broad topic. Actually. It has lots of issues…" (TS - N 01 - SA)*

The medication safety contents sub-theme includes some topics, components and sections included in medication safety teaching in nursing programmes. The content of medication safety (or patient safety) varied from year to year of study, and curriculum to curriculum and there are several existing courses that include medication safety teaching. The following section includes views from nursing teaching staff in the UK and Saudi Arabia about current medication safety content in their curriculum.

The Near Miss topic was part of the third-year content in some of the nursing curricula in the UK, while the Five Rights are in the content of medication administration model

in the first year in studied nursing schools. Furthermore, it was noted that pharmacology content is taught in the second year in the UK. Furthermore, pharmacology was considered synonymous with medication safety in nursing education. In addition, some participants noted that teaching pharmacology including a medication safety component was optimal in the second year of the nursing programme rather than the final year as students have more knowledge about medication.

> *"Yes, we do that in the third year; near misses when students cover that...we cover it in medication safety inter professional education ..." (TS – N 06 - UK).*
>
> *"... the medication administration argument in terms of the Five Rights... in the skills lab in the first year definitely." (TS - N 03 – UK)*
>
> *"But we definitely do pharmacology as a concept in the second year…, the mechanical part of it." (TS - N 03 – UK)*

Nursing teaching staff in the Saudi Arabian sample revealed that a medication safety component is included in existing courses in the nursing curriculum, courses such as fundamentals of nursing, pharmacology, medical and surgical. In addition, they highlighted some of the medication safety topics which are being taught to students like calculation, Five and Ten Rights of medication administration, high alert medication and look-alike sound-alike. Furthermore, nursing teaching staff in Saudi Arabia agreed with their colleagues in the UK in considering pharmacology as a topic related to medication safety and that it should be taught starting from the second year of nursing programmes and they felt that the medication safety component is better to be taught within the pharmacology course.

> *"The students here … when they join the programme in the second year they take the fundamentals of nursing. And then in the third year they take pharmacology. When it comes to theoretical knowledge regarding medications... basically the medical surgical courses ...two courses that allow the students to know how to prepare medications, to be in the skills and how to watch the Five Rights." (TS – N 01 – SA)*
>
> *"Now we are having medication calculation discussion a side of course the basic Ten Rights of Medication we always include these and when we do the clinical rounds." (TS - N 10 - SA)*

"We mainly talk about high alert medication, and they cover a lot of look-alike sound alike, medications." (TS - N 07 –SA)

"In my point of view, pharmacology and medication safety are linked with each other..." (TS – N08 – SA)

"Pharmacology must be considered in patient safety education...it's an excellent course to teach medication safety topic within pharmacology." (TS - N 03– SA)

Accordingly, many participants stressed pharmacology as a synonym for medication safety, thinking that because pharmacology is about how medications work in the body and how the errors in using medications can lead to medication errors; it will be a suitable course in which to incorporate the concept of medication safety.

A2) Medication Safety Theories Sub-theme

Few nursing teaching staff in the UK noted the use of the human factors' theory underlying medication errors, while none of the nursing teaching staff in Saudi Arabia identified the use of the human factors' theory:

"We do in terms of human factors' theory go through types of error ... and get the students to think about those different types of error in their life in general and also in practice." (TS - N 04 – UK)

"No, I don't use human factors theory." (TS – N 03 –SA)

A3) Medication Safety Curriculum Guide and Guidelines Sub-theme

Medication safety curriculum guides and guidelines are used when designing educational materials, reviewing or consulting. These guides can be international guides such as the WHO Patient Safety Curriculum Guide for Multi-professionals, International Patient Safety Goals (IPSG) and Joint Commission International (JCI's). Furthermore, they can be a national guide, such as the Nursing Midwifery Council (NMC), The Royal College of Nursing guidance and The National Institute for Health and Care Excellence (NICE) guidelines.

Some participants in the UK noted using curriculum guides such as the WHO Patient Safety Curriculum Guide; however, other participants noted that the WHO curriculum guide is not used in their universities or did not know about it. In addition, most of the nursing teaching staff mentioned referring to NMC guidance as the national guide, which includes the official practice standards although the NMC guide is ambiguous and does not include enough information and guidance regarding medication safety teaching. In addition, the Royal College of Nursing guidance and NICE guidelines are used.

> *"Well as an organisation we refer to the WHO 2011 Patient Safety Guide which has got 11 topics of patient safety... So, we refer to that guide." (TS - N 04 – UK)*

> *"We don't use WHO. No." (TS - N 01 – UK)*

> *"The Royal College of Nursing guidance for what the nursing safety issues are about what I should be teaching. NICE guidelines." (TS - N 06 – UK)*

> *"We use all NMC stuff, in terms of drug safety ..." (TS - N 01 – UK)*

Nursing teaching staff in Saudi Arabia revealed that some nursing curricula use international guides such as the WHO patient safety curriculum guide, IPSG and JCI's, and some used online medication information and national resources.

> *"Guidelines includes for medication safety education; I think it will follow WHO guidelines …" (TS - N 03–SA)*

> *"Yes in the hospital intranet we have a resource where you can find information about the patient and medication safety programme…They call it one-stop resource yes…In the unit we discuss the Joint Commission International (JCI's) tips and the International Patient Safety Goals (IPSG)." (TS - N 08 –SA)*

A4) Medication Safety Protocol and Guidelines' Sub-theme

Consideration is given in this section to medication safety internal protocols and guidelines which are recommended to be used when teaching medication safety by college administration or educational bodies, and if there is also a particular approach recommended and described in the curriculum.

Nursing teaching staff in the UK noted some of the different approaches to teaching medication safety recommended by the university; however, some participants reported that there was no specific approach recommended by the university. Similarly, nursing teaching staff in Saudi Arabia revealed there is no particular approach recommended in the curriculum or specific internal guide used when teaching medication safety (or patient safety). In addition, there was no clear evidence that nursing programmes refer to any national standard or guidelines specific to medication safety teaching.

> *"I think the approach here was deliberately struck across different methods so there's the more traditional lecture teaching sessions approach but there's also the skills approach ... so quite a good principle here is that we try and do these things in several different ways in the curriculum." (TS - N 04 – UK)*

> *"No, I would say we teach it in several different ways. It's not expressed in the curriculum." (TS - N 06 – UK)*

> *"There is no specific approach or guide when teaching about medication safety..." (TS - N 02 –SA)*

A5) Learning Outcomes Sub-theme

Participants in the UK and Saudi Arabia samples anticipated certain outcomes to be achieved after teaching the medication safety component to their students and most of the desired outcomes are general and follow the general outcomes mentioned in the curriculum.

> *"In terms of medication safety, I think there are three elements. I would probably look at an outcome which would be a clear understanding of the nursing process and how that fed into medication safety, then the underpinning argument of basic sciences of how those contribute in terms of keeping safe in terms of pharmacodynamics or pharmacokinetics and how they impacted on medication safety, and then looking at clinical environment, not just in terms of the environment but in terms of safe clinical guidelines and how these impacts on medication safety."(TS - N 03 – UK)*

> *"The outcome is no less prepared for them to become safe practitioner like I said. Because you are preparing nurses at a general level and so medication safety actually becomes one of the most important components when it comes to patient safety. So. the ultimate goal actually is patient safety and safe practitioner at the end." (TS - N 01 –SA)*

A6) Target Knowledge, Skills and Attitudes (KSA) Sub-theme

Most participants felt that students needed to develop certain knowledge, skills and attitudes when studying in order to practise medication safely after graduation.

Participants in the UK and Saudi Arabia pointed out a range of knowledge such as having good knowledge about medication use (pharmacology), medication calculation, and medication administration techniques, medication administration rights (Five, Six and Ten Rights), medication policy and procedures and medication safety.

> *"Well, the knowledge would be all the knowledge in terms of the basic science and ... the policies and guidelines that go with that... the process of administration.... administration techniques..." (TS - N 03 – UK)*

> *"Ok well they need to understand the fundamentals of patient safety...They also need knowledge of the policies and procedures ... They need knowledge around drug calculation. They need to know about the drug therapy itself and pharmacokinetics." (TS - N 04 – UK)*

> *"Pharmacology and education related to pharmacology." (TS - N 03 –SA)*
> *"Know about medication safety then they will know why it is safer." (TS - N11– SA)*

Participants in the UK pointed-out a range of skills such as calculation skills (which is knowledge as well), communication skills, medication administration skills (technical skills), psycho-motor skills, double checking skills and questioning skills (which is also an attitude). Similarly, participants in the Saudi Arabia sample identified the same skills as the UK sample and they added clinical assessment skills and critical thinking skills.

> *"Good communication skills... they need to be able to be reflective and have an awareness of their own limitations around medication." (TS - N 01 – UK)*

> *"They need the psycho-motor skills. They need the checking skills...and then the skills around calculation." (TS – N04 – UK)*

> *"Nurses have to calculate doses accurately...they need to master medication administration skills."(TS – N 08– SA)*
> *"Clinical assessment skills…critical thinking." (TS - N 03 - SA)*

Participants in the UK pointed-out a range of attitudes such as being confident, assertive, being accountable, possessing a positive proactive attitude, being error wary, having a professional attitude and many more. Similarly, participants in Saudi Arabia pointed out a range of attitudes such as being honest, patient, qualified, confident, having a positive professional conduct, being open to learning and conduct research, having a professional attitude, being humble, reporting errors and speaking up when there is something wrong, team working, being positive toward work and much more.

> *"I think they need assertiveness ...they need to have an attitude and an awareness of their accountability...and they have to have an enquiring mind." (TS - N 06 – UK)*

> *"We want them to worry that things can go wrong so attitude wise we want them to be error wary." (TS - N 04 – UK)*

> *"The attitude... the students must be qualified, must have the concern for medication safety ...must be confident and must be honest in work this is a critical issue. The nurse must have a positive professional conduct." (TS - N 03 - SA)*

> *"Yes. Open to learning. I want them to do their own research. I want them to question what we do. I want them to have an open mind."(TS - N 05 –SA)*

B. The teaching Process Theme

B1) Underlying Learning Theories Sub-theme

Underlying learning theories are the educational theories which are used when teaching medication safety to students, such as Kolb's cycle, Bloom's taxonomy, Capstone theory, Gibbs reflective cycle (model), Maslow's learning theory and others.

Most participants in the UK sample reported using Kolb's cycle as an educational theory when teaching medication safety. However, a few participants mentioned other educational theories such as Capstone theory, Gibbs reflective cycle (model) and Maslow's theory. In addition, some lecturers used a combination of educational theories. In contrast, most participants in the Saudi Arabian sample indicated that they do not use specific educational theories when teaching medication safety and they do not know about them. However, one participant mentioned that she came across an educational theory (constructive theory).

"… I'm personally a big fan of constructivist ...sort of Kolb, reflective type approaches, experiential learning." (TS - N 01 – UK)

"I blend the theories, I guess. I guess we look at learning styles. We look at Schon reflecting on action, Bloom, Maslow, Conscious Competence Model. Those are the ones that come to mind." (TS - N 02 – UK)

"No I don't use specific theory when teaching." (TS - N 10 - SA)

"When we attended this education to prepare us to be educators that time, they mentioned about a constructive way of delivering the information to the students." (TS - N 07 —SA)

B2) Teaching Style Sub-theme

Most participants in the UK sample indicated use of both didactic and experiential approaches; however, a few participants indicated using one approach using either more didactic or experiential methods of delivery. In addition, some participants indicated using an interactive teaching style which is a way to engage students in the session by sharing ideas, questioning and participating. Similarly, most participants in the Saudi Arabian sample agreed with the UK sample on using of both didactic and experiential approaches and indicated that they use an interactive style. Moreover, some participants used a blended approach.

"Well it's very much taught in a didactic setting and through simulation so that experientially ... I think that you could argue skills and simulation work is experiential in part." (TS - N 04 – UK)

"More didactic type stuff to try...It's quite an interactive teaching style." (TS - N 01 – UK)

"Well I think it is blended now. We use the traditional one. And we use the E-learning so it is blended." (TS - N 02–SA)

B3) Time Allocated for Medication Safety Teaching Sub-theme

Participants in the UK reported that the time allocated for medication safety teaching is insufficient and some were not sure about the adequacy of the time assigned. Similarly, most participants in Saudi Arabia noted that the time allocated for medication safety teaching is not enough and some were uncertain whether it was

sufficient. However, few participants thought the time allocated for medication safety teaching was sufficient.

> *"We probably need more time."* (TS - N 05 – UK)

> *"I don't know. It is endless. I don't know really. I am not sure."*(*TS - N 07 – UK)*

> *"I don't think so. The lecture time will never be enough for medication safety." (TS - N 10 -SA)*

> "*Yes, for us it's enough. It is divided accordingly from the theory down to the simulation laboratory and down to the clinical experience."* (*TS - N 09 –SA)*

B4) Mode of Integration Sub-theme

Most of the participants in the UK reported that medication safety is taught as part of existing courses and clearly labelled in medication administration, fundamental nursing skills and pharmacology courses. Additionally, some participants felt that both types of integration were valid. However, others thought medication safety as a standalone course was beneficial for the students. In addition, some felt it was better to integrate a medication safety component in the pharmacology module. Moreover, some participants indicated that medication safety is not labelled or named as medication safety; it is part of the pharmacology course. Furthermore, participants in the UK were divided over medication safety being taught explicitly or implicitly (i.e., clearly labelled or not). Moreover, most participants indicated that the medication safety component is compulsory in practice not optional.

> *"Well yes. I suppose we haven't labelled it particularly as patient safety. We've put it in the curriculum as medication administration and we haven't specifically labelled it as medication safety…No. We don't have a specific module for medication safety. It's integral within the modules that we do have so I start off running it. I have a skills' module, so it's involved in that. In addition, looking at medication safety in the context of patient care. I don't know. Perhaps you need a combination of both." (TS - N 05 – UK)*

> *"No but I think just as a pure perspective idea for the students, if they have a whole module called it medication safety... they'll put more importance in it than they would if it was part of something larger."(TS - N 08 – UK)*

"I think possibly a medication safety module that incorporates pharmacology would be useful then you could put everything related to medication so practical elements as well as theoretical components together." (TS - N 05 – UK)

"So, I think we don't do the medication side of things and safety as service by not making it really explicit in the curriculum." (TS - N 02 – UK)

"I think it is compulsory not optional." (TS – N 04 - UK)

Most of the participants in Saudi Arabia reported that medication safety is being taught as part of existing courses such as medication administration, fundamental nursing skills and pharmacology and they feel comfortable in addressing the medication safety component within existing courses. However, some participants indicated a preference for teaching medication safety as a stand-alone course. Additionally, other participants felt that both types of integration were better. Moreover, participants felt that medication safety is clearly labelled and is explicitly taught. However, other participants revealed that medication safety is not clearly labelled; it is implicitly taught. In addition, most participants reported that the medication safety component is compulsory in practice not optional:

"It's better to include it in each course; integrated…I think medication safety education is better to be integrated in every course related to patient care." (TS - N 03 – SA)

"Yes, of course both types of integration will be beneficial." (TS - N 11 - SA)

"Yes, very explicitly …very clearly labelled because it is incorporated in most professional nursing subjects." (TS - N 10 – SA)

"Not that much. We do not have a clear label for medication safety." (TS - N 02 – SA)

"For nursing, I don't think there is an optional component for medication safety. It is compulsory". (TS - N 10 – SA)

B5) Mode of Supervision Sub-theme

Participants in the UK highlighted some training issues during the clinical placement, as the number of facilitators should be increased to allow more support to the students. In addition, the mentors and their allocated time to train students can

sometimes conflict with the time which should be allocated for patient care, highlighting that insufficient training was being provided to students. However, it was emphasised that a good mentor can provide students with effective training.

> *"From a practical point of view, it's just a number of facilitators. It would be nice to have more facilitators so we could do more individual support, although we assess them individually on their skills." (TS – N 05 - UK).*

> *"Some mentors won't have sufficient time to train students... So it's all always a kind of pay off between the needs of the patient which must come first and the needs of the students. And that's why mentorship is so important and so students have good mentors who recognise that their students are there to learn, will encourage that whole thing …" (TS - N 02 – UK)*

Nursing teaching staff in Saudi Arabia identified some issues related to students' supervision during their hospital training (clinical placement): mentors (in Saudi Arabia referred to as tutors/preceptors) are different; some are willing to spend time with students and explain to them about medications, while others have no time to teach students as they are overwhelmed with work and need to focus on their patients. As a result, students' training may be affected by mentors' and trainers' willingness to provide appropriate training to students. These findings reflect those in the UK.

> *"Because preceptors (tutors) were very busy doing such things with the number of patients she is having, that is why, when it comes to discussing and explaining further to our students, there are some limitations… some preceptors have the guts to explain further to our students such thing that they encountered in the clinical area. Probably because of the reason that they are probably tired or don't have enough time or they rather prioritise dealing with the patient, giving care rather than explaining or talking to our students especially if they are in front of the patient." (TS - N 09 – SA)*

> *"Another could be the increased workload of the mentor or the preceptor (tutors) of the students. Sometimes they want to finish their task, so instead of giving the chance to the student, they will just let the student observe, and they don't give them the upper hand in giving or administering medication. So that will contribute to the loss of chance to students' practice." (TS - N 10 – SA)*

B6) Methods to Deliver Medication Safety Sub-theme

Nursing teaching staff in the UK indicated several methods used to deliver medication safety education in nursing education such as lectures, seminars, workshops, simulation labs which include case study and role play, e-learning and blackboard

learning, shadowing of pharmacists during clinical placement, use of videos on medication errors incidents and using root cause analysis as a quality improvement tool. In addition, they indicated that patient and medication safety teaching is mostly uni-professional learning (UPL) with very little inter-professional learning (IPL) mainly in the third year or last part of nursing training in some nursing schools. However, most of the participants in the UK highlighted the importance of using the inter-professional learning method (which combines healthcare profession students like nursing, pharmacy and medical students during medication safety teaching) and thought it could be beneficial to the students, allowing them to understand and appreciate the role of other healthcare professions, which could enhance medication safety and reduce the prevalence of medication errors specifically and medical errors in general. [Some examples are presented below.]

> *"Well, we do things like lectures… medication safety in a skills lab (simulation lab). So, if they are doing a case-based study where the patient well they may have to talk about the drug therapy that the patient is on." (TS - N 04 – UK)*

> *"... When we get them into the third year, we have these videos that have been made with actors and they actually act out real medication errors that have taken place in a large London hospital... then we get the students to discuss these medication errors and do a root cause analysis ..." (TS - N 06 – UK)*

> *"We do some role-plays and things where we perhaps have some scenarios." (TS – N 01 – UK)*

> *"It's uni-professional with small examples of inter-professional learning. But generally, I would say the bulk of it is uni-professional." (TS – N 04 – UK)*

> *"I think that it's important for the inter-professional aspect that they can see and that's the beauty of the third-year work that they can see altogether how it all fits together… I think it's useful for them, it's very useful to do that inter-professionally in some shape or form." (TS – N 03 – UK)*

Nursing teaching staff in Saudi Arabia identified a number of methods used in teaching medication safety such as lectures, case-based study, using videos of medication safety clips, role-play, E-learning, simulation and clinical placement. In addition, it was reported that the clinical placement method includes other methods like observation and simulation of medication administration using mannequins. Moreover, nursing

teaching staff indicated that uni-professional learning is used in nursing colleges and there is no inter-professional learning at all. Furthermore, some teaching staff felt that inter-professional learning (IPL) is a good method which can give a good opportunity for nursing students to mix with other healthcare profession students, provide the opportunity to learn from each other and introduce the concept of teamwork.

> *"One of them is traditional lecturing, another is we run scenarios and high-fidelity mannequins (participant meant simulation method) …role playing." (TS - N 01 –SA)*

> *"In the college we give lectures, and the application in clinical practice… applications through video listening, we discuss case study and recommend session from case study to motivate them to contribute their own opinion, position…E- learning, yes, also blackboard, discussion board and we discuss with students." (TS - N 03 – SA)*

> *"Just the nursing students… only uni-professional learning". (TS - N 04 – SA)*

> *"So maybe sharing knowledge in between students from different specialties like nursing, with pharmacy, with dieticians and medical students together sharing their knowledge. Maybe it can be useful why not?" (TS - N 06 – SA- talking about inter-professional learning)*

B7) Applied Medication Safety Practices Sub-theme

Participants in the UK identified how they are applying medication safety practices in their work as a lecturer, especially as some of the lecturers are purely academic and have no current clinical practice in the hospital, apart from supervising and training nursing students. In addition, they highlighted applying medication safety principles when teaching students about medication administration safety in simulation sessions and in the hospital, and when teaching pharmacology. Similarly, nursing teaching staff in Saudi Arabia agreed with the UK sample in applying medication safety in their practice when training and teaching nursing students. In addition, most of the teaching staff in the Saudi Arabian sample had academic affiliation and clinical practice experience.

> *"Well, that's across two areas. Well, I am actually at university in a skills lab... So, I teach students how to safely administer medication … we actually have packets made up of pretend medication. We have a pretend drug chart and one person will take the role of the patient and the other will take the role of the nurse and they sort of act out how they would administer medication safely…And the other things that I would do*

would be administering medication in the hospital which would involve patients."(TS - N 06 – UK)

"Part of our seminars and post clinical conferences will be discussion about medication, especially computation and the different rights of medication administration. We always stress to them that we are giving them this information because they have to be sure when they give medication to the patient. And also, when we do our clinical rounds, we make sure or we ask the students about the different medications that may give, name, what is the classification, and to which route they have given. So that it will also stimulate their knowledge and critical thinking regarding medication administration." (TS - N 10 – SA)

B8) Medication Safety Feedback Sub-theme

Nursing teaching staff in the UK and Saudi Arabia indicated that feedback is not specific to medication safety as it is provided on the whole nursing programme. In addition, they indicated that the feedback format is either verbal or through an evaluation form (mostly online). In addition, exams and OSCE results and scores are used as feedback and indicators to assess students' knowledge and how effective was the programme. Moreover, the limited and low rate of feedback received from students makes it difficult to use it as a tool for evaluation and cannot help in improving nursing education or curricula in general and cannot be used as an indicator for medication safety and patient safety education.

"Yes. Not on medication safety specifically but we receive usually at the end of each semester something called 'Course Evaluation Survey."(TS - N 02-– SA)
"I do also assess students that are doing observed skills assessments, so these are sometimes called OSCEs." (TS - N 04 – UK)

"We have the course evaluation survey and multiple-choice questions that they respond to…... plus the verbal feedback." (TS – N 01 – SA)

"We have a very low rate of feedback; last year it was 20 per cent feedback obtained by quality assurance department ..." (TS – N 03– SA)

C. Evaluation of Medication Safety Education Theme

C1) Perceptions of Teaching Staff regarding Adequacy of Current Education Sub-theme

Given the findings relating to previous themes, it may be concluded that most nursing teaching staff in both countries felt that the current medication safety education is not adequate and needs updating and revision by educational bodies and universities.

Nursing teaching staff in the UK perceived that medication safety training could be enhanced and made more specific and clearly explicit for students. Similarly, nursing teaching staff in Saudi Arabia perceived that education provided to students in the classroom were insufficient as students came to the subject with poor medication knowledge and inadequate calculation skills.

> *"Could be enhanced and it could be more specific, and it could be more clearly set out for the students what it is they need to learn and why." (TS - N 04 – UK)*

> *"They do not have enough practice in the college especially relating to the insertion of the IV line… Maybe related to nursing skills that's one thing we notice that in the beginning that they do not have enough skills; that this is one of the difficulties. But they are students, and we always consider that they are students. So, they still do not have enough experience, so we have to be patient with them." (TS - N 06 – SA)*

C2) Lessons Learned from the Course Evaluation and Student Feedback Sub-theme

As mentioned previously in relation to medication safety feedback and related sub-themes, due to the limited and low response rate for both the questionnaire and students' course evaluation and feedback, it is not possible to draw a full conclusion from which to learn lessons. It is possible, however, to benefit from the overall findings and to learn lessons which can help to improve medication safety education.

Nursing teaching staff in the UK identified several lessons learnt such as the need to make the medication and patient safety component clear and specific to pre-registration students, with more focus on pharmacology as linked to medication safety and other aspects of medication safety such as medication administration of Five Rights which should be taught earlier in the nursing programme, addressing the realities of clinical practice.

> *"I think in with the rise of patient safety we are need to be clearer and more specific about what we are delivering to pre-registration students about patient safety and*

more coordinated in the way that we do it and the same with medication safety." (TS - N 04 – UK)

"What we need to get them to understand before we give medication to patient ...they need more understanding of pharmacology so they can understand about side effects, contraindications and they can also be wise about giving out information to patients."(TS – N 02 – UK)

"But that needs to be from the very, very beginning so that you are teaching them that actually if they are involved in medication rounds like I mentioned earlier about the Five Rights..." (TS - N 07 – UK)

"I think we need to talk about the reality of clinical work But I think we need to have a discourse about the realities of clinical practice and …give the students some tools to deal with it in a safe way rather than saying you are going to work and you are going to do this. Sometimes it doesn't actually marry with what takes place on the ward."(TS - N 06 – UK)

Nursing teaching staff in Saudi Arabia agreed with most of the UK sample points and, in addition, they identified several lessons learnt such as that medication safety should be introduced earlier in the nursing programme from year two and that the medication safety component and knowledge and skills relating to medication administration techniques should be strengthened in the classroom, simulation lab and clinical placement. Furthermore, medication calculation skills should be improved, simulation and inter-professional learning methods should be enhanced and used more frequently, pharmacology should be strengthened, error reporting and medication errors topics should be taught, and technology and e-learning used to improve medication safety learning. It was also felt that a shortage of facilitators and trainers may affect students' training experience in the hospital. (Quotations to support the above observations are presented in the strategy to improve medication safety education sub-theme.)

C3) Barriers to Positive Medication Safety Educational Outcomes Sub-theme

Nursing teaching staff in the UK identified a number of barriers to positive medication safety educational outcomes such as the medication safety component not being addressed properly with details and there being a lack of medicine management, pharmacokinetics not being embedded in theory as part of the pharmacology course,

inadequate medication calculation and an insufficient number of facilitators in simulation sessions.

> *"I think that most of the aspects of the medication safety are there in the programme but they are not necessarily followed up in as much detail as they should be..." (TS - N 04 – UK)*

> *"I think the whole platter that hasn't been addressed clearly or has been addressed but hasn't necessarily been embedded yet in theory so the whole kinetic argument hasn't been really embedded very well, the understanding of how the different the kidneys influence drugs hasn't really been clearly embedded." (TS - N 03 – UK – talking about not embedding pharmacokinetics in pharmacology)*

> *"…when you go for a job as a nurse, especially if you were to go to King's College Hospital, they have the most rigorous medication calculation and safety assessment and I think it's slightly worrying how many fails it. Which is very telling." (TS - N 08 – UK)*

> *"It's always a dilemma getting enough facilitators. There comes a point where we can't run the simulation session if we don't feel we are going to be safe. Yes." (TS - N 05 – UK)*

Nursing teaching staff in Saudi Arabia agreed with the UK sample findings such as deficient calculation skills taught in classroom which can affect the nursing students' safety practice when qualified, insufficient basic knowledge about medication safety before coming to clinical placement and poor pharmacology knowledge, busy training sites and busy preceptors (tutors). However, the Saudi Arabian sample identified a number of other barriers such as hands-off training which affects students' hospital training experience; students cannot practise medication administration via all routes of administration such as IV and IM injections and inadequate time allocated in classroom and clinical placement.

> *"Like I said it was only the thing with the hospitals not allowing the students to have hands-on... They do not want to bother the patients with student training. So they learn from observation." (TS - N 01 – SA)*

> *"There are some medications and some routes such as IVs and IMs that they are not allowed to do or to give because they are bonded by the student nurses' scope of practice…wherein some routes like intravenous they will not be allowed to give. So can be a limitation also regarding their practice in safely administering medication." (TS - N 10– SA)*

"Maybe the time, the time is not enough; they have something they could come to the clinical areas as nursing students. They only come from 7.00 o clock to 12 o clock." (TS - N 06 – SA - talking about insufficient time during hospital training)

C4) Strategies to Improve Medication Safety Education Sub-theme

Nursing teaching staff in the UK suggested a number of strategies to improve medication safety education, such as teaching medication safety earlier in and throughout the nursing programme can protect students from picking up bad practices, having better co-ordination across the programme and structural model, allocating more time and facilitators, including more simulation and inter-professional learning sessions, shadowing pharmacists during hospital training and using technology to facilitate teaching of the medication safety component. As mentioned previously few examples were provided here and more examples are provided in Appendix 11.

"But I think it's important to get on to it quite quickly because as students go into practice they sometimes see, unfortunately…. see poor practice or old-fashioned practice and can easily start to pick up bad habits, you know, which can be harder to undo than if we pick them up in the first place." (TS - N 01 – UK)

"Well better co-ordination across the programme would be a way of doing it, that there would be a more structured model for how patient safety and medication safety were going to be delivered across the programme and then making it explicit to all lecturing staff where it came in and how it came in." (TS - N 04 – UK)

"I think having more time, more facilitators, and obviously at the moment we mockup the drugs as much as possible." (TS - N 05 – UK)

"If you could do some more elements around simulation or inter-professional work." (TS - N 05 – UK)

Nursing teaching staff in Saudi Arabia agreed with the UK sample findings such as teaching medication safety earlier in the second year in the nursing programme (by then they feel that students become more knowledgeable and aware about medication related problems and have already started the pharmacology course) and that medication safety should be stressed and repeated throughout the programme, exposing students to inter-professional learning and more simulation sessions, and

including the medication safety concept at different levels and complexity.

In contrast, the Saudi Arabian sample suggested a number of strategies to improve medication safety education such as teaching the students about error reporting and medication errors topics, using technology (like videos related to medication safety) and using e-learning. They revealed that it is important to have co-ordination between college, clinical and training objectives, to strengthen medication safety teaching in the classroom and simulation lab and teach students about medication administration techniques before clinical placement. In the hospital, instructors' involvement in students' training should be improved, having quizzes on pharmacology and calculation during hospital training and integrating a medication safety component in all existing courses in nursing programmes.

> *"We improve the teaching through technology, the technology which can be available for nursing students. You must encourage the students to create a work provided fields like preparing a video related to medication safety education." (TS - N 03 – SA)*

> *"So it is about cooperation between college objectives and clinical objectives and training." (TS - N 06 – SA)*

> *"When the student comes to the clinical area this is the first exposure for the infusion pump for them … it would be much better if they were exposed in their labs. So if it will be done in their labs then when they come to the clinical area it will be excellent actually! That will give me more time to discuss a lot of things with them rather than spending time on using this infusion pump." (TS - N 07 – SA)*

> *"It is always better that medication safety component will be integrated in all subjects, aside from Pharmacology, it should be integrated in all professional nursing subjects." (TS - N 10 – SA)*

4.4.2.1.2 Pharmacy Teaching Staff in the UK and Saudi Arabia Themes

A. The Medication Safety Curriculum Theme

A1) Medication Safety Contents Sub-theme

As mentioned in the nursing teaching staff (paragraph 4.6.2.1.1), the pharmacy teaching staff were asked to define medication safety concept before starting to

obtain and explore their views on this topic. A range of answers were received about understanding the concept of medication safety and defining medication safety.
Some participants had no definition for medication safety or thought the medication safety topic too broad. Medication safety means different things to different people, and definitions vary according to site of practice. However, one member of pharmacy teaching staff indicated using WHO and other definitions.

> *"I couldn't put a definition to it, because it is such a broad topic… so really hard to define." (TS - P 07 – UK)*

> *"Medication safety is making sure that patients get the right medications. It is all at the right time and at the right dose without contra indications etc. and it is preventing harm to the patient by use of medicines really for so many different reasons... I think it might mean different things to different people."(TS - P 09 – UK)*

Pharmacy teaching staff in Saudi Arabia provided a wide range of definitions of medication safety, some participants felt it was too broad a term or difficult to define and somewhat vague and another participant felt that it is difficult to have a specific definition for medication safety as the concept sets up many aspects. However, one participant noted it was easy to define medication safety as related to medication errors. Furthermore, participants have a different understanding and conceptualisation of the term 'medication safety'.

> *"I think medication safety, there is no assured definition it's a kind of vague it has multiple definition, because it can fall under a medication error, can fall under side effect and adverse effect but an assured definition no... Medication safety is a broad topic we can't specify." (TS – P 12 – SA)*

> *"Medication safety, my understanding is we are trying to avoid errors, not necessarily things that might kill patients but even near misses, I think identifying near misses is really important because I think most people when you think of medication safety, they just hear that they just want to avoid errors but for me I feel like 'Yes, we need to avoid errors but also we need to identify near misses in order to avoid these errors as well." (TS - P 10 – SA)*

From the above quotes, it is clear that there is no agreement on the concept of medication safety, no specific definition, or it is a difficult term to define in the pharmacy profession in both countries.

Participants in the UK indicated some of the topics, components and sections included in medication safety teaching in pharmacy programmes. The content of medication safety (or patient safety) varied from year to year of study, and curriculum to curriculum and there are a number of existing courses which include medication safety training. Moreover, participants revealed that students in pharmacy programmes are taught some topics such as quality tools such as: Root Cause Analysis (RCA) and Failure Mode and Effect Analysis (FMEA)**,** medication errors in the1st year and pharmacology and communication skills:

> *"The way the curriculum is applied here effectively is in a spiral so that most of these concepts are started in year one, but they are of increasing complexity throughout the course so that in year two they will re-visit aspects of the same points but are more complex and then again in years three and four so rather than being taught in a single place they are being taught repeatedly at escalating complexity." (TS – P 08 - UK).*

> *"Teach them how to do root cause analysis and failure mode effect analysis (FMEA)." (TS - P 01 – UK)*

> *"Teach them pharmacology." (TS - P 03 – UK)*

> *"Yes, in terms of communication for example we teach that a number of different points across all four years in communication skills ..." (TS - P 05 – UK)*

Pharmacy teaching staff in the Saudi Arabian sample revealed that each pharmacy programme teaches different medication safety components/aspects and uses different amounts of integration. Some are very explicitly teaching medication safety while some are teaching issues related to medication safety but implicitly, ie., not stated as medication safety. Furthermore, the content of medication safety education varied from year to year of study, and curriculum to curriculum, but. there are a number of existing courses which include medication safety teaching the medication safety component is part of other courses and there is no specific course)such as non-prescription drugs courses, Drug Information and Evidence Based Medicine courses, clinical toxicology courses, therapeutics related topics, pharmacology courses, pharmacy management courses (which include sentinel events, medication errors and reporting system), look-alike sound-alike drug names, and quality tools like RCA and

FMEA. In contrast to the above, however, one participant mentioned having a specific medication safety course.

> *"Yes, yes, exactly. There is no specific course by name like medication safety, but we have three different courses that you know deal like somehow with medication safety. We have non-prescription drugs courses that have some material about medication safety. We have another course called Drug Information and Evidence Based Medicine. Also we have a clinical toxicology course." (TS - P 02 –SA)*

> *"My main focus currently in therapeutics to prevent side effects ... prevent drug interactions... these are medication safety issues." (TS - P 07 - SA)*

> *"I think we have the course called Pharmacy Management. I think they talk about the sentinel event, medication error, reporting system. So I think they talk about that because this course." (TS - P 06 – SA)*

> *"Also we teach them root cause analysis (RCA) and failure mode & effect analysis (FMEA)."(TS – P 03 - SA)*

> *"For us, the module is called "Principle of Safe Medication Practice."(TS – P 03 – SA-talking about medication safety module taught in pharmacy college)*

A2) Medication Safety Theories Sub-theme

Some pharmacy teaching staff in the UK noted the use of the human factors' theory (Swiss cheese model = Reason Model of Accident Causation) underlying medication errors. However, fewer of the pharmacy teaching staff in Saudi Arabia reported using the human factors theory when teaching students.

> "*The theories relating to medication errors…probably the human factors theory. We refer to reason model of accident causation…" (TS - P 02 – UK)*

> *"We teach students about human error theory and how it relates to medication errors… yes, reason model of accident causation." (TS – P 05 - – SA)*

From the above it can be seen that the use of medication safety theories is limited in some pharmacy programmes in both countries.

A3) Medication Safety Curriculum Guide and Guidelines Sub-theme

Medication safety curriculum guides and guidelines are used when designing educational materials, reviewing and consulting. These guides can be international

guides such as the WHO Patient Safety Curriculum Guide - Multi-Professional Edition and medication errors books such as that by Michael Cohen, ASHP and ACCP, in addition to ISMP alerts or can be national guides such as the General Pharmaceutical Council (GPhC) and the National Patient Safety Agency (NPSA) guidelines in the UK and Saudi FDA for Saudi Arabian national guidelines.

Participants in the UK sample reported using a number of medication safety curriculum guides and guidelines including the WHO patient safety, GPhC and NPSA. Furthermore, some participants felt that the WHO curriculum guide was useful. On the contrary, other participants stated that they never used the WHO curriculum guide or were unaware of it while another participant reported that no international curriculum guide was used to teach medication safety in her pharmacy school. In contrast, some participants felt that the information about medication safety included in the GPhC standard is insufficient and vague and they have to depend on their own experiences and resources. Moreover, one participant mentioned looking at the Patient and Safety Institute's recommendations included in ISMP. Another participant noted NPSA is the main source of information regarding medication safety aspects used by some of the pharmacy schools in the UK.

> *"Yes, the WHO Patient Safety Curriculum we looked at and the GPhC obviously… In terms of medication safety there are the two key documents ...and national patient safety agency (NPSA) material that has been used to implement medication safety on the course. We have found the WHO stuff quite useful as well in terms of medication errors.....I found it very useful when we were drawing up the course and some of the material within it is used in the course as well...". (TS - P 10 – UK)*

> *"I don't know. It sounds interesting but I have never used it or known about it."* (*TS - P 03 – UK- talking about WHO curriculum guide)*

> *"I haven't used any international curriculum guides." (TS - P 09 – UK)*

> *"The GPhC standard there is not a lot there in terms of what they are expecting so we had to go through our own personal experiences of what we think is important in medication safety in hospitals and in the literature as well…GPhC obviously we have to bear in mind has a limited number of specifics about medication safety because it tends to be not too detailed…" (TS - P 10 – UK)*

> *"A fairly vague description that comes from the GPhC." (TS – P 08 - UK)*

"Yes. We are always looking at the various institutes for safe medication practices and the ISMP work..." (TS - P 09 – UK)
"The main … the main source of information I use is for medication safety aspects is usually the NPSA guidance..." (TS - P07 – UK)

Pharmacy teaching staff in Saudi Arabia revealed that a number of curriculum guides and guidelines are used or consulted when teaching medication safety. Few pharmacy curricula use international guides like the WHO patient safety curriculum guide. However, some participants stated that they do not use the WHO Patient Safety Curriculum Guide. In addition, more participants revealed using the medication errors books by Michael Cohen, the American Society for Hospital Pharmacy (ASHP) and the American Council of Clinical Pharmacists (ACCP) and many used the Institute for Safe Medication Practice (ISMP) alerts. The Tennessee curriculum was used by one pharmacy school, and the Saudi FDA alerts and circulations on medications were used as a national resource. Furthermore, a few participants indicated using some articles on medication errors.

"Well our curriculum has to be approved by the university but the specific content, what we go through to develop the course, the content, ... and the WHO ... and also Michael Cohen and 'To Err is Human' reports and the ASHP, the clinical pharmacy and the American Pharmacists Association, American Council of Clinical Pharmacists (ACCP)."(TS - P 04 – SA)

"No, I have not used WHO Patient Safety Curriculum Guide." (TS - P 02 – SA)

"I went through the ASHP guidelines book ... I think this is a very interesting chapter for medication safety … in addition to the ISMP alerts …and medication errors book by Michael Cohen which is really very nice." (TS - P 05 –SA)

"Yes, because here we focus mainly in Tennessee curriculum. Also, we use the American College of Clinical Pharmacy... We mainly focus on those references." (TS - P 06 – SA)

"I give those cases; they applied it on Saudi FDA reporting system...I can see the recalls from the Saudi FDA and I just show it to the students ..." (TS – P03 -- SA)

"In addition to some selective articles for medication safety like I have one article called Medication Errors. It provides with a basic classification about Five Rights and their prevention strategies for medication errors." (TS - P 05 – SA)

A4) Medication Safety Protocol and Guidelines Sub-theme

This section encompasses internal medication safety protocols and guidelines which are recommended to be used when teaching medication safety by college administration or educational bodies; and any approaches which are recommended and described in the curriculum.

Most pharmacy teaching staff in the UK noted that there is no specific approach recommended by universities about educational methods or teaching style, but different methods are used. However, some participants noted some of the different approaches to teaching medication safety recommended by universities such as using a mixture of methods and blended approach.

> *"There is no set curriculum from the pharmacy school council. They give an indicative curriculum but it's not particularly detailed and although it talks about methods of delivery it doesn't go to the level of detail that you are suggesting. Within the school we agree within ourselves how we will deliver various aspects." (TS – P 08 - UK).*

> *"We do a mixture … we try and introduce the theory to them potentially didactically, so in the sort of lecture. So, for example the human factors are done as a lecture. We expect them to go and do some self-directed learning too, so we will send them away to do some reading. And then we bring them back to do small group teaching sessions, usually around case studies…we do workshops, and then if you like, you could describe what we do in terms of role play and prescription dispensing as simulation." (TS - P 07 – UK)*

> *"I think all of the above approaches... Blended approach." (TS - P 02 – UK).*

No particular approach is recommended in the curriculum and no specific internal guide is used when teaching medication safety (or patient safety) as perceived by pharmacy teaching staff in Saudi Arabia. However, one participant indicated that there is a general recommendation regarding methods used for teaching the pharmacy programme overall, which is not specific to medication safety. Yet, some participants indicated that the college recommends them to present at least one slide regarding medication safety in their lectures.

> *"No, not anything that I know. I do not know if there is anything specific written of how to teach medication safety or if there is any specific approach to teach medication*

safety. Again, I did not hear that… Nothing specific written that I could remember." (TS - P 02 – SA)

It is explicitly mentioned in the curriculum that we use these methods in teaching – the case study, the role play and case discussion, we do all the things that mentioned because in the curriculum in each learning domain we have to write the learning outcomes of the course and beside the learning outcome we write the applied teaching methodology, the methods we use to assess learning outcomes." (TS - P 01 – SA)

"The Administration is encouraging us to put a slide in each lecture that is related to medication safety…" (TS - P 07 – SA)

A5) Learning Outcomes Sub-theme

Participants in the UK expected certain outcomes to be achieved after teaching medication safety components to their students; most of the desired outcomes being general and following the general outcomes mentioned in the curriculum. An example of expected outcomes is awareness of medication safety. Similarly, participants from Saudi Arabia agreed with the UK sample outcomes in expecting teaching outcomes from teaching students based on general outcomes mentioned in the curriculum. Example of expected outcomes is considering medication safety component as part of students' daily activities, becoming an advocate for medication safety and medication safety to be the responsibility of everyone.

"An awareness of medication safety, an awareness of the factors that cause errors, understanding their own role in preventing the errors an understanding the importance of teamwork. It is quite basic at this stage." (TS – P 02 - UK).

"Ok if you ask me honestly my primary goal is to tell them that medication safety is part of their daily activities. They must think of safety whenever they do anything in the pharmacy. And I would love them to be an advocate for medication safety. Knowing the tools, knowing the consequences of medication errors, knowing how to prevent and how to deal with medication errors is really very important I would like to reach with my students. And mainly I want them to love medication safety… And they also need to know that medication safety is not the topic or job for a medication safety officer or pharmacist only. Medication safety a mission for all and this is one of the topics that I always teach them." (TS - P 05 – SA)

Accordingly, the learning outcomes reported by pharmacy teaching staff in the UK and Saudi Arabia are quite similar and cover a wide range of general outcomes mentioned in pharmacy curricula.

A6) Target Knowledge, Skills and Attitudes (KSA) Sub-theme

Most participants felt that students needed to develop certain knowledge, skills and attitudes when studying in order to practise medication safely after graduation.

Participants in the UK pointed out the necessity of students having a range of knowledge such as having knowledge about medication calculation and pharmacology (medication interaction and contra-indication). Similarly, participants in Saudi Arabia identified a range of essential knowledge for students to acquire such as pharmacology, pharmaceutics, pharmaco-epidemiology, drug safety, pharmaceutical care and therapeutics.

> *"A pharmacist definitely they should be able to do calculations and they should be able to think about interaction between different medications, and they should know about a contraindication, and they should be aware of the patient in terms of compliance as well..." (TS – P 01 – UK)*

> *"I think there are some courses that are very crucial as knowledge needed for pharmacist to practice medication safety - like pharmacology, pharmaceutics, Pharmaco-epidemiology and drug safety, pharmaceutical care, last but not least therapeutics." (TS - P 01 – SA)*

Furthermore, participants in the UK emphasised the importance of students acquiring a range of necessary skills such as communication skills with patients and the healthcare team, and critical thinking analysis. Similarly, participants in Saudi Arabia pointed-out a range of skills students should acquire such as having good communication skills with patients, colleagues and prescribers, problem solving, research skills and drug information finding skills, critical thinking skill and having calculation and route of medication administration skills.

> *"Skills. Lot about communication skills as well, so being able to communicate with patients and communicate with your team because a lot of errors are due to communication. So, I think that is one very large skill that you can help and certainly*

provide them with the building blocks for that but it is something that you need to practise." (TS – P 09 UK - talking about skills).

"I said we require that they have some critical thinking analysis to be able to participate in any root cause analysis or analysis that is relevant to risk assessment for incidents that happen as well." (TS - P 01 – UK - talking about skills needed)

"I think communication skills are very important. Problem solving skills are very important, research skills are very important, all these drug information finding skills are very important. All these skills are very important." (TS - P 01 – SA)

"They have to have critical thinking skills…calculation and which drug should be taken for example as orally and one given as IV and so on." (TS - P 09 – SA)

Participants in the UK displayed a range of attitudes regarding medication errors such as the acknowledging mistakes and being open to accepting discussion about them, having the confidence and the professionalism to deal with and prevent medication errors and developing a questioning and conscientious attitude towards them. Similarly, participants in Saudi Arabia highlighted a range of attitudes they felt necessary for students to develop safe medication practice such as persistence, assertiveness, certainty, clear thinking and being a good listener, respecting the opinions of others and being open minded, as well as confidence, accuracy, and professionalism. Additionally, they stressed the importance of admitting errors, reporting of medication errors and solving problems.

"The acknowledgment that they made mistakes and the ability to be open and receptive to the notion that somebody may be pointing out that they made mistakes." (TS – P 02- UK - talking about attitudes).

"Should always have confidence on day one. If they see something which they don't understand or they think could potentially be an error or a mistake to be able to say hang on a minute could someone explain why this isn't here, and I am not entirely happy... That is professionalism..." (TS - P 03 – UK - taking about attitudes.)

"You have to be persistent. ...you have to be assertive certain and have a very clear mind. And this is the best way to focus …They need to be good listeners. They need to be respecting others, and they need to be open minded … open for new ideas..." (TS - P 05 – SA)

"Maybe it's all related to accuracy and to be concise, confident in you and professional of course." (TS - P 07 –SA)

B. The teaching Process Theme

B1) Underlying Learning Theories Sub-theme

Underlying learning theories are the educational theories which are used when teaching medication safety to students.

Most of the pharmacy teaching staff interviewed in the UK stated that there are no teaching and learning theories used when teaching medication safety specifically or other pharmacy modules in general. However, one participant reported use of Harden's ladder theory which is recommended by GPhC.

> *"Not that I'm aware of, not particular theories of learning, I'm aware of Bloom's taxonomy. I don't use that when I'm teaching." (TS – P 02 - UK).*

> *"Integration between science and practice and we used the Harden Ladder which the GPhC recommends (so knows, knows how, shows how and dose), we used outcomes for learning based on the Harden Ladder." (TS - P 05 – UK)*

Most of the pharmacy teaching staff in the Saudi Arabian sample indicated that they depend on their personal skills and experience in teaching; that they do not use or refer to any specific educational teaching or training theories when teaching medication safety and that they are not familiar with theories. However, one Saudi Arabian participant mentioned that he preferred to use constructive theory as an educational theory, and another noted that she knew Bloom's taxonomy theory and might use it in the future to teach students:

> *"Teaching theories, no I am not using theory, no, any theories of what? How to teach? I use my personal skills…Maybe it is my practice and personal skills which I obtained from work experience. I did not go through theories of teaching. I did not go there." (TS - P 05 –SA)*

> *"In fact, I like the constructive theory in which we can start by discussion and help our students generate knowledge themselves in order to conclude we would like to say." (TS - P01 - SA)*

> *"I am familiar with Bloom's taxonomy…I probably take that into account when I prepare my exam so that I focus on that when I prepare the lecture but actual teaching theories no." (TS - P04 –– SA)*

B2) Teaching Style Sub-theme

Most of the UK and the Saudi Arabia pharmacy staff interviewed indicated using a mixed or blended teaching style which combines didactic and experiential styles; however, few participants indicated using a solely didactic or experiential approach. Moreover, they expressed their preference for an interactive style when teaching students.

> *"Blended. It is a mix of lectures and interactive work." (TS – P 02 – UK).*

> *"It's currently taught in mainly lecture based (didactic approach) …My teaching style is interactive. So, I prefer to question the students to make sure they understand any concepts... This is my style on patient safety teaching." (TS - P 04 – UK)*

> *"Yes, I think it is both didactic and experiential styles." (TS - P 05 – SA)*

> *"It is a didactic and interactive style at the same time." (TS - P 05 – SA)*

B3) Time Allocated for Medication Safety Teaching Sub-theme

Pharmacy teaching staff in the UK and Saudi Arabia had different opinions regarding time allocated to teaching medication safety. Some felt that the time was sufficient while others felt that the time allocated was not enough or was difficult to determine the adequacy. In addition, some were unsure about the satisfactoriness of the time allocated.

> *"I think we spend enough time talking about medication safety explicitly." (TS - P 08 – UK)*

> *"I don't know about that, I'm not sure about adequacy of time allocated." (TS - P 04 – UK)*

> "*I think the time and the curriculum is enough." (TS - P 01 – SA)*

> *"I think we should add more time to teach medication safety."(TS - P 12 – SA)*

B4) Mode of Integration Sub-theme

Most UK pharmacy teaching staff interviewed agreed on both types of integration; stand-alone courses and integration as part of existing courses, but some felt that a

pharmacy degree is wholly about medication safety, and it should be integrated as part of existing courses and not taught separately. There was an agreement that a medication safety component should be integrated from the beginning of the programme and continued throughout. Most of the pharmacy teaching staff recognised that medication safety is not labelled as such and is not taught explicitly in most programmes, as most programmes do not teach medication safety as a stand-alone or single unit it is taught implicitly. However, few staff pointed out that medication safety is included everywhere throughout the programme and that it is explicitly highlighted. Moreover, they indicated that the medication safety component is compulsory in practice.

> *"So, I think there is a need to combine both types of integration probably." (TS – P 01 - UK)*

> *"I think it should be probably integrated in all of the courses from the very, very beginning." (TS - P 01 – UK)*

> *"Medication safety is taught implicitly. Lectures and workshops are not designed specifically to identify medication safety issues." (TS - P 04 – UK)*

> *"So, it is not just seen as a separate subject because it would be everywhere really. So, it is explicitly highlighted to you as well that you are going to learn about error theory for example and how that applies to prescribing when dispensing etc." (TS – P – 10 – UK)*

> *"So, all the course components are compulsory." (TS - P 02 – UK)*

Most of the pharmacy teaching staff in the Saudi Arabian sample noted and preferred both types of integration when teaching medication safety, indicating that medication safety is being taught as part of courses in most of pharmacy programmes. In addition, some participants felt that integrating the medication safety component as a stand-alone course is beneficial for the students as it would be more focused on medication safety issues. Moreover, there was a differentiation and disagreement in perceptions toward how explicitly or implicitly medication safety is addressed and whether it is clearly labelled/named as medication safety. However, most of the participants felt that is important for medication safety to be clearly labelled. There was an agreement

that medication safety should be introduced earlier and should continue throughout the programme. In addition, all participants indicated that the medication safety component is compulsory in practice.

> *"No, I think, mixed is better, special module and integrated in different courses." (TS - P 03 – SA)*

> *"Stand alone course. Because if you combine with other courses like pharmacology, you will add a little information there and only related to the drugs. If it's a stand-alone course, you will focus to the whole aspect of medication safety, in that way, it will be more beneficial." (TS - P 13 – SA)*

> *"Medication safety component is very explicit in pharmaceutical care courses, therapeutics courses, and mainly hospital pharmacy courses…All elements of medication safety are compulsory not optional." (TS - P 01 – SA)*

> *"I believed it is definitely very important to the students to be clearly labelled and to know this medication safety". (TS - P 10 – SA)*

> *"…but I think till now it's not clearly labelled as medication safety." (TS - P 12– SA)*

> *"...it is extremely important to teach medication safety earlier in the pre-graduate level in bachelor or PharmD programmes." (TS - P 05 – SA)*

B5) Mode of Supervision Sub-theme

Participants in the UK noted that pharmacy students are supervised in the clinical setting and monitored to be consistent with medication and patient safety practice and no serious issues in supervision or training were reported:

> *"Well, we supervise students, so students are set tasks and we supervise their practice and we identify whether their practice is consistent with patient safety or not. So we watch for example in the dispensing process we watch them to see if they have a logical and safe work flow..." (TS – P 04 - UK).*

Pharmacy teaching staff in Saudi Arabia identified that they do supervise their students during their hospital training (clinical placement) and reported that tutors/trainers are asked to address reporting of medication errors to students during hospital training. However, there was a very serious issue reported that can affect pharmacy students' experience in the hospital which concerns the shortage of qualified clinical pharmacists and pharmacists who can provide proper training, and

preoccupied tutors who are unable to devote time to training students. This issue might explain why some pharmacy teaching staff train their students themselves during hospital training:

> *"I have to supervise my students during their internship and during the clinical training in the hospital, that's part of my job..." (TS - P 01 – SA)*

> *"We tried to ask the preceptors (tutors) to teach the students how do you report, what did you do about rather than just discuss the case and that's it." (TS - P 10 – SA)*

> *"Most of them (training sites) are short of clinical pharmacists who are really qualified to teach our students." (TS - P 01 - SA)*

> *"The hospital preceptors (tutors) because you know some hospitals are so busy, so sometimes they do not have time to teach students. They do not have time to train students actually, so I have to be with them to train them. I think that the schedule and the overload that they have in some really big hospitals make us not able to train our students very well …" (TS - P 02 –SA)*

B6) Methods to Deliver Medication Safety Sub-theme

Participants in the UK identified several methods used to deliver medication safety in pharmacy education such as lectures, case-based study, role-play, observation/shadowing, workshops, simulation labs (the simulation method is used in a wide range of pharmacy schools and it includes case-based study and role-play methods and simulation always combines other methods), inter-professional learning (IPL), self-directed learning and using root cause analysis as a quality improvement tool. In addition, participants highlighted that medication and patient safety teaching is delivered mostly using the uni-professional learning (UPL) method in which only pharmacy students study together about medication safety and without the opportunity to mix with other healthcare profession students. However, few participants revealed using IPL method in some pharmacy programmes. Furthermore, many participants felt that using the inter-professional method, combining healthcare profession students like nursing and medical students during medication safety teaching can be beneficial to students, allowing them to understand and appreciate the role of other healthcare professions which might enhance medication safety and reduce the prevalence of medication errors specifically and medical errors in general.

"We have workshops and inter-professional education so we're working with groups of medics, we have didactic lectures, and they have ... I think they may have role plays as well… so quite a variety of different methods. They must do a root cause analysis of a medication and they start to think about what is that process actually..." (TS – P0 9 - UK).

"… They do clinical placements currently in the third year… The clinical placement is observational." (*TS - P 08 – UK)*
"They have simulated role play and practice and there's aspects in which if this affects the issue, they will play the equipment." (TS - P 03 – UK)

"I would say at this point it is uni-professional… we don't have a nursing and medics students…" (TS - P 03 – UK)

"Yes. Currently in terms of the inter-professional learning around patient safety the second-year students, they work alongside social work students and radiography students to study a patient case where medication safety or safety for the patient had been neglected." (TS - P 04 – UK)

"But I think as a concept it's a very good idea to get students working together at that stage in training rather than waiting until they are Pre-Registration junior pharmacists in the workplace setting…And they get teaching with others, with medics as well. I think that that's a very insightful way of teaching this, working with other professions about medication safety." (*TS - P 09 – UK)*

Pharmacy teaching staff in Saudi Arabia identified several methods used in teaching medication safety such as using a combination of methods such as lectures, problem-based learning, case-based study, role-play, simulation and flip chart classroom method, e-learning and blackboard learning, observing/shadowing of pharmacists during clinical placement. In addition, Pharmacy teaching staff revealed that the uni-professional learning method is used in pharmacy schools in the Saudi Arabian sample. Moreover, no inter-professional learning method is used in pharmacy schools although some of pharmacy teaching staff felt it is a promising method and it can help in teaching of medication safety and medication errors. Furthermore, some pharmacy teaching staff stated that simulation is not used in teaching medication safety in pharmacy schools. However, a pharmacy school in a Saudi Arabia sample had a simulation setting and is working to consider inter-professional learning with other healthcare professional schools in the university but has not yet used a simulation lab in teaching medication safety. Additionally, one participant revealed using quality tools as RCA and FMEA as methods to teach about investigating medication errors.

"Right now, yes, we have lectures and problem-based learning, we have case studies and sometimes we make like role play and simulation session for students, using sim man until we get well-designed pharmaceutical care lab and the satellite pharmacy… And sometimes we use something like flip classroom strategy in order to help our students to be self-learners." (TS - P 01 – SA)

"It is a uni-professional learning right now." (TS - P 02 - SA)

"Inter-professional education that is the ideal but actually we haven't applied it yet. We are thinking about inter-professional education to have pharmacy students, nursing students and medical students learning together…" (TS - P 01 – SA)

"No simulation used for medication safety in our school of pharmacy." (TS - P 04 – SA)

"No, we're working on this, because we have a simulation sitting, we're working on it to make it inter-professional... …but for the medication safety course we don't use simulation before, we can integrate it with other courses like the labs." (TS - P 03 - SA)

"Also, we have got some projects like root cause analysis, failure mode & effect analysis (FMEA) you give them cases and they conduct the RCA in failure mode & effect analysis (FMEA)." (TS - P 03 – SA)

B7) Applied Medication Safety Practices Sub-theme

Most pharmacy teaching staff in the UK reported applying and practising medication safety through the daily supervision and teaching of students and through conducting research related to medication practice, but not principally through clinical practice as most of the teaching staff are purely academic. Furthermore, the pharmacy teaching staff sample in Saudi Arabia concurred with the UK sample as they indicated that they apply medication safety principles (when discussing cases in pharmaceutical course, when teaching students about medications side effects and when teaching about therapeutics) and practise medication safety through supervising and teaching their students as most of them are not practising in a clinical setting unless they are clinical pharmacists and also have academic affiliation.

"Within the universities we have also undergraduate student projects I supervised with medication safety, and I also teach medication safety in the undergraduate and post graduate curriculum within the pharmacy school." (TS – P 02 - UK).

"Well as I said I'm not really practising in clinical setting, so it's usually related to more research aspects of things, and doing studies and doing pilot work with undergraduate student projects is that sort of thing?" (TS – P 01- UK)

"As I said, I'm just supervising my students...I'm not practising pharmacy in the clinical setting." (TS - P 03 – SA)

"When we supervise students, we make sure to present medication errors and how to avoid medication error and identify drug therapy problems in patient files in their prescriptions and during the therapeutic planning or what is called pharmaceutical care planning …" (TS - P 01 – SA)

B8) Medication Safety Feedback Sub-theme

Pharmacy teaching staff in the UK and Saudi Arabia indicated that the feedback from students is on the pharmacy programme generally and is not specific to medication safety. There is a range of feedback formats such as questionnaires, evaluation forms, exams as indicators of student knowledge, surveys and MCQ questionnaires and quizzes. In addition, feedback is verbal or online. Moreover, the response rates from students were limited and low, which makes it difficult to use feedback as a tool for assessment.

"Feedback is general on the whole programme; it is not specific about medication safety." (TS – P 05 – UK)

"For example, we have in lecture questionnaires, MCQ questionnaires...and we just quickly quiz them about what we have covered …We have an annual feedback form … We have students who fill out our optional online surveys..." (TS - P 06 – UK)

"It is a low response rate I think." (TS – P 08 – UK – talking about feedback received from pharmacy students)

"They are requesting us to collect our students 'feedback at the end of the year through course evaluation surveys and lecture-skills surveys... Feedback is limited." (TS - P 01 – SA)

C. Evaluation of Medication Safety Education Theme

C1) Perceptions of Teaching Staff on Adequacy of Current Education Sub-theme

There are a range and differences in the views and perceptions of pharmacy teaching staff on the quality and adequacy of current medication safety education. (For example, there is the question of whether the amount of medication safety education is sufficient to satisfy the requirements and meet the need for safe medication practice.). In addition, some pharmacy teaching staff felt that the methods currently

available are enabling students to learn about medication safety.

Pharmacy teaching staff in the UK felt that the awareness of medication safety and error-causing factors taught to students is quite basic. Furthermore, they considered that the amount of medication safety teaching is not sufficient. However, other participants felt that the experiential methods used when teaching medication safety were satisfactory. Similarly, pharmacy teaching staff in Saudi Arabia expressed different views on the adequacy of current medication safety education. Some participants felt that the medication safety component taught in college was not enough, and it needed to be made clearer and more specific, also they suggested that medication safety should be presented earlier and throughout the pharmacy programme. However, other participants felt that the current medication safety education is sufficient, but they indicated that it could be improved, and methods updated.

> *"Whether we teach it sufficiently in terms of amount is an arguable point really." (TS - P 08 – UK)*

> *"Generally, yes, for methods that involve the student's participation to be able to apply the learning from didactic sessions and theory based teaching." (TS - P 02 – UK)*

> *"We need medication safety component to be more clear, specific and more presented from starting of the pharmacy programme and throughout ... also the quantity of medication safety component is not enough I think." (TS – P 11 – SA)*

> *"There is always a room for improvement...of course we need more integration and focus on medication safety teaching." (TS – P 05 – SA)*

C2) Lessons Learned from the Course Evaluation and Student Feedback Sub-theme

As mentioned previously, due to the limited and low rate of feedback received from students in the form of course evaluation and feedback, it is not possible to draw a full conclusion and learn lessons, but it is possible to benefit from the overall findings to learn lessons which can help in improving medication safety education.

Pharmacy teaching staff in the UK identified several lessons learned such as they felt that year one is the most suitable year for teaching medication safety, and they

suggested the use of a multitude of different methods to suit the point being made.

Similarly, pharmacy teaching staff in Saudi Arabia agreed with most of the UK sample points such as it is important and beneficial for students to start medication safety education earlier on and throughout the pharmacy programme, that educational methods can be updated and new methods can be included such as simulation and the inter-professional learning method. They also felt that the amount of medication safety teaching provided in the college is not sufficient and needs to be reviewed by educational bodies and universities. In addition, they added that medication safety teaching can be improved by making it more specific and clearer.

> *"I believe that it should be taught in the first year - the importance of medication safety and the basic concepts of what medication safety is - and I think there should be recognition of that in the first year." (TS - P04 – UK)*

> *"I think you have to use a multitude of different methods to try and get across different points." (TS - P 10 – UK)*

> *"We need medication safety component to be more clear, specific and more presented from starting of the pharmacy programme and throughout ... also the quantity of medication safety component is not enough I think." (TS – P 11 – SA)*

> *"I think there is a need to update the current methods and include more simulation and inter-professional learning." (TS – P 08 – SA)*

C3) Barriers to Positive Medication Safety Educational Outcomes Sub-theme

Pharmacy teaching staff in the UK identified a number of barriers to positive medication and that safety educational outcomes such as clinical placements are relatively short and can affect the time of actual practice, in addition, they emphasised the problems of limited exposure to medication safety practices like error reporting, insufficient time allocated and it being necessary to find external speakers to teach medication safety.

> *"Clinical placements are relatively short and because they are compressed in terms of time the amount of actual practice that a teacher can show them is not huge. I think this is one of the problems that we have found in training …the exposure to clinical practice is very slight." (TS – P 08 - UK)*

"The students also get real practice by using reporting forms and documentation, they get exposure in filling in error reports ... The students get some exposure, but it is quite limited because it is not that routine made practice not doing it on a day-to-day basis. That is one of the limitations." (TS – P 02 - UK)

"I think covering all the issues can be quite problematic. There is a lot to cover; it is not just about errors but also covering the basics. Time is an issue. You must find a dedicated time to cover that. In addition, finding external speakers is not always easy, so you might want medics, nurses, people with knowledge of medication safety can be quite problematic." (TS – P 05 – UK)

Pharmacy teaching staff in Saudi Arabia identified several barriers such as the congested curriculum does not allow enough time for medication safety teaching, and the lack of simulation labs and lecturers to teach in labs. In addition, training sites are short of qualified clinical pharmacists and trainers to train students, especially given the large number of students on clinical placement. Furthermore, an obstacle to hospital training is that preceptors (tutors) are very busy and have no time to train students.

"So I do not think there will be enough time to teach this especially with other different courses you know." (TS - P 02 –SA)

"In the real setting we cannot do this because yes, we have a lack of these simulation labs, and we have a lack of people to teach them in the labs." (TS - P 02 – SA)

"Most of them are short of clinical pharmacists who are really qualified to teach our students." (TS - P 01 - SA)

"But I think most of the hospitals have a shortage in staff and the number of students is a little bit more than their capacity especially we have other universities competing with us on the training sites. Training is a big challenge… The hospital preceptors (tutors) in some hospitals are so busy, so sometimes they do not have time to teach or train students…so I have to be with them to train them." (TS - P 02 –SA)

C4) Strategies to Improve Medication Safety Education Sub-theme

This sub-theme was divided into two categories; related to improving the curriculum in general and to improving the educational methods used when teaching.

Pharmacy teaching staff in the UK suggested a number of strategies to improve medication safety education such as re-designing the curriculum by moving the patient safety materials regarding errors to the second and third years (meaning that

teaching medication safety topics are introduced earlier in the programme). Additionally, It was felt that there is a need to redesign the curriculum focusing on the practice and application of patient safety in the fourth year, using multiple methods such as having recognised experts in the field of medication safety, making it clear that patient and medication safety is the pharmacists' and other healthcare professionals' role, and teaching the concept of medication safety earlier and throughout the curriculum and building up medication safety through the course (spiral curriculum). In addition, pharmacy teaching staff suggested a number of strategies to improve educational methods such as doing more work-based practice assignments and developing research and evidence-based practice, teaching clinical reasoning and critical thinking, explicit coverage of adverse drug reactions (ADRs) and errors reporting, use of videos on medication safety and patient stories which are powerful teaching tools, running virtual simulation and following a patient's journey, more inter-professional learning (IPL), teaching medication safety more in clinical placement (hospital practice) and allocating more time to its teaching would all be beneficial.

> *"The only thing I would consider probably change is potentially move the explicit patient safety materials around errors, medication errors and pharmacovigilance we can move that if we have the space to move it to, to earlier in the curriculum … I think the students may want to learn about it in more detail in the second or third year." (TS - P 05 – UK)*

> *"…and then when they got to fourth year what they are really focusing on is application of that kind of patient safety knowledge which they do in the fourth year..." (TS - P 05 – UK)*

> *"I suppose we could run virtual simulation in the form of videos or could follow a patient's journey where they have been exposed to poor medication safety and the students can identify what the potential consequences of that would be." (TS - P 04 – UK)*

> *"The inter-professional education and it would be good to do more of that because a lot of these are in there and a lot of problems arise in patient safety from miscommunication to lack of understanding about teams and how the teams work… It is way of improving things …" (TS - P 09 – UK)*

> *"… more clinical placements where students are coming to the clinical area reviewing real patients so you can do that as well on a more regular basis …" (TS - P 02 – UK)*

"I think more time allocated will help." (*TS - P 06 – UK)*

Pharmacy teaching staff in Saudi Arabia suggested a number of strategies to improve medication safety education such as teaching the concept from the first year and throughout the course and making medication safety an objective in each lecture and course, providing a clear definition of medication safety, strengthening the medication safety component within therapeutics and introducing medication safety in the beginning of the therapeutic courses. Including a reporting of medication errors topic in the pharmacy curriculum was also regarded as a strategy for improving the teaching of medication safety and it was also felt that teaching students how to manage medication errors was important as it was an area of weakness. This could be achieved by including medication safety research in the pharmacy curriculum as conducting research helps students to understand medication safety, teaching medication errors cases, using theories, showing how to prevent medication errors and creating a no blame environment, teaching quality tools as part of a medication safety component or course, adding a section on the role of technology in preventing medication errors to the medication safety course or component and introducing more hospital experience combined with the medication safety course. Moreover, more training could be provided in simulation labs and more time allocated for clinical placement, and also launching simulation labs to train students inside colleges to allow them to practise medication safety in a safe environment, as well as using simulation, medication safety research, studying the history of medication safety and adding inter-professional learning (IPL) method to pharmacy programmes, and using videos on medication errors to educate students and draw their attention to errors.

"Yes, it can be from first year until they finish their study. It is something that should be built in their mind." (TS - P 01 – SA)

"I think we have to include it in the lecture objectives or course objectives or clinical discussion objectives. One of the objectives should clearly talk about medication safety issues." (TS - P 02 –SA)

"What is medication safety? I think we went through the programme but we did not come across with the definition of medication safety so what do you mean with medication safety, what are the elements of medication safety…Anything that will

clarify and simplify this concept it will be our benefit and it will help us to deliver more information to the students." (TS - P 07 – SA)

"They have to go to the hospital to see real patient and have to interact with them and solve the problem" (TS - P 08 – SA – talking about clinical placement)

"It could be through simulation…through an introduction what it is in the real world for medication safety research and history how it has evolved." (TS - P 04 – SA)

"But I think it would be a good thing to have this as an inter-professional thing, even to have as a major option to have an inter-professional course... So, I would say it is inter-professional… More beneficial, yes, yes, it will be more beneficial to have IPL." (TS - P 02 – SA)

4.4.3 Nursing and Pharmacy Students Interviews

The results of nursing and pharmacy students from the UK and Saudi Arabia are presented in the following pages. In this section, the findings from six semi-structured interviews from the UK, and 11 semi-structured interviews and five focus groups (i.e., the five focus groups consisted of 30 students from nursing and pharmacy schools in the KSAU-HS site) from Saudi Arabia were reported. In addition, students who participated, came from different years of study from different nursing and pharmacy schools, providing different experiences and perceptions on patient and medication safety education and training. The low number of interviews conducted in the UK is due to several limitations described in the limitation section in this chapter. Despite the low number of student interviews conducted in the UK, they were useful in developing questions for the questionnaire study presented in Chapter 5.

A focus group was an option considered when conducting the study with pharmacy and nursing student participants from KSAU-HS in Saudi Arabia, as there was a restriction of time as the researcher was studying in the UK and came for a short visit to Saudi Arabia to collect data (one month only). Back in 2016, there were also some restrictions due to some social and cultural norms at the time, such as not allowing the mixing of opposite sexes in Saudi Arabia (i.e., the researcher as a female was not allowed to stay alone with no third person present with a male student during a one-to-one individual interview). In addition, the university was not able to allocate a meeting room to accommodate lengthy individual meetings for extensive hours

(average of 30 hours to interview a total of 30 students; one hour for each student). The telephone interview option was not possible either as the university does not offer student mobile numbers to researchers (as part of maintaining student confidentiality). Therefore, for all the above reasons, it was decided to conduct a focus group at the KSAU-HS site. Moreover, two individual semi-structured interviews were conducted with two female students from the nursing school at the site, but this method was replaced by the focus group due to the reasons mentioned.

Five focus groups were conducted (with a total of 30 students from pharmacy and nursing schools in KSAU-HS); the target group that was engaged was the pharmacy and nursing students in different years of study at KSAU-HS (in the professional years), and the number of participants in each focus group is presented in table 4.7 in the beginning of this chapter.

Krueger & Casey (2015), p. 71, highlighted that "the focus group is characterised by homogeneity but with sufficient variation among participants to allow for contrasting opinions" The pharmacy and nursing students in KSAU-HS were homogeneous groups as they were students studying in the same year of study at one university with similar age categories. Furthermore, they were interested in the topic of medication safety and had many insights and views to share and interact about.

My role as a mediator was to take notes, encourage discussions between the group members, and ensure that all students participated in the discussion. "The role of the mediator is to take notes on the discussion and the feedback shared by the participants" (Google, 2023 & Grankjaer et al. 2011).

4.4.3.1 Themes that Emerged from Students' Interviews

As mentioned in 4.4.2, the data analysis framework for pharmacy and nursing students was adapted from the Donabedian model. Figure 4.2 shows the main three themes and the sub-themes that emerged. In addition, the sub-themes shown in bold font represented the sub-themes that were recorded in the students' group only (not shown in the teaching staff group). Moreover, table 4.11 shows the themes and sub-themes that emerged from student's interviews and provides definitions for the sub-

themes under themes. As mentioned previously, three main themes emerged, which were divided into sub-themes. The sub-themes were defined and described.

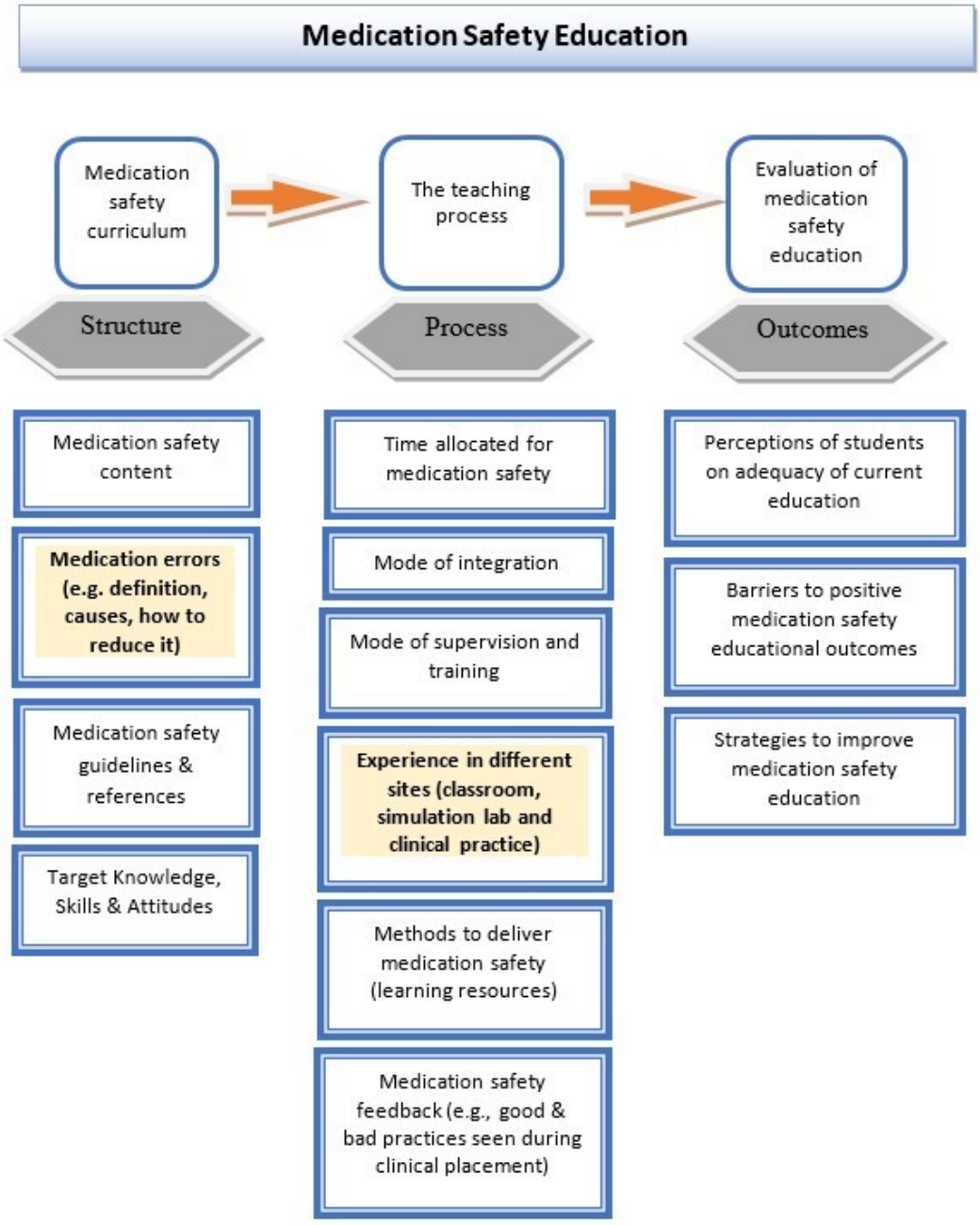


Figure 4. 2 Data Analysis Framework - Pharmacy and Nursing Students

Table 4. 11 Definitions of Themes and Sub-themes Emerging from Student Interviews

Main Themes	Sub-themes	Definitions/Overview
A. Medication safety curriculum	A1) Medication safety contents	Deliberates on the constituents, chapters and sections included in the medication safety curriculum.
	A2) Medication safety guidelines and references	Discusses guidelines used when teaching medication safety and references used as sources for the medication and patient safety component [such as the World Health Organisation (WHO) Patient Safety Curriculum Guide, Nursing and Midwifery Council (NMC) and General Pharmaceutical Council (GPhC)] as perceived by students.
	A3) Medication errors	Introduces the medication safety concept talks about students' perceptions regarding medication errors, how they define them, what are the causes and what strategies can be used to reduce medication errors from their point of view.
	A4) Target knowledge, skills, and attitudes (KSA)	Discusses KSA dominos/models that students feel they need to develop when studying to practise medication safely after graduation.
B. The teaching process	B1) Time allocated for medication safety teaching	Considers the time allocated for medication safety teaching and whether it is adequate to cover all aspects of the medication safety component as perceived by students.
	B2) Mode of integration	Addresses how the medication safety component is integrated in the curriculum whether as a stand-alone course or part of existing courses or both, which year is best for integration of a medication safety component or course, and whether medication safety is being taught explicitly or implicitly.
	B3) Mode of supervision and training	Examines the type of supervision during clinical placement and training related issues.
	B4) Experience in different sites	Focuses on the setting in which students feel they learn most about medication safety such as the classroom, skills/simulation labs and in clinical placement in a hospital.
	B5) Methods to deliver medication safety	Addresses the methods or learning resources currently used to teach the medication safety component and those which should be used in the future such as inter-professional learning (IPL), simulation, e-learning, etc.
	B6) Medication safety feedback	Discusses the following: A. Form of feedback from students about medication safety education: is it positive or negative, methods used in teaching and difficulties faced during training, *etc*... B. Good practices seen during clinical practices (double checking) and bad practices seen during clinical practices (poor communication)
C. Evaluation of medication safety	C1) Perceptions of students regarding adequacy of current education	Discusses the views and perceptions of students on the quality and adequacy of the current medication safety education. (i.e., Is the portion of medication safety education sufficient to satisfy requirements and meet

Main Themes	Sub-themes	Definitions/Overview
		the need for safe medication practice?)
	C2) Barriers to positive medication safety educational outcomes	Addresses the difficulties and obstacles which prevent or block improvement in medication safety education as perceived by students.
	C3) Strategies to improve medication safety education	Presents ideas, methods and plans suggested by students to improve medication safety education.

In the following section, quotes will be presented and three full-stops (...) are used to indicate omitting of non-essential parts from the original transcriptions of the interviews data. However, the logic and meaning of the original transcripts were maintained. Moreover, a few quotes will be presented as examples under each sub-theme, while a full list of quotes were presented in Appendices 15 and 16.

4.4.3.1.1 Nursing Students in the UK and Saudi Arabia Themes

A. The Medication Safety Curriculum Theme

A1) The Medication Safety Contents Sub-theme

Nursing students in the UK outlined the content of the medication safety component taught to them and revealed that it is always part of existing courses like bioscience, medication management, clinical skills modules, and pharmacology. Furthermore, it was revealed that medication related issues are also taught in the pharmacology course, which nursing students felt is not enough. They expressed the need for more teaching on pharmacology and medication safety issues. (Nursing students consider pharmacology to be a synonym for medication related issues.)

> *"Or in the process of learning about various other things … specific medications in specific circumstances …what sort of things do you give them and why we give out is bioscience and they cover that." (ST - N 01 - UK)*

> *"Well, I think I would like the method we started off with and that was last year before we got into placement. So just teaching us how to give medication and follow all the Rights you know. … It's medication administration that is what it is called – medication management." (ST - N 02 - UK)*
> *"Patient safety component taught in clinical skills." (ST - N 04 - UK)*

> *"For pharmacology I think we are not getting enough pharmacology...So we should do more pharmacology like on and off all the time." (ST – N 02 – UK –talking about pharmacology course as related to medications)*

Nursing students in the Saudi Arabian sample identified the content of medication safety they are studying and indicated that the medication safety component is part of existing courses such as the Fundamentals of Nursing, Medical Surgical, Psychiatric, Maternity, Paediatrics, Critical Care and Pharmacology, Adult 1 and 2 and ethics courses. In addition, they highlighted the topics of medication safety being taught in the nursing programme such as calculation, Five. Six and Ten Rights of medication administration and medication error reporting. Moreover, topics such as medication expiry date, route of medication administration, medication storage policy side effects, physical examination and vital signs were also reported as being included in medication safety education.

> *"Maybe it's all of the practical courses like Fundamental of Nursing, Medical Surgical…Psychiatric and Maternity in third year, Pediatrics and Critical Care in fourth year …also Pharmacology …Any practical course we have to take about medication safety and medication errors." (ST - N 03 – SA)*

> *"In the hospital they taught us the 5 and 6 rights, while in the classroom we learn its almost 10 rights… also medication calculation... Yes we have medication error reporting I think in the Medical Surgical course …in the third year. "(ST - N 03 – SA)*

Nursing students in the Saudi Arabian sample considered pharmacology as synonymous with medication safety and medication related issues, and they placed great importance on teaching pharmacology and being able to reduce medication errors and practise medication safety, like their colleagues in the UK. In addition, students felt that education in pharmacology is not enough as they took few courses throughout their nursing programmes. However, they reported negative feelings about the pharmacology course as they felt it is a hard and complicated topic, as there are many medication names, classifications, and modes of medication actions they have to study. Furthermore, it was also felt that although pharmacology is not easy, it can be better understood when training in hospital.

"When you know the classification of medication, each action for each medication also the Pharmacokinetics…Pharmacology is an important course and it help to understand medication safety." (ST - N 06 –SA)

"...we learn the theory in pharmacology. We take two pharmacology courses only which is not enough..." (ST - N 02 – SA)

"I did not like the pharmacology course and it was so hard… The course was so hard to understand, it is just a lot of memorizing and I do not know. It was hard." (ST - N 04 – SA)

"… but it is not stuck in our mind. But when we go to the hospital and we learn the most medication that they used, so we can learn more pharmacology." (ST - N 01 – SA)

A2) Medication errors Sub-theme

As teaching staff interviews revealed that it was always a difficult, surprising question to ask someone to define medication safety, in the students' interview study more general questions were asked in order to pave the way to asking for a definition of medication safety. Students were first asked what they thought medication errors were and how they can be prevented, which led on to asking for a definition of medication safety and how they conceptualise it.

Nursing students in the UK defined medication errors easily and most definitions included the Five Rights of medication administration. In addition, they identified several causes of medication errors such as time pressures, workload, and look-alike sound-alike. Moreover, they identified several strategies to reduce medication errors such as improving communication between healthcare professional teams as well as communication with patients, proper double checking, following the Five Rights and patient involvement.

In view of the above opinions on medication errors topic, nursing students in the UK defined medication safety and mostly included the Five Rights of medication administration.

"Not following the Five Rights of medication administration. That is what I think medication error is." (ST – N 02 – UK)

"Time pressures tend to be a cause for error." (ST – NURS 03 – UK)

"Improving communication is a key point…people are not willing to and professionals are not willing to interact with each other and communicate with each other then you are going to make mistakes …." (ST – N 01 – UK)

"I think medication safety is ensuring that the correct medication is given to the correct person. As a nurse we have the Five Rights: the right dose, the right time, right person, right date and right route to ensure that the correct thing that has been prescribed is going to the correct person." (ST - N 01 – UK)

Nursing students in Saudi Arabia, as in the case of their counterparts in the UK, defined medication errors easily and most definitions included the Five Rights of medication administration, and the term 'harm'. In addition, they identified a number of causes of medication errors such as not following the Five or Ten Rights, extra doses, wrong dose, wrong route and wrong patient, illegible handwriting on prescriptions and not using electronic prescribing system, miscommunication or poor communication and incomplete endorsement (whether between medical team or patients and nurses) and ignoring patient comments (miscommunication with patient) which may lead to medication errors. Lack of patient education and proper counselling were also highlighted as areas of concern, along with the lack of adequate patient history, and language barriers between patients and medical team were also seen as a potential cause of medication error where the communication language is English in a situation where most patients do not speak English. Not following aseptic technique was also seen as potentially harmful to patients, as well as workload and distractions, alongside poor calculation skills, which were also viewed as factors which may lead to medication errors. Moreover, they identified a range of procedural strategies to reduce medication errors such as double checking, applying Five and Ten Rights, using technology (electronic prescribing system), involving the nurse in the treatment plan, checking medications' expiration date and storage conditions, following aseptic technique and checking for allergy. Patient-related strategies were also identified, such as educating patients about their medications, listening carefully to patients, reporting of medication errors by medical team and patients, using simulation, limiting the problem of language barriers by using a translating service,

developing a unified patient system, and differentiating between high alert medications.

In view of the above opinions on medication errors topic, nursing students in Saudi Arabia defined medication safety mostly in terms of the Five Rights of medication administration and doing 'no harm' to the patient. As mentioned previously, one example was provided for each item and more examples are provided in the Appendix 13.

> *"Any medication given for example in the wrong dose, missed medication that can put the patient at risk or harm...We must check the Five Rights…For the patient and we have to ensure that it is the right medication for the right patient at the right time at the right dose. All Five Rights there." (ST - N 05 – SA – talking about medication error definition)*

> *"Extra dose of medication caused side effects to patient; wrong route of medication may lead to medication error." (ST - N 06 –SA -talking about causes of error)*

> *"Maybe we need to check the Five Rights and check the order of physician." (ST - N 07-FG (3) – SA – talking about strategies to prevent error)*

> *"Medication safety is following the Five Rights when giving medication." (ST – N 06 – SA)*

A3) Medication Safety Guidelines and References Sub-theme

Nursing students in the UK revealed that they use the British National Formulary (BNF) and NICE as guidelines and references for medication safety and medication related issues in general. In contrast, most nursing students in the Saudi Arabian sample did not specify any guidelines or references related to medication safety which they used when studying medication safety. However, one nursing student reported using a nursing drug guide when checking information about medication.

> *"BNF's for half an hour and learn about drugs." (ST - N 03 - UK)*

> *"...you read through the NICE guidelines and then you are right when you start. So when you go into placement you are reading through this technical stuff step by step." (ST - N 02 – UK)*

> *"No we don't use guidelines on medication safety topic when studying or during hospital training." (ST - N 07 - FG (2) – SA)*

"Any medication that we give we have to know, we have to open the nursing drug guide and know the side effects for the patient and the warnings..." (ST - N 04 – SA)

A4) Target Knowledge, Skills, and Attitudes (KSA) Sub-theme

Nursing students in the UK and Saudi Arabia identified several targeted knowledges, skills and attitudes, which they felt to be important for the nurse to practise medication safety.

Participants in the UK pointed out a range of knowledge such as pharmacology, applied skills knowledge, calculation, and Five Rights of medication administration. Similarly, participants in Saudi Arabia identified the same knowledge as with their colleagues in the UK (i.e., knowledge related to the Five Rights of medication administration and medication calculation, pharmacology, and pharmacology-related issues such as classification, action, side effects, and medication interaction). However, the Saudi Arabian sample highlighted additional knowledge such as the interaction between herbal medication and other medication, knowledge of first aid, medication safety, medication errors and error reporting and knowledge on patient education was regarded as important as it reduced the likelihood of patients making errors.

"I think we need to know and to have a basic understanding of pharmacology, I do think pharmacology is very important to stop medication errors …" (ST – N 01 – UK)

"Yes, definitely it is an applied skill to do and to calculate so definitely that is a very important thing...also the Five Rights." (ST – N 04 – UK)

"Of course, how the medication it works for the patient, its side effects and the interaction between the medications itself...What herbal medication the patient is taking which might interact with the medication." (ST – N 05 –SA)

"The knowledge of medication safety and medication errors...If we do a mistake or accident, we have to report it." (ST - N 03 – SA)

Nursing students in the UK identified a range of skills such as medication administration technique skills (i.e., withdraw up medications and injection techniques), medication calculation, communication and double-checking skills,

organizing a drug round and time management of medication administration skills. Similarly, participants in Saudi Arabia identified the same skills as with their colleagues in the UK (i.e., medication calculation skills and good communication skills with the medical team, patients and sitters and medication administration skills). In addition, Saudi Arabian sample highlighted additional skills which are the psycho motor skills.

> *"Learning skills to do with draw up medications as well and I think we as well need more practice with things like injection techniques and stuff and making sure that we give medication properly." (ST – N 03 – UK)*

> *"You need calculation skills …some people make a lot of errors from doing the wrong calculations when giving medication… communication skills…and double checking." (ST – N 02 – UK)*

> *"Of course, communication skills which is one of our priorities." (ST – N 05 – SA)*

> *"Like I said the psycho motor skills have to be enhanced or stressed on." (ST – N 04 – SA)*

Nursing students in the UK identified a range of attitudes such as assertiveness, powerfulness and transparency, positivity, vigilance, care, being competent, double-checking medication, using references and professional development. Similarly, participants in Saudi Arabia identified a range of attitudes such as co-operation and patience, competing with oneself, determination to do things correctly and open-mindedness, explaining to the patient about their medication (patient education), respecting the patient and the medical team, having a positive attitude to self-learning, and learning from mistakes and possessing a questioning attitude about medications given to the patient.

> *"Assertiveness yes and powerfulness and transparency if they committed a mistake." (ST – N 04 – UK)*

> *"And I think it is making sure that you are competent and making sure of the medication you are giving and also keeping up to date." (ST – N 03 – UK)*

> *"I think nurses should be more open minded to improve the patient safety and to improve the quality of care given to the patients." (ST - N 04 – SA)*

"Respecting the patients and the team that they work with. Develop his learning and self-learning…any mistakes that can be done in the hospital or obstacles that be in front of the nurse. The nurse has to go to the home and learn about it." (ST - N 01– SA)

B. The Teaching Process Theme

B1) The Time Allocated for Medication Safety Teaching Sub-theme

Nursing students in the UK and Saudi Arabia both indicated that the time allocated to teaching medication safety is insufficient:

"I think it is not enough, we need to cover more topics of medication safety." (ST – N 02 – UK)

"We need more time allocated for medication safety teaching." (ST – N03 – SA)

B2) The Mode of Integration Sub-theme

Nursing students in the UK revealed that there are two ways in which the medication safety component is integrated in nursing programmes which are stand-alone courses and teaching the topic as part of existing courses like pharmacology. In addition, students felt that they needed more pharmacology training, and the medication safety component should be part of pharmacology. Moreover, some students revealed that the medication safety component is clearly labelled. However, others felt that medication safety teaching should be made more explicit as it is a serious topic.

"Kind of both…Like to happen as patient safety and also throughout the modules." (ST – N 04 – UK)

"Yes. I think a larger pharmacological component would be a very good thing and medication safety could easily be part of that and so I think more pharmacology would help." (ST – N 01 – UK)

"Yes. It has been labeled and it has been labeled as medication safety." (ST – N 02 – UK)

"Yes. It should be made more explicit. Medication safety is a serious thing." (ST – N 02 – UK)

Many nursing students in the Saudi Arabia stated a preference for both modes of integration and indicated that medication safety is not taught as a stand-alone course.

In addition, some nursing students indicated that the medication safety component is taught as part of existing courses; while other nursing students felt it is better to have the medication safety component as part of existing courses to ensure repetition and reinforcement of the concept. Moreover, the students felt that medication safety should be taught earlier in the nursing programme. However, nursing students pointed out that medication safety is clearly (explicitly) taught during hospital training. Additionally, most nursing students felt that the medication safety component was clearly labelled in existing courses. Yet a few nursing students indicated that medication safety is not clearly labelled in the nursing programme.

> *"Yes, both, it should be a separate course and also to put it in other courses…every course or every year we learned about the medication safety like in the fundamentals in medical and surgical and in the critical care course. Every course has a topic about the medication safety." (ST – N 01– SA)*

> *"I think that - I do not think it would be good to have as separate course. I think when you repeat it in so many courses like as I said fundamental, pharmacology or medical surgical, it is like reminding you 'Patient safety, patient safety' and medication safety is important but having it as one course and not having it repeated as part of other courses…" (ST – N04 – SA)*

> *"It should be start earlier in the programme like in the second or third year." (ST – N 05 – SA)*

> *"Yes. They tend to say it clearly in general and one of the topics is medication safety." (ST – N 04 –SA)*

> *"Medication error, I always hear about it. But medication safety as a term is not clearly labeled." (ST – N 06 –SA)*

B3) The Mode of Supervision and Training Sub-theme

Nursing students in the UK felt that supervisors, trainers and mentors are doing a good job in training students during hospital training and that they are training students appropriately and give enough time for students to learn. Similarly, nursing students in Saudi Arabia were satisfied with supervision during hospital training as nurses and instructors had enough time to train and teach students about medication safety.

"The mentors do well with teaching… So far, its fine you know and it's working well in the hospital because we are attending to everything that they tell us to do. The mentors are really approved as well." (ST – N 02 – UK)

"*Yes. The training nurses have time to teach the student about the medication safety or error." (ST – N 02 – SA)*

B4) Experience in Different Sites Sub-theme

Nursing students in the UK and Saudi Arabia felt that most learning about medication errors and medication safety was obtained during clinical placement, not in the classroom. In addition, students in the Saudi Arabian sample felt that pharmacology (medication mode of action) is better learned in a hospital setting and medication safety education is optimally delivered using a combination of lectures and hospital training. In contrast, however, one participant felt that classroom learning is better and prepared students for practice during clinical placement.

"I do not know I think my main learning in terms of medication errors has happened in the hospital when I have been in placement not one of those done in university... In terms of medication safety, I think I have learned more in the hospitals than I have in the university." (ST - N 01 - UK)

"It's the same but if we practise it in a real situation it remains in my mind, and I will not forget because I see how we do it really… I think I learn more in the clinical training." (ST - N 03– SA)

"When we go to the hospital … we learn what the most popular medication that is used is. So, by that we can learn the action of medication (pharmacology). Yes, I learn about medication safety in the lecture and in the hospital.". (ST - N 01– SA)

"Actually, in the university we learn more because in the hospital I will practise what I learned." (ST - N 02– SA)

B5) The Methods Used to Deliver Medication Safety Sub-theme

Nursing students in the UK indicated that several methods are used in the teaching of medication safety such as lectures, simulation, observation during clinical placement, E-learning, IPL, workshops, discussions, role-play scenarios, self-directed learning and using videos on medication errors and medication safety issues. In addition, they revealed that teaching is mostly uni-professional, with some inter-professional

learning in the form of a one-day IPL session. It was also reported that this session included a medication errors component.

> *"So, I would like to practise everything I have learned in the lecture and skills sessions (meant simulation sessions)." (ST – N 02 – UK)*

> *"We had to do an E-learning module on pain management and …workshop … that was discussion in groups and looking things up on the Internet and things like that or looking things up about medications and medication errors. We had a simulation skills lab and role play…"* (*ST – N 01 – UK)*

> *"It is mostly uni-professional with some inter-professional workshops with medical students." (ST – N 03 – UK)*

Nursing students in Saudi Arabia also identified a number of educational methods used when teaching medication errors and medication safety such as lectures, case-based study, simulation, role-play and using blackboard for communication, using e-library, using e-learning, group discussion, research about medication safety and observing the preceptor. In addition, they indicated that learning is uni-professional learning (UPL) only and that there is no inter-professional learning provided during the nursing programme. Moreover, nursing students preferred the simulation method and thought it good preparation before hospital training.

> *"We have lectures, and we have case-based study in the simulation lab also. Yes, there is role play. She must check about the six rights of medication to present, and we practice it when we go to the hospital with the instructor. Yes, we have the blackboard … we have the e-library." (ST - N 01 – SA)*

> "*No inter-professional learning, only uni-professional learning." (ST - N 03 – SA)*

> *"First, we must finish the simulation before we go to the hospital. So, we do like some like role play inside the labs." (ST - N 02 – SA)*

B6) The Medication Safety Feedback Sub-theme

Form of Feedback about Medication Safety Education

Nursing students in the UK felt that it is better to use a combination of methods and indicated their preference for methods like simulation and inter-professional learning, which they felt is useful and helps to break barriers and improve communications between healthcare professions. They also acknowledged the effectiveness of

methods currently used but felt that more IPL would be beneficial:

> *"I tend to think it is variety that makes a difference. Some lectures are always good and also workshops and simulations … I learn something differently by learning it from a different method." (ST - N 01 – UK)*

> *"I think it is very beneficial. I think it helps to break down some of the barriers we have here in this country between the different professions and I think that is really, really important for the safety of the patient." (ST – N 01 – UK – talking about IPL method)*

> *"Well, I think they are effective (meant current educational methods) and I don't think there is enough of it. I think we just need more inter-professional stuff as well." (ST – N 04 – UK)*

Nursing students in Saudi Arabia provided their feedback on methods used to teach medication safety and their preference for some methods like simulation, workshops, and case-based study to increase understanding of medication safety and medication errors. Moreover, they realised that it is important to practise in a simulation lab first then to apply what they have learnt in a hospital setting. In addition, they highlighted the importance of medication safety education as a big topic and in decreasing medication errors. Also, they felt that medication safety education is a very important part of the curriculum and should be emphasised.

> *"Yes of course simulation will help us to understand about medication safety and medication errors." (ST – N 07- FG (2) – SA)*

> *"The workshop and case-based scenario are good method and it help us to understand medication errors." (ST – N 07- FG (5) – SA)*

> "*I think the simulation is very important because it is based on how it is like in the hospital. It prepares us for the real life and we would have simulation rotations before we go to the hospital so preparing us to the hospital life or environments." (ST – N 04– SA)*

> "*It helps to decrease incidence of medication error." (ST – N 06 – SA)*

> *"It is a big topic and every person in the hospital should deal with it and practise it." (ST - N 01 – SA)*

Good and Bad Practices Seen during Clinical Practices

Nursing students in the UK observed some good practices during hospital training

(clinical placement) such as proper checking of medication charts, a questioning attitude when there is something wrong and applying the Five Rights. However, students also reported seeing some poor practices by some nurses such as not reading electronic medication charts thoroughly (clinical reality).

> *"I have seen a nurse go to get the medication chart and go through it and look at something and go "That does not seem right. The dosage does not seem right" And sort of hold back on it before and query it before she actually gave it and in fact it did turn out right, it was the wrong dosage. So that was good she queried it." (ST – N 01 – UK)*

> *"Although I will say what happens in reality people read through it all and do not actually read most of it which is a problem." (ST - N 01 - UK- talking about bad practice seen – not reading of electronic medication charts in the hospital)*

Nursing students in Saudi Arabia also observed several good and poor practices during clinical placement. Good practices included where nursing staff applied the Five Rights and performed proper patient counselling. However, students also observed some poor practices such as nurses not following proper aseptic techniques before administering medication to patients (did not do a skin swab or not wear a glove), and not following the Five Rights.

> *"We have the medication Five Rights - right name, right dose, right time, so and so. And also, explanation of medication for the patient like you take this medication for this disease, it will be like this, you might have this…explain about the medication when given." (ST - N 03 –SA – talking about good practice seen)*

> *"I have seen like sterilization techniques which were like they were given the medication with like no gloves and withdrawing the medication from the bottle with no gloves or that kind of stuff or not checking the Five Rights before preparing the medication I have seen that". (ST - N 04 – SA – talking about bad practice seen)*

C. Evaluation of Medication Safety Education Theme

C1) The Perceptions of Students Regarding the Adequacy of the Current Education Sub-theme

Nursing students in the UK highlighted the need for a good understanding of pharmacokinetics and pharmacodynamics and felt that pharmacology should be included at the beginning of the programme. In addition, students expressed the

desire for more practical methods like IPL and simulation sessions but felt that the medication safety component it was well addressed during clinical placement.

> *"I think, for like dosing and for pharmacokinetics and pharmacodynamics, it is so important that understanding that why you need to space doses, why medications are dosed in the way that they are and what different forms of medications means …" (ST – N 03 – UK)*

> *"I think we are not getting enough pharmacology." (ST – N 02 – UK)*

> *"I think also more inter-professional stuff will get us involved with medics and pharmacists… also practising in simulation lab." (ST – N 03 – UK)*

> *"I have seen that in clinical practices. It is very well done usually. We do get some training." (ST – N 03 – UK – talking about medication safety component.)*

Nursing students in Saudi Arabia agreed with their colleagues in the UK and identified some difficulties in the teaching of pharmacology which must be improved and also reported that there was no equal opportunity to practice in all sections during examinations. In addition, they highlighted the lack of proper training and poor supervision during clinical placement. Moreover, it was also noted that time specified for hospital training is limited.

> *"I honestly do not know. Because honestly, I do not think it can be. Maybe the way they teach it should be changed, I honestly think the way of teaching is very important to understand the course. I do not know. I do not know how to overcome that problem." (ST – N 04 –SA – talking about teaching of pharmacology.)*

> *"For example, in our examination they have a lot of work they have to divide us about it. So, when the one chooses the medication, they have proper chance for using medication, know about it. But others don't choose it so the chance of practice about medication is decreased." (ST – N 03 –SA)*

> *"In hospital, the nurses cannot clarify them sometimes for us. They are busy always don't have any time." (ST – N 06 – SA)*

> *"Yes, we have limited time for hospital training as we visit the hospital once per week." (ST - N 07 – FG (4) – SA)*

C2) Barriers to Positive Medication Safety Educational Outcomes Sub-theme

Nursing students in the UK identified several barriers which prevent positive medication safety educational outcomes which focus on pharmacology such as insufficient pharmacology being taught which makes learning about medication safety harder and the lack of a clear link between medication safety and pharmacology.

> *"I think it is a problem. That is my opinion. I think we need more… I really think a more basic understanding of pharmacology would be a good thing. So, I think we need more pharmacology." (ST – N 01 – UK)*

> *"I think if you don't understand that (meant pharmacology) it makes medication safety harder." (ST – N 03 – UK)*

Nursing students in Saudi Arabia agreed with the UK sample in their identification about the pharmacology topic, regarding students scoring low marks in pharmacology as they do not understand the topic properly. In addition, they identified additional barriers such as students feeling uncomfortable questioning nurses when observing incorrect practices during clinical placement and being poor at medications' calculation. In addition, students also felt that factors such as not being able to safety practise intra-muscular (IM) injection, a shortage of materials and supplies used for training purposes and some medications being prohibited for use in training made learning about medication safety were problematic.

> *"For us we have the lowest mark in Pharmacology for all of us…I think we don't understand pharmacology." (ST – N 03 –SA)*

> *"... I said medication calculation some of the students have like a problem with that and they were not concerned about that...one student say I did not understand how to calculate this medication ...". (ST – N 04 –SA)*

> *"There are some difficulties when we go to administer like IM injection, I think it's difficult for me because the nurse doesn't allow me always to administer like this type of injection, IM." (ST – N 06 –SA)*

> *"… So, we use a normal saline because there is no ringer lactate…Some medication we are not allowed to use it and deal with it in the hospital..." (ST – N 03–SA)*

C3) Strategies to Improve Medication Safety Education Sub-theme

Nursing students in the UK suggested several strategies to improve medication safety education such as the integration of the medication safety component throughout the course as it is an essential component, increasing pharmacology portion and including more medication safety components within it to improve their understanding of both components. Moreover, students also felt that inter-professional learning (IPL) should be used to teach medication safety starting from the first year of nursing programme, more simulation should be used, and that e-learning could be used to support pharmacology learning. They also indicated that it would be useful to have exposure to using IV's medications.

> *"I think it needs to be integrated throughout the course. We have done, anytime that medications or pharmacology or anything like that is talked about I think it needs to be, the safety part needs to be brought back into it if only by talking about what could go wrong." (ST – N 01 – UK)*

> *"Yes. I think a larger pharmacological component would be a very good thing and medication safety could easily be part of that and so I think more pharmacology would definitely help." (ST – N 01 – UK)*

> *"I think if you were going to make it as a course, I think that that should be an inter-professional course in the first year of pharmacy, nursing and medicine. They should all have to do this together really…And I think working inter-professionally is the only way forward." (ST – N 03 – UK)*

> *"More simulated practices are needed." (ST – N 04 – UK)*

Nursing students in Saudi Arabia also suggested several strategies to improve medication safety education such as including new teaching methods such as inter-professional learning, shadowing pharmacists as a method of learning about medication safety, including research on medication safety, including more examples of medication errors and including more videos on medication safety and errors. Additionally, it was also felt that practising nurses should train the students and be instructors, and that students should receive training in reporting of medication errors as well as using technology to improve medication safety teaching such as smart phone applications.

"Really, I think inter-professional teaching will be a good method to include … It will be interesting because one student will come from pharmacy and one from the nursing profession, really yes and real not just acting." (ST – N 02 – SA)

"Maybe visit the pharmacy and learn about it and shadow pharmacists would be good." (ST – N 03 – SA)

"I think if we had like research on medication safety or something, I think it is going to be more beneficial." (ST – N 04 – SA)

"Because our instructor they learn how to teach us but they practice less than us. So if we have practiced nursing like instructor for us, it will be better." (ST – N 03 – SA)

4.4.3.1.2 Pharmacy Students in the UK and Saudi Arabia Themes

A. The Medication Safety Curriculum Theme

A1) Medication Safety Contents Sub-theme

Pharmacy students in the UK identified the content of the medication safety component taught to them, stating that the medication safety component is always part of existing courses and that there is no specific module on medication safety. However, one student stated that at his pharmacy school there is a specific module which focuses on medication safety (i.e., the Public Health and Patient Safety module). Also, students spotted medication errors in dispensing classes, and in addition, students are always reminded of the impact of medication safety and medication errors throughout the pharmacy programme.

"So, medication safety was part of other modules. We never had a module which was dedicated purely to medication safety or errors as it were always part of other modules." (ST – P 02 – UK)

"So, what they did was to merge them together so there was like an outbreak for example public health outbreak disease how does patient safety impact etc. But when they did teach us about patient safety it was very much medication safety focused". (ST – P 02 – UK – talking about Public Health and Patient Safety module)

"In dispensing classes, we were told to spot medication errors." (ST – P 01 – UK)

Pharmacy students in the Saudi Arabian sample identified the content of medication safety that they are studying and stated that a medication safety and medication errors components are part of existing courses such as clinical pharmacy practice,

communication skills, pharmaceutical care, therapeutics, medicinal chemistry, pharmacology, ethics, management courses, in-patient pharmacy institutional module and the introduction to pharmacy practice experience *(*IPPE) course. In addition, pharmacy students in Saudi Arabian sample highlighted the topics of medication safety being taught in the pharmacy program such as: high alert medication (first mentioned during hospital training), patient counseling and patient education, and root cause analysis (RCA) which is taught as part of the introduction to pharmacy practice experience (IPPE) course. Other topics the pharmacy students in Saudi Arabia emphasised included medication adherence, medication incompatibility, contra-indication, drug-drug interaction, formulary, and different formulation, and how to deal with medication error topic, which is part of the management course.

> *"Communication skills, pharmaceutical care courses, institutional hospital pharmacy practice course, and in therapeutics." (ST – P02 –SA)*

> *"Introduction to pharmacy practice experience was the main cause of teaching a lot of concepts about Medication Safety." (ST – P 07 – FGM1 (3) – SA)*

> *"They just gave us a title but the word high alert medication we just knew it in the hospital, in the summer training." (ST – P04 – SA)*

> *"Part of the IPPE course is the root cause analysis." (ST – P 08 – FGM2 (4) – SA)*

> *"Incompatibility of two drugs, contra-indications, drug-drug interactions, allergy, crushing the tablets, pharmaceutical control, drug-food interactions, formulary, and different formulation for the same drug will give us different dosage." (ST – P06 – FGF1 (3) – SA)*

A2) Medication Errors Sub-theme

As previously mentioned in the nursing students' themes, it was observed from the teaching staff interviews that it was always a difficult, surprising question to ask someone to provide a definition of medication safety, which is why in the students' interview study, gradual questions were used to pave the way for seeking a definition of medication safety or how the participant conceptualised it. By defining medication errors and what do you think the reason for the error (causes) and how to prevent it (strategies), it is easier to define, conceptualise and understand what is meant by the term 'medication safety'.

Pharmacy students in the UK defined medication errors easily and most definitions included general types of medication error such as prescribing, administration and dispensing errors in addition to general causes such as wrong dose or drug given to patient other than what was prescribed. In addition, they identified several causes of medication error such as, wrong drug dispensed, and pinpointed several strategies to reduce medication errors such as, placing look-alike medications in different places, separating different strengths of medications and double checking, ensuring accuracy and clinical checking, having the right number of staff to operate safely, with three people to check medications and two people to double check medication before dispensing, as well as ensuring that staff are well trained.

In view of the opinions on medication errors topic, pharmacy students in the UK defined medication safety as the prevention of errors and measures to ensure the safe provision of medication. As mentioned previously, one example was provided for each item and more examples were provided in Appendix 14.

> *"OK, it could be a prescribing error, it could be an administration error, it could be a dispensing error, and there are several types. But at the end of the day, it could be something like a near miss so it hasn't gone out to the patient or an actual error, so it has harmed the patient." (ST - P 01 – UK – defining medication error)*

> *"Yes. I think there was a case a long time ago when a woman gave out Propranolol instead of Prednisolone … and she passed away I think." (ST – P 02 – UK – talking about wrong drug error as a cause)*

> *"Double checking, accuracy and clinically so not just checking once, but double checking and accuracy, clinically checking." (ST – P 02 – UK – talking about strategy to prevent error)*

> *"Medication safety in my opinion would be the measures put in place to ensure the safe provision, supply of medication and use of medication I would think."* (*ST - P 02 – UK – defining medication safety)*

Pharmacy students in Saudi Arabia defined medication errors as easily as their colleagues in the UK and conceptualised the term in many ways. Definitions of medication errors perceived by students in Saudi Arabia included the following: that a medication error is still an error even if it has not harmed the patient, drug therapy

problems, adverse drug events and calculation mistakes and that it includes different medication processes. In addition, the students identified several causes of medication errors such as the lack of proper patient counselling and education, deficiency in patient awareness and patients not knowing enough about their disease and treatment and not being engaged in their treatment plan were also felt to be contributory factors to medication errors, Furthermore, herbal medications (not considered as medication) being mixed with other dangerous medications, an undocumented allergy to a medication which may lead to the patient going into anaphylactic shock and unknown drug allergy (such as antibiotics) were also recognised . Good communications with physicians and among healthcare providers in general was also seen as important in reducing medication errors.

In view of the above opinions on the medication errors topic, pharmacy students in Saudi Arabia defined medication safety and included the criterion of not causing harm and they revealed that it is a wide term which includes many aspects and provided a diverse understanding of the term.

> *"Medication error can come in different causes, It's maybe from the pharmacist, from the doctor or relative to the patient administration. Error in the process of prescribing, dispensing or even the administration." (ST – P 02 – SA – defining medication error)*

> *"I think maybe it's related to the lack of patient education, like the doctor or the pharmacist did not educate the patient… This will lead to errors if the patient did not know how to administer these medications." (ST - P 02 – SA – talking about cause of error)*

> *"Before the administration of the medication, we should ask if there are, the patient has undocumented allergy or problem related to medication." (ST - P 08 – FGM2 (2) – SA – talking about strategy to prevent error)*

> *"Make sure that the patient gets the right medication, right dose, at the right time. In addition, by applying medication safety principle we can save some money from the hospital, from the government." (ST - P 05 – SA – defining medication safety)*

A3) Medication Safety Guidelines and References Sub-theme

Pharmacy students in the UK revealed that they use the British National Formulary (BNF) as a point of reference for medication information but nothing specific for

medication safety. However, most pharmacy students in the Saudi Arabian sample did not specify any guidelines or references used when studying medication safety. However, one pharmacy student reported following the ISMP recommendations for prohibited abbreviation and medication warnings and alerts.

> *"We use the British National Formulary (BNF) to search for information about medication use, but nothing in particular for medication safety." (ST – P 02 – UK)*

> *"We follow the ISMP recommendations for the prohibited abbreviation. Every warning or alerts in the ISMP is mentioned in our college website." (ST – P 08 – FGM2 (2) – SA)*

A4) Target Knowledge, Skills, and Attitudes (KSA) Sub-theme

Pharmacy students in the UK identified a number of areas of targeted knowledge, which they feel important for the pharmacist to practise medication safety such as being up to date, having thorough, comprehensive knowledge and being open and receptive to improving and increasing knowledge. Similarly, pharmacy students in Saudi Arabia identified a range of knowledge such as pharmacology, pharmacology related issues, toxicology and medication knowledge, therapeutics, pathophysiology, drug-drug and food-drug interactions, dose calculation, and drug information. In addition, students also noted the importance of the reporting of medication errors, medication errors knowledge (for example causes, types, prevention of medication errors), medication safety knowledge, having a wide knowledge about medication based on experience, and knowledge of emergency procedures.

> *"In terms of knowledge there you have to know your stuff and you cannot forget about it anyway... So yes, I think up to date and knowing all your knowledge." (ST - P02– UK)*

> *"Pharmacology and Toxicology is very important when to use it and how to use it and when it's become a toxic or, when it's overdose, what are the symptoms." (ST - P 03 - SA)*

> *"Yes. Therapeutics and how to choose the right medication, how to choose the right dose, what dose to start with, how to titrate for example… I think this is the most important thing to know to prevent medication errors in the future." (ST - P 02 - SA)*

Pharmacy students identified a range of skills which they feel pharmacists need in order to practise medication safety such as maintaining a solid and consistent

checking process (including expiry date) and having good communication skills. Similarly, pharmacy students in Saudi Arabia identified a range of skills such as communication skills, writing and documenting skills and critical thinking, patient involvement, education, and teamwork skills.

> *"Your checking process must be solid. It must be consistent all the time again like the expiry date thing, so it has to be always, always checking that no matter what." (ST - P01 – UK)*

> *"Good communication skills are absolutely necessary." (ST - P02 – UK)*

> *"…for Medication Safety, yah you need to have communication skills, a good communication skill." (ST – P 05 – SA)*

> *"Critical thinking skills are very important one." (ST – P 08 – FGM2 (1) – SA)*

Pharmacy students identified a range of attitudes which they felt were needed for pharmacists to practise medication safety such as being always active and alert and not passive, always learning and keeping up-to-date and double-checking medication orders and prescriptions. Similarly, pharmacy students in Saudi Arabia identified a range of attitudes such as being balanced, patient, calm, tolerant and cheerful, double checking, not being passive or aggressive, open-mindedness, professionalism, good communicating skills with colleagues and patients, readiness to admit errors and maintaining a pleasant environment, not pointing out other people's mistakes and educating them, reporting medication errors in order to learn and improve, transparency, and the ability to accept discussions and different opinion. Confidence, alertness and communicating with physicians were also seen as important, as were an attitude of linking knowledge (theory) to practice, and taking responsibility, calmness, clear-mindedness, accountability, vigilance, encouraging patients to talk and not neglect any information, listening carefully to patients, supporting a no-blame culture and learning how to prevent errors, being positive and working co-operatively with others as part of a team.

> *"Being active and not being passive in everything you are doing … So, take an active role in everything you are doing instead of just being a passive robot. I think that is also a good skill to have." (ST - P 02– UK)*

"Coming back to knowing that you are alert at all times and knowing yourself if you know that your brain is not focusing as much be honest with your employer or your staff, so you know I need a break now…attitudes of always double-checking medication." (ST - P 01 – UK)

"Responsibility, to learn how to be accountable for your actions. This is very important, and this would help a lot to make an action against the Medication Error." (ST – P 07 – FGM1 (6) – SA)

"And to keep in mind the famous saying in Medication Error is "to err is human" so we don't blame people who do mistakes." (ST – P 07 – FGM1 (3) – SA)

B. The Teaching Process Theme

B1) Time Allocated for Medication Safety Teaching Sub-theme

Pharmacy students in the UK sample felt the time allocated to medication safety education is insufficient, and students in the Saudi Arabian sample either felt time allocated is insufficient or were unsure about the adequacy of time allocated:

"Maybe we need more time for medication safety." (ST – P01 – UK)

"I'm not sure maybe we need more time." (ST – P 02 – SA)

"I think we need more time for medication errors and medication safety topics." (ST – P 07 – FGM1 (1) –SA)

B2) The Mode of Integration Sub-theme

Pharmacy students in the UK revealed that the medication safety component is mostly integrated as part of existing courses in the pharmacy programme, and that some pharmacy students preferred both modes of integration. In addition, they felt that medication safety teaching should be made more explicit in the pharmacy curriculum as pharmacists are the drug experts.

"Yes. I think that would be better to be a part of other courses which were there. I think integration works better." (ST - P 01 – UK)

"I think personally I prefer both, I think both." (ST - P02 – UK)

"Yes. It should be made extremely explicit. There is a lot of reading on it as well and there are a lot of severe possible consequences that could happen. And at the end of the day our job is as medication experts, we are the drug experts …" (ST - P 02 – UK)

Pharmacy students in Saudi Arabia revealed different views regarding the medication safety mode of integration and how explicit is the medication safety component. Some students reported their preference for both modes of integration. While others believed it is better to integrate the medication safety component as part of existing courses and not as a stand-alone course. Furthermore, they also indicated that the medication safety component is taught as part of existing courses such as the Introduction to Pharmacy Practice Experience and medication administration and management courses. However, few students revealed their preference for integrating the medication safety component as a stand-alone course. In addition, most pharmacy students felt that the medication safety component is clearly labelled in existing courses, and that this is important. They also felt that it is explicitly taught, although some felt that medication safety education is not clearly labelled in the pharmacy curriculum.

> *"I think the best way is to have them both. Separate and a part of other subjects … So yah I prefer to take them both." (ST – P 05 – SA)*
>
> *"I disagree with the course about medication safety. We don't need to add anything to the curriculum." (ST – P 09 – FGM3 (7) – SA)*
>
> *"I think new courses for medication errors and a specific course for the medication safety". (ST – P 06- FGF1 (6) – SA)*
>
> *"Yeah ...yeah. Sure, medication safety is clearly mentioned and labeled." (ST – P 04 – SA)*
>
> *"We need to have it (meant medication safety topic) more clearly labeled." (ST – P 05 – SA)*

B3) The Mode of Supervision and Training Sub-theme

Pharmacy students in the UK sample stated that clinical and practitioner pharmacists teach medication safety, and that they feel it is beneficial for the lecturers who teach medication safety to have pharmacy experience gained from the hospital and community practices. Similarly, pharmacy students in Saudi Arabia indicated that they prefer to be trained and taught by clinical pharmacists with clinical experience, however there was some disagreement between students regarding this issue, with

some participants feeling that academics are not best-suited to teach medication safety as they lack clinical experience, while some felt that as academics teach medication safety as part of other modules this was not problematic, and still others thought that clinical pharmacists are most suited to the task because of their knowledge and expertise.

> *"Who teaches? …we would have certain pharmacists who were specialists in clinical or practicing pharmacy and they would generally be the ones teaching us about medication error and safety." (ST – P 02 – UK)*

> *"It would be interesting to see points of views from hospital and in the community. Like in the hospital. At university we get teacher practitioners so some come from hospital, and some come from community …they would explain what they come across in practice." (ST - P 01 – UK)*

> *"I think the clinical pharmacist…. who practice in the hospital is suitable to teach medication safety topics…he sees cases every day." (ST – P08 – FGM2 (4) – SA)*

> *"Both of them. Everyone, everyone who is interested will know how to teach medication safety." (ST – P 08 – FGM2 (3) – SA – talking about clinical pharmacist with clinical experience and pure academic lecturer)*

> *"You will not learn from someone who has never been practicing, someone in academics." (ST - P 07- FGM1 (6) – SA)*

B4) Experience in Different Sites Sub-theme

Pharmacy students in the UK and Saudi Arabia felt that they learned most about medication errors and medication safety during clinical placement in the hospital, rather than the classroom. However, one junior student in Saudi Arabian sample felt that he learned most in the classroom. In addition, Saudi Arabia students dislike the experience of shadowing pharmacists during clinical placement as it is a hands-off practice.

> *"I think we learn most of medication safety in clinical placement." (ST – P 01 – UK"I would say in the hospital, we have more time, we have the practice. We learn more medication safety in the hospital." (ST - P05 – SA)*

> "*We did not do anything just shadowing the pharmacist and the instructor said observes here and there. And we did not do anything." (ST - P 09 FGM3 (3) – SA)*

B5) The Methods to Deliver Medication Safety Education Sub-theme

Pharmacy students in the UK revealed having several methods used in the teaching of medication safety such as lectures, and simulation methods including role-play. In addition, they reported that teaching is mostly uni-professional with some inter-professional learning in the pharmacy programme and that it includes a medication errors component.

> *"And the way we were taught was traditionally speaking lecture based with examples of really bad errors which have led to horrible consequences." (ST - P 01 – UK)*

> *"But when we did the simulations now, we think "OK", we know how not to administer Amoxicillin if they are unsure they are allergic or not. Just always be extra cautious. Also, we do a role-play about medication in the dispensing class." (ST - P 02 – UK)*

> *"It is pharmacy students only … it is mostly a uni-professional learning experience." (ST – P -01 – UK)*

> *"Yes. I think inter-professional learning would help a lot. When we were in the third year of university, we had a module called inter-professional learning where we would have classes…" (ST - P02 – UK)*

Pharmacy students in Saudi Arabia identified a number of educational methods used when teaching about medication errors and medication safety, such as lectures, case-based study, role-play, group and case discussions, workshops, using videos, reporting medication errors using safety reporting system (SRS), presentations, clinical placement, shadowing, simulation and inter-professional learning (IPL). In addition, students indicated that learning is unit-professional only, and they expressed different views regarding the importance of integrating IPL in their curriculum, with some feeling that IPL helps them to understand the concept of teamwork and others seeing IPL as beneficial as they hear other people's perceptions and share experiences as well as exploring different aspects of medication safety. However, some participants expressed a preference for UPL, while others favored both IPL and UPL as methods of learning. Furthermore, pharmacy students had different views regarding simulation, as it is used in some pharmacy programmes but not in others. It was noted that the simulation method is used during OSCE exams, and some students preferred simulation seeing it as a good method to develop problem-solving skills before

hospital training.

"Discussions, lectures, case discussions, role play. We have also cases, case reported from the hospital, and we calculated the dose to the scale." (ST - P 07 – FGM1 (1) – SA)

"He took us actually to the hospital and he arranged like a visit, and we reviewed the patient file and discussed this case, what are the errors." (ST - P 03 – SA – talking about clinical placement method)

"Yes, only uni-professional. No inter-professional learning in my college." (ST - P 02 – SA)

"I think the IPL method helps to understand teamwork, it's engaged the nurses, doctors, pharmacist all of them. From the beginning everyone knows what his role and what he does, and what you do." (ST - P 09 – FGM3 (1) – SA)

"*For me, I prefer to be with Pharmacists only (meant UPL method). But I don't know, maybe, maybe it will be good but for me I prefer to be with pharmacists, because pharmacists are drug experts, so it is better for me." (ST - P 05 – SA)*

"I think both inter-professional and uni professional learning, there are things between pharmacists and there are things with other health-care professionals." (ST - P 06 – FGF1 (6) – SA)

"I think simulation is really good method of teaching because it doesn't only teach you the problem, it also teaches you how to solve this problem." (ST – P 09 – FGM3 (1) – SA)

B6) Medication Safety Feedback Sub-theme

Form of Feedback about Medication Safety Education

Pharmacy students in the UK felt that medication safety is important and provided their feedback on methods used to teach the topic indicating their preference for some methods like simulation and inter-professional learning, with IPL being thought more helpful in a hospital setting.

"Very, very important! At the end of the day our main focus should be the patient. But whatever we can do to improve patient safety and prevent the harm from happening to them so that would be amazing, so it is crucial, it is very important." (ST - P 01 – UK– talking about medication safety)

"I think it would be a really good idea to have simulation for medication safety, yes. So it would be very interesting and it would add to the degree definitely." (ST - P 01 – UK)

"So yes, inter-professional learning was very helpful in preventing medication errors."(ST – P 02 – UK)

Pharmacy students in the Saudi Arabian sample expressed a preference for some methods such as simulation, clinical placement, IPL, research on medication safety (self-directed learning), reporting of medication errors, workshop and case-based study, and quality tools as in the use of root cause analysis (RCA). However, they expressed a dislike of spoon-feeding methods as lectures and presentations. In addition, they provided their views on the importance of medication safety education as a topic and indicated the significance of medication safety in saving money and lives.

"I think it's important to have simulation sessions. In addition, the best way is to bring the students in the hospital and see the real cases. This is the best way to teach the students, to involve them in the situation." (ST - P 07 – FGM1 (3) – SA – talking about simulation and clinical placement methods)

"Inter-professional learning is very beneficial because it will break the barriers between pharmacies, nursing and medical students…and the case-based study is helpful." (ST - P 01 – SA)

"I don't like spoon feeding it is an old method you know, lecturers they are just reading from the presentation …, sorry long presentation or book they just tell you don't do this you know an old method; I don't like it." (ST - P 04 – SA)

"I don't like the lectures, it's boring. We want to practise it." (ST - P 01 –SA)

"I think medication safety is very important". (ST - P 02 – SA)

Good and Bad practices Seen during Clinical Practice

Pharmacy students in the UK observed some good practices during hospital training (clinical placement) such as different techniques to ensure that pharmacists check medications (separating different strengths and putting all the strengths in one box to force people to check) and giving examples of medication safety initiatives and errors. However, students did not identify any bad practices seen during hospital training.

"Usually if the strengths are being mixed like citalopram, they are always next to each other on the shelf so you would separate that out, put different strengths in different places, and there was also carbamazepine with the Tegretol… So, we just put all the

carbamazepine in a box so now you must go through the whole lot to know that you are picking up the right one. So that was quite good. It takes time but at least you are getting the right one." (ST - P 01 – UK – good practice of separating different strengths from the same medication)

Pharmacy students in Saudi Arabia observed several good and poor practices during their clinical placement which they reported and learned from, such as using technology such as automated dispensing cabinets, double checking and order verification, flagging the system to document allergy and in-patient pharmacists reporting medication errors. However, students observed some bad practices during their hospital training such as patients not always being counselled and educated on how to use medications, incomplete patient files, misplacing returned medications, and not engaging patients in their treatment plan.

"Yes, this is the new technology and it's called script-pro device…which is not available in all the hospitals. It's mainly used for filling and labeling of medication for outpatient patients... Yes, it was very accurate and even it reduces the time of preparing these medications, so you dispense it in faster way for patients." (ST - P 02 – SA – using automated dispensing cabinet)

"Double check… So, the pharmacist will check and then the technician and then after that the pharmacists will recheck, that is how they do it… also flagging the system to document allergy." (ST - P 06 – FGF1 (2) – SA)

"Yes, during the dispensing sometimes, the pharmacists don't give the patient full education on how to use medications for example how to use insulin pen." (ST - P 03 – SA – talking about bad practice seen)

"I think the patient is not engaged in the treatment plan…physicians and pharmacists do all the job." (ST - P 09 – FGM3 (1) – SA - talking about bad practice seen)

C. Evaluation of Medication Safety Education Theme

C1) The Perceptions of Students regarding the Adequacy of Current Education Sub-theme

Pharmacy students in the UK expressed a need for more medication safety components in all settings. Similarly, pharmacy students in Saudi Arabia feel that medication safety education is insufficient and that they need more hospital practice.

"More medication safety components are needed in the classroom and in the clinical

placement settings as well." (ST – P02 – UK)

"No, at this time we have to know the basics, but in general it's not enough. For example, practising in the hospital will add a lot for us, will teach us how to prevent these errors correctly. So practice is very important and we haven't been to a real practice until now."(ST - P 02 – SA)

C2) Barriers to Positive Medication Safety Educational Outcomes Sub-theme

Pharmacy students in the UK did not identify any barriers to positive medication safety outcomes, however, pharmacy students in Saudi Arabia identified several barriers. They noted that students are grade oriented more than knowledge oriented, the herbal medication topic is not taught, there is no research on medication safety, no hands-on training is given during clinical placement and there is a gap between theories learned and practice in the clinical setting.

"We are focusing on the grade we score… we think about the grades not the information that presented to us." (ST - P 06 – FGF1 (6) – SA)

"*There is a problem with the curriculum, the way that they teach us about herbal medication because it's an American curriculum. I think there is no information about herbals and other things that it's not in our curriculum. The curriculum is an American curriculum, which lacks the information about herbal medication, which is an important part of our medication list." (ST - P 09 – FGM3 (3) – SA)*

"The problem that there is no medication safety research like maybe implementing some medication safety research as graduating research." (ST - P 09 – FGM3 (1) – SA)

"So, sometimes there is a gap between theories that is taught in the school and the real practice." (ST - P07 – FGM1 (5) – SA)

C3) The Strategies to Improve Medication Safety Education Sub-theme

Pharmacy students in the UK suggested several strategies to improve medication safety education such as gaining practical experience early in the programme and using simulation.

"Also, some people work during placements for our university. I know I did for all four years or like weekend jobs. Or get us to relate our experiences to the other students' experiences so the more experiences you have had about the more you will be cautious when dispensing that drug next time or if that mistake was made be careful with that so it does not get mixed up next." (ST - P 01 – UK)

"The simulation idea was a good one." (ST - P01 – UK)

Pharmacy students in Saudi Arabia also suggested several ways in which medication safety education can be improved, such as implementing or integrating medication safety components in pharmacology courses and integrating a specific medication safety course (a stand-alone course). In addition, it was also felt that medication safety should be taught from the first year and practised throughout the pharmacy programme and should be maximized in the final year of programme. Additionally, it was suggested early and more frequent hospital training be combined along with improving the hospital experience and involving students in clinical rounds during hospital training. Furthermore, students pointed-out a number of methods by which to share knowledge, such as using the self-directed learning method to teach medication safety (search information about the topic) and inter-professional learning (IPL) , group discussions and case-based studies, shadowing pharmacists on the quality improvement component in later years, including problem based learning (PBL), encouraging students to do research on medication safety and including a critical thinking skills component which can be implemented in all courses. Additionally, students also felt that it was important to include a topic on how to prevent and deal with medication errors after they happen, quality tools such as root cause analysis (RCA) reporting of medication errors and how to deal with stress and workload.

"*We can implement medication safety in pharmacology course." (ST - P 08 – FGM2 (2) – SA)*

"There is an opinion, which was mentioned in the beginning that medication safety be as a specific course (meant stand-alone course) …" (ST - P 09 – FGM3 (6) – SA)

"I think medication safety is good to be started the first year in the college, and then medication safety teaching should be divided throughout the years." (ST - P 06 – FGF1 (6) – SA)

"If there is a practice session and we have the chance to practise with real situation and get deeper with medication safety and medication errors issues, this would be very good for us to learn." (ST - P 05 – SA -– talking about early exposure to clinical placement)

"Yes, I think it would be a very good experience to have IPL as we can share knowledge. They can tell us the errors that they have done before or we can discuss these errors and how it occurs, what's the role of each healthcare professional in preventing these errors." (ST - P02 – SA – discussing errors during IPL session)

4.5 Discussion

In this study, a document review was performed, documents across the studied universities were examined and course descriptions were accessed from universities' webpages or course handbooks. It was found that the medication safety component was delivered to nursing and pharmacy students as part of existing courses and this is the case in most universities, while a few universities (mentioned in tables 4.8 and 4.9) had a stand-alone module or a course which focussed on medication safety in addition to delivering a medication safety component as part of existing courses. These findings support Alkatheri et al. (2017) who reported that most pharmacy educators preferred teaching medication safety as part of existing courses such as the pharmacy practice course, while a few preferred teaching medication safety as a stand-alone course. Furthermore, the medication safety component was a mandatory topic in the two professions and both countries. This finding supports the finding of Alkatheri et al. (2017), who indicated that medication safety is a mandatory topic in the pharmacy programme. Moreover, the UK sample used mostly the GPhC and the NMC which are the national standards, with a rare use of WHO curriculum guide. This finding supports the literature review study which indicated that six studies used the WHO Curriculum Guide explicitly (Mansour, 2013; Hwang et al., 2016; Mansour et al., 2018; Bohomol, 2019; Kirwan et al., 2019; Svitlica et al., 2021), while a further 37 studies used other guides and frameworks (see table 3.6). In contrast, the Saudi Arabian sample indicated using number of curriculum guides including a "medication errors book" and the WHO curriculum guide (as shown in table 4.9). These results indicate that each university has its own way of teaching medication safety, different types of integration and different curriculum guides were used and also suggest the need for a review and revisit of medication and patient safety curriculum in nursing and pharmacy schools.

As mentioned earlier, semi-structured interviews and focus groups were conducted,

and the following themes emerged: 1) the medication safety curriculum; 2) the teaching process; and 3) the evaluation of medication safety education. The findings of the teaching staff and students' interview study are discussed under the main themes of the study.

Medication Safety Curriculum

The study suggests that the content and quantity of medication safety taught to pharmacy and nursing students should be revised and updated as it varies within the same profession in the same country and between different professions and countries. This finding supports those of a number of studies. Vaismoradi et al. (2014) noted that the curriculum needs to integrate patient safety aspects throughout to ensure compliance with patient safety policies. In addition, Cresswell et al. (2013) reported that healthcare students were mainly taught about safety-related issues in separation, with limited opportunities for inter-professional learning. Similarly, Usher, K., et al. (2018) pointed out that different universities have quite different content for teaching patient safety. Additionally, Naser, A. Y., et al. (2020) emphasised the need for pharmacy curricula to include a detailed content of patient safety topics.

This study found that there is a substantial finding concerning nursing education indicating that an insufficient amount of pharmacology education is being delivered to nursing students and that there is an urgent need to strengthen pharmacology courses. As reviewed in chapter 3 the following studies Adhikari et al. (2014), Holdforth et al. (2013) and Page et al (2006) are supported by the findings from this particular study. In addition, it was highlighted that the Five Rights principle during medication administration is not sufficient to ensure holistic medication safety (Adhikari, 2014).

A new finding from the current study was that the definition of medication safety is not unified and should be well defined for both teaching staff and students, this finding not being reported in the previous studies. However, nursing and pharmacy students in the UK and Saudi Arabia defined medication errors easily, using comprehensive terms. Moreover, they were able to identify many causes of

medication error and indicated strategies to reduce the number of errors. Finally, they provided a definition of medication safety. Pharmacy students agreed with nursing students finding in having a diverse and different conceptualization of medication safety concept. This finding suggests unifying a definition of medication safety.

Finding from this study identified that medication safety theories (e.g. Reason's human errors theory, 2000) are not included in most teaching and should be enforced in the curriculum. This finding supports the one of Milligan (2006); there is an urgent need to improve patient safety education and to include the human factors theory in healthcare education (Milligan, 2006). Instructional strategies focused on human and systems factors implicated in medical error will provide opportunities to build skills such as, situational awareness, clinical reasoning, and judgement (Debourgh, 2012).

This study identified the lack of unified patient or medication safety curriculum guide (whether international or national) available in most programmes. This finding supports the literature review finding regarding the use of curriculum guide when designing, preparing educational material and teaching medication safety. Six studies (as mentioned earlier in this section) used an international guide such as the World Health Organisation Patient Safety Curriculum Guide while the remainder used different guides such as those issued by the NMC, GPhC and other bodies as outlined in chapter 3, Table 3.6. Therefore, a unified curriculum guide should be defined and used.

This study indicated the lack of specific aims and objectives or recommended approaches to teaching medication safety. The learning outcomes in the curriculum are general for the whole pharmacy and nursing programmes and not specific to medication safety education; this should be made very clear in the curriculum. Targeted knowledge, skills and attitudes needed for safe medication practice are not specified in the curriculum and this needs to be addressed.

The Teaching Process

This study highlighted that there were no specific learning theories (e.g., Kolb (1975), Bloom (2008)) recommended in the curriculum and learning theories should be defined in order for teaching staff to meet the aims, objectives and learning outcomes specified in the curriculum and to structure and design their educational material around these learning theories. This finding supports the literature review finding regarding the use of theories and frameworks when teaching medication safety as six studies only (East et al., 2015; Hayes et al., 2015; Hewitt et al., 2015; Mawhirter et al., 2016; Weatherford et al., 2015; Bridgeman et al., 2018) used learning or training theories such as Bloom's taxonomy, Kolb cycle and the Kirkpatrick model which were presented in chapter 3 Table 3.6.

Furthermore, participants described how teaching staff used different styles; some were comfortable with a didactic style or experiential style, and others use both styles. Teaching style should be identified in the curriculum. No other studies have reported this aspect in relation to medication safety education.

Time allocated for teaching of, and training in, medication safety in different sites (i.e. classroom, simulation lab and clinical placement in the hospital) was not sufficient to cover the medication safety component and time allocated should be reviewed and increased. This finding agrees with that of Ragucci et al. (2016) who identified the need to devote more time to training students on communicating with patients, about the occurrence of medical errors and how to report errors. In addition, Lee et al. (2020) and Usher et al. (2018) pointed out that patient safety education is limited in hours of instructions, and there were differences in the amount of time allocated for teaching patient safety in nursing schools.

The study findings showed different views regarding mode of integration of medication safety, as few programmes integrated medication safety as both types of integration, and most of the programmes include medication safety as part of existing courses. In addition, there was disagreement regarding how explicitly or implicitly medication safety is taught and whether it is labelled clearly as medication safety. In

the same way, Attree et al. (2008) found that patient safety content was not explicitly addressed in the curriculum. In addition, Steven et al. (2014) agreed with Attree noting that within academic contexts patient safety was not visible as a curricular theme. Cresswell et al. (2013) argued that patient safety tended to be either implicit in curricula or explicitly identified in a limited number of separate topic areas. Similarly, Kirwan, M., et al. (2019) highlighted that patient safety as a topic generally remains a hidden element within the curriculum taught across many subjects. Therefore, the mode of integration of the medication safety component, whether as a stand-alone course or as a part of existing courses should be specified, taking into consideration congestion in the curriculum and most important clearly labelling and explicitly teaching the medication safety component.

This study indicated Issues regarding supervision and training of students which negatively affected students' experience in the hospital and must be addressed with the responsible persons in the universities and hospital. The findings of this interview study support Warholak et al. (2011), who stated that SoS education should be "hands-on" or interactive. as both pharmacy and nursing students always feel uncomfortable with "hands-off" training in the hospital and think that giving students a chance to have hands-on training can improve hospital experience a great deal and prepare students for better medication safety practice. This study suggested that there were a limited number of clinical pharmacists, pharmacists and nurses who can train pharmacy and nursing students in the hospital. Similarly, as described in chapter 3, Cresswell et al. (2013) noted that although patient safety role models were key to student learning, in helping to develop and maintain a consistent safety ethos, their numbers were limited.

In this study, there was agreement among teaching staff and students that the clinical placement method is more beneficial when learning about medication safety, as this educational method provides the opportunities for students to practise all medication safety aspects while training in the hospital setting. Attree et al. (2008) also noted that students gained most knowledge and experience from clinical practice. However, few nursing and pharmacy students in the Saudi Arabian sample felt that they learned

about medication safety in both the classroom and hospital settings. This finding suggests a need to improve the teaching of medication safety during clinical placement, including strengthening the content, methods used and implementing a particular curriculum guideline and educational framework. In addition, the issue of pre-occupied trainers who cannot provide time to train students was highlighted and needs to be reviewed and addressed.

This study described various methods used in teaching the medication safety component, with some methods being more effective than others, such as simulation, inter-professional learning, and clinical placement. Participants perceived these methods should be used more and inter-professional learning should be integrated in the curriculum especially for Saudi Arabian pharmacy and nursing students as they are not exposed to this method in their programmes. In addition, methods should be revised for effectiveness and adequacy. Similarly at chapter 3, Vaismoradi et al. (2011) suggested that nursing education curriculum designers need to go beyond theoretical concepts of patient safety education and develop strategies to increase the application of safety knowledge and competencies in nursing practice. As described in chapter 3, several studies have advocated the use of simulation method when teaching medication or patient safety (Badir, 2015; Hayes, 2015; House, 2016; Madhavanpraphakaran, 2012; Mariani, 2015; Mawhirter, 2016; Sears, 2008; Whitehair, 2014; Ottis, 2016; Atayee, 2016; Komperda, 2019; Korayem, 2020; Skoy, 2018).

Additionally, this study indicated that, simulation and inter-professional learning methods are combined in the form of workshops which is believed to be an effective method of delivering medication safety education in a safe environment. Reime et al. (2016) identified that making mistakes during simulation-based inter-professional team-training (SBITT) appeared to improve the quality of patient care once the students returned to clinical practice as it made the students more vigilant and gave the students an opportunity to practise clinical reasoning skills and to share professional knowledge. Vyas et al. (2012) noted simulation training enhanced the pharmacy student's inter-professional collaboration and communication skills.

Similarly, Lee et al. (2020) and Popkess (2017) found simulation in inter-professional education effective in developing undergraduate nursing and medical students' collaboration skills, particularly in error disclosure.

This study identified that Inter-professional learning method was preferred by teaching staff and students participated in this study. Similarly, as described in chapter 3, many students indicated an interest in inter-professional opportunities and the potential for inter-professional multimedia learning resources to positively impact the behaviours of registered nurses in relation to safe medication practices (Thom, 2016; Omura, 2015). Furthermore, several of studies advocated using inter-professional learning method when educating students and perceived it as a promising strategy to improve students' safety competence and learning with other health profession students (Fuji, 2010; Holdford, 2011; Hwang, 2016; Ernawati, 2015; Bridgeman, 2018; Rotz, 2021; Seaman, 2018). However, some studies highlighted the limitations and difficulties of integrating the inter-professional learning method. As mentioned above, Cresswell et al. (2013) noted the consequence that there were only limited opportunities for inter-professional learning and bridging the gaps between educational practice and policy contexts. In addition, Lapkin et al. (2012) identified time-tabling restrictions and lack of appropriate teaching and learning resources as the main barriers to implementation of IPE. Furthermore, Hardisty et al (2014) highlighted that there are considerable organizational challenges in arranging inter-professional groups when students come from different organisations with different placement arrangements in practice, and curricular demands sometimes act as a barrier. Additionally, this study identified, other educational methods used such as problem-based learning, e-learning and use of videos on medication safety, which were considered to be effective methods of teaching medication safety. Hewitt et al. (2015) noted that using problem-based learning provided nursing students the opportunity to engage with systems factors that contribute to medication errors. Lee et al. (2013) noted that using an e-learning programme is an effective learning and East et al. (2015) noted that most nursing and midwifery students indicated that the filmed scenario was a valuable learning tool.

There is an important finding perceived by several teaching staff that including quality tools such as root cause analysis (RCA) and failure modes and effect analysis (FMEA) when teaching about medication errors and how to investigate them. These techniques are very beneficial for students to understand how medication errors occur and the factors which may lead to medication errors. Schafer et al. (2012) reported medication error evaluation and prevention was successfully introduced in a medication safety course using team-based root cause analysis projects.

Steven et al. (2014) noted students learnt by observing staff who acted as role models and Rickles et al. (2010) reported students have learned by observing how others handled medication errors. However, this study found that most pharmacy and nursing students felt that observation or shadowing of practitioners, does not improve their knowledge and skills, especially technical skills. Students prefer hands-on practice.

There is a new finding revealed by nursing and pharmacy teaching staff in both countries that their application for medication safety practices were during supervision, training and through conducting research on medication safety.

This study found that feedback about the teaching process was limited and cannot be used as an effective tool to assess teaching in general. There was no specific feedback for the medication safety component and that pharmacy and nursing schools should find a solution for low response rate feedback and develop specific sections in the evaluation form for medication safety teaching. In addition, students reported their views on good and bad practices seen during hospital training, which is a unique finding to this study, and should help in evaluation and improving hospital training.

Evaluation of Medication Safety Education

In this study, teaching staff and students indicated that medication safety education was inadequate. Therefore, the curriculum should be re-designed and improved as a first step towards medication safety education adequacy. Similarly, Vaismoradi et al. (2014) noted that nursing students felt that their education programmes were leaving

them vulnerable to “drug errors”. Bradly et al. (2011) reported that elements of patient safety were not adequately addressed in the formal curriculum such as safe systems and errors and professionalism. Noland et al. (2009) noted that students’ training on handling medication errors is inadequate and inconsistent. Warholak et al. (2011) noted that pharmacy colleges and schools prepared students well in some areas of medication safety but not in others. Rickles et al. (2010) reported that most students received little or no formal didactic or on-the-job training on how to handle the communication of medication errors; and that those students who reported receiving formal training felt it was insufficient or inadequate. There were many lessons learned from the findings of this study, and these are presented as strategies for improvement of medication safety education (see Appendix 17).

In this study, many barriers which prevent positive outcomes were identified and these should be reviewed. Similarly, Rickles et al. (2010) identified a clear gap in the pharmacy curriculum and a possible gap experienced by other schools and colleges of pharmacy. Furthermore, Mansour et al. (2018) highlight a key challenge, which is the need for faculty experts in patient safety teaching and research to shift the mindset of the future nursing workforce. In addition, this study indicated that various strategies were suggested by teaching staff to improve medication safety education, and these should be reviewed, implemented, and evaluated on a regular basis to ensure that they are affective. Similarly, several researchers suggested strategies which can improve medication safety education; providing pre-licensure students with a strong foundation in quality and safety in an introductory clinical course, revising pre-licensure curricula to include practical teaching activities focused on patient safety, engaging students consistently in safety principles early and throughout their health care programs, using several teaching methods to deliver patient safety education more comprehensively and effectively, revising nursing curriculum and including creative teaching strategies to foster critical thinking, critical analysis and reasoning skills, articulating and standardising a minimum level of medication error instruction for pharmacy curricula, combination of classroom and clinical learning activities to strongly impact student knowledge, skills and attitudes. (Armstrong et al., 2013;

Debourgh et al., 2012; Duhn et al., 2002; Lee et al., 2016; Ruth-Sahd, L, 2014; Johnson et al., 2002; Miller et al., 2009)

4.5.1 Strengths and limitations

This study included a good sample size of teaching staff in the UK and Saudi Arabia and students in Saudi Arabia. In total, 70 interviews were conducted using a comprehensive topic guide that covered a large area of medication safety. However, this study had the following limitations: there were technical problems (the ethical approval processing took a very long time) which resulted in wasted time and effort and only a small sample size in the UK pharmacy and nursing students was achieved; However, using two interview methods (a semi-structured and a focus groups) in Saudi Arabia may have provided some rich data and insight. The difficulty of recruiting of students in the UK was compounded by limited access to students and the timing of recruitment which coincided with the examination period and long vacations. In addition, there were no incentives allocated for students due to limited resources.

4.5.2 Summary

In this study, the views of the teaching staff and the students in number of pharmacy and nursing schools in the UK and Saudi Arabia were explored. Three qualitative approaches were used; documents reviews, semi-structured interviews and focus groups. Three main themes and sub-themes emerged from the interviews' data analysis: the medication safety curriculum, the teaching process and evaluation of medication safety education. The themes that emerged from this qualitative study were used to drive the development of the questionnaire study instrument (chapter 5) for further exploration and explanation of the research problem. Therefore, in the following chapter, I investigate and analyse the perceptions of pharmacy and nursing students on medication and patient safety education in the UK and KSA.

Chapter 5: Questionnaire study on the Perceptions of Nursing and Pharmacy Students on Medication and Patient Safety Education

5.1 Introduction

The previous interview studies supported the findings of the literature review study and identified additional areas regarding medication safety education as perceived by pharmacy and nursing teaching staff and students. As in the previous interview study, qualitative data were collected and analysed, this being the first phase of the exploratory sequential design. Therefore, it was a logical consequence to follow with a quantitative phase, which builds on the results of qualitative data analysis to test or generalise its findings (Hadi, 2012). In a study to assess the patient safety component Lee, S. E., et al. (2020) reported the need for curriculum development to include all important aspects of patient safety and cultural competencies in various teaching and learning venues. In addition, Kirwan, M., et al. (2019) pointed out that there are no guidelines that address how patient safety should be taught to nursing students, and regulatory bodies have not yet advocated criteria on the subject. Similarly, Alwhaibi, M., et al. (2020) highlighted the need for including patient safety courses in the curricula of the different pharmacy programmes, given the importance of patient safety training in improving the quality of patient care. It is notable that around one-half of the surveyed pharmacy students did not receive any courses on patient safety. Similarly, Dimitriadou et al. (2021) highlighted the gap between theory and practice and the need for collaboration between classroom and clinical settings. The questionnaire study was aimed at investigating and analysing the views and experience of the students, as they are the stakeholders or end-users of medication safety education. Views expressed by nursing and pharmacy students were analysed and used to build part of the questionnaire (part 1), which will be described below, while the other part of the questionnaire was a validated questionnaire, the Health Professional Education in Patient Safety Survey (H-PEPSS), which was adapted for this study. The Health Professional Education in Patient Safety Survey (H-PEPSS) tool uses the patient safety competencies framework developed by the Canadian Patient Safety Institute (CPSI). The framework includes the following: (1) Contributing to a culture of

patient safety, (2) Working in teams for patient safety, (3) Communicating effectively for patient safety, (4) Managing safety risks, (5) Optimising human and environmental factors, and (6) Recognising, responding to and disclosing adverse events.

Several studies which used the H-PEPSS tool were conducted in nursing, while there are no studies conducted in the pharmacy profession which use this tool. Duhn (2012) noted that nursing students as a group scored highest in the domain of clinical safety (in both classroom and clinical settings). This domain focuses primarily on hand hygiene and infection control, and might be the most familiar to students due to public campaigns on health care safety contributing to their knowledge base. Furthermore, in his study in Saudi Arabia Colet (2015) noted that female nursing students reported higher patient safety competence in both classroom and clinical settings within the domains of 'working in teams' and 'communicating effectively' while males reported higher competence in settings such as 'managing safety risks' and 'understanding human and environmental factors' domains. In addition, Ginsburg (2013), in a study on new graduates, found greater confidence in patient safety learning was reported for learning experiences in a clinical setting compared with the classroom setting with one exception: nurses' confidence in learning about working in teams compared with other healthcare professionals deteriorated as they moved from thinking about learning in a classroom setting to thinking about learning in a clinical setting.

Duhn (2012) noted that, "The expectation exists that confidence increases with clinical experience; however, fourth-year nursing students reported less confidence in their knowledge about key domains compared with junior-year students." In addition, Duhn (2012) noted decreasing levels of confidence in the third-year and fourth-year students in her study regarding nursing students. Stevanin (2015) had similar findings noting high patient safety knowledge and competence was reported by first-year students, moderate by second-year students, but then higher at the end of the third year. Furthermore, Duhn et al. (2012) and Ginsburg et al. (2013) reported that upper-year students progressed in their learning and are exposed to more situations, they are more aware of the scope and complexity of patient safety and have more

questions than answers. Lukewich (2015) reported nursing students were confident in what they were learning in a clinical setting about working in teams, whereas confidence in managing adverse events and responding to adverse events declined in the later years of study. A study by Suliman, M. (2019) recommended in order to close the gap between theory and practice in the nursing curriculum, there is a need for developing a comprehensive framework that incorporates patient safety knowledge and competencies.

In view of these studies, the rationale for conducting this study was to bridge the gap found in the literature (i.e. limited studies on the curriculum content, the methods, the curriculum guides) by exploring and discovering more about the subject.

5.2 Aim and Objectives

The aim of this study was to investigate and critically appraise the views and experience of undergraduate pharmacy and nursing students on medication safety education. The objectives were as follows: three primary objectives and one secondary objective.

1. To explore how medication safety topic is taught as perceived by pharmacy and nursing students in the UK and Saudi Arabia.
2. To describe the perceived effectiveness of methods used in delivering medication safety education in pharmacy and nursing curricula.
3. To explain students' confidence in patient safety education provided in classroom and clinical settings (using the six core domains of the Safety Competencies Framework developed by the Canadian Patient Safety Competencies Framework).
4. To evaluate the perceived effectiveness of topics, teaching settings and educators on the medication safety education in pharmacy and nursing curricula (as a secondary objective).

5.3 Method

5.3.1 Design

This study was a cross-sectional survey using a questionnaire, to collect quantitative and qualitative data. As the students were the end-users of the medication safety education, it was a logical consequence to conduct a quantitative study in the student population using a questionnaire after conducting a qualitative study to explore relationships and build on the results of qualitative data analysis to test and generalise the findings obtained from the literature review and the qualitative studies (Abdul Hadi et al., 2012), gather numerical data that can be analysed statistically, and also measure the occurrence of a particular phenomenon within the population being studied. Moreover, as mentioned at the beginning of this thesis in the methodology chapter, the study design is an exploratory sequential design.

5.3.2. Participants and Sampling

A purposive sampling approach was applied to recruit participants. Invitation emails were sent to 23 universities in the UK and seven universities in Saudi Arabia, then six universities accepted to participate in the study from the UK and five universities from Saudi Arabia. In addition, all nursing and pharmacy students from all years of study were approached (i.e. in the UK years one to three nursing students and years one to four pharmacy students, whereas in KSA years one to five nursing students and years one to six pharmacy students).

The inclusion criterion was that respondents had to be undergraduate pharmacy or nursing students. An exclusion criterion was pharmacy and nursing students in the first semester of the first year of study as they are unlikely to be exposed to medication safety teaching. The target sample size was 800 participants in total from the two professions in both countries. This sample was sufficient and suitable for the chosen population. The sample size was large enough to represent the studied population and fell within the range determined by Krejcie and Morgan (1970). A table for determining the sample size of a known population is presented in Appendix 23. Students from pharmacy and nursing schools within the UK and Saudi Arabia were invited to take part in the study. The administrative staff of the institutions that

agreed to take part in the study sent invitation e-mails to pharmacy and nursing students.

5.3.3 Research Materials

The research material was developed based on a review of the literature and on recent qualitative interviews with students and staff teaching medication safety both at pharmacy and nursing schools in a sample of UK and Saudi Arabian universities. In addition, the recommendations presented in the WHO Patient Safety Curriculum Guide: Improving Medication Safety (WHO, 2011) for Multi-Professionals were consulted. The questionnaire study was conducted in English. The English language is the educational language in the nursing and pharmacy schools in Saudi Arabia.

The questionnaire was divided into three parts:

1. **Part 1: Demographic information**: questions sought information about nursing and pharmacy students such as their current year of study, previous education level before starting the undergraduate degree, age, gender, previous experience working in a clinical setting and current experience in a clinical setting as part of the degree programme.
2. **Part 2: Medication safety education**: students were asked for their perceptions of the current medication safety education in their schools. This section was based on the literature and on the previous interview studies in the UK and Saudi Arabia reported in Chapter 4 and 5. Fourteen questions were asked.
3. **Part 3: Health professional education in patient safety survey (H-PEPSS**) was used. This is a 38 item scale developed by Liane Ginsburg (Ginsburg, 2013). A Likert type scale assessed knowledge, skills and attitudes towards patient safety education. Approval to use the instrument with a minor adaptation was obtained from Liane Ginsburg. (See Appendix 16 for evidence of correspondence emails acknowledging permission for its use.). The H-PEPSS questionnaire was chosen because it is based on the patient safety competencies' framework which included pharmacy and nursing students. At the time there were not many alternative scales available except for a patient safety tool which was tailored to medical students (Alper, 2009). The H-PEPSS

consists of three sections: learning about specific patient safety content areas, how broader patient safety issues are addressed in health professional education, and feeling comfortable speaking up about patient safety experience in clinical setting. The original H-PEPSS contains 38 items, (see Appendix 19). However, in this study, 36 items were used, (see Appendix 20 – part 3). The questionnaire was distributed in the English language for Saudi Arabia sample as English is the teaching language in pharmacy and nursing schools.

5.3.4 *Validity*

A panel of experts in medication and patient safety, which includes the supervisors and colleagues at Imperial College, reviewed and assessed Part 2 of the questionnaire for content validity and commented on the content, format and outline. In addition, colleagues, who are native speakers of English, were consulted for clarity and appropriateness. Moreover, the instrument was piloted (survey pilot testing) with 30 pharmacy and nursing students in the UK and Saudi Arabia for face validity to ensure that questions were clear and understandable. Overall changes to the questionnaire were made as follows: improved sentence structure, re-phrasing and re-formatting some questions, and correcting the grammatical mistakes.

5.3.5 Data Collection

Questionnaires were distributed as soon as ethical approvals were obtained from the Ethics Committees in the UK and Saudi Arabia, (see Appendix 11, 12 and 21). The total data collection period started on 14th October 2016 and continued until 31st March 2017. An invitation e-mail, sent to participants who met the inclusion criteria, included participant information sheet, (see Appendix 22), completion instruction and the link to the questionnaire's webpage. A paper format of the questionnaire was also available and sent to participants who preferred to use this format. Reminder invitations were sent at two weeks and again at one month after the initial invitation message with the cooperation of the administrators at each site.

5.3.6 Data Analysis

A code book was developed which included question or code number, variable name, SPSS variable name, coding instructions, type of question and variable type (Pallant, 2013). The codebook included information about participant, ID number assigned to each survey questionnaire format and university name. The data extracted from the paper format questionnaire were entered into an Excel spreadsheet, then the data file was imported to a SPSS data sheet, as the data entry process was completed using a basic data file on Excel (Pallant 2013, page 27), while, the electronic format questionnaire, developed in Qualtrics (online survey platform/software) was imported directly to a SPSS data sheet. In SPSS (variables view screen) each variable was given a name to identify it, and labelled to define the meaning; specific values were assigned (99, -99 and 66) to indicate missing data. Prior to starting data analysis, it was vital to check the data set for errors (Pallant, 2013). Variables were checked for errors and those identified were corrected. Moreover, the comparison between teaching methods, used in the UK and Saudi Arabia, depends on percentages not frequencies, as the sample size for the two countries is not equal.

5.3.7 Missing Data

Hair (2010, p 41) defined missing data as "when valid values on one or more variables are not available for analysis." It is rare to obtain a complete data set from every case when doing research with human beings (Pallant, 2011; Coakes, 2005). The data file was reviewed for missing values and missing data were defined and specified as 99, -99, 66 values (where 99 refers to 'respondent failed to give a response', -99 refers to 'no response needed' and 66 refers to a 'not applicable'). Moreover, a 99 missing value indicates that the data was missed due to respondent refusal to answer or accidentally missing the question. In addition, questionnaires that completed minimum part one (demographic information) and part two (medication safety education) were included in the analyses, and missing data were coded.

5.3.8 Outliers

An outlier is defined as a data point that varies significantly from other observations and indicate error which may affect the statistical analysis (Grubbs, 1969; Maddala,

1992). Some statistical analyses are sensitive to outliers (Pallant, 2013, page 40) therefore, the data set was checked for outliers and outliers were excluded and removed from data set whenever found.

Data were entered into IBM SPSS software (version 24). Parametric and non-parametric statistical techniques were used to analyse the data for each of the three research questions as follows:

Research question 1*:* "How is medication safety education delivered in the UK and Saudi Arabia?"

Descriptive statistics were used to describe the responses related to this question. A simple statistical test (frequency and percentages) and non-parametric tests (i.e. chi-square test) were used to compare whether medication safety education was taught explicitly and whether it was taught as uni-professional (UPL) or inter-professional (IPL) across selected universities in the UK and Saudi Arabia. Results are presented in tables. Level of significance was set at 0.05 for the Chi-Square test. In addition, "Unsure" response was included when testing the frequency of how explicit was the teaching of medication safety.

Research Question 2: "What are the most effective methods of teaching according to students? Do preferences vary by country, year of study and profession?"

The frequency and percentage of 11 teaching methods used and assessing the effectiveness of each method is presented in tables below. Scores were compared across countries, discipline and year of study using t-tests. In addition, an Analysis of Variance (ANOVA was used for the Saudi Arabia sample and Chi-Square test and crosstab for the UK sample, due to difference in the sample size between the two countries. Post-hoc tests (for Saudi Arabia sample) were conducted to indicate where these differences lie across years of study. Level of significance was set at 0.05 for the independent sample T-test, the One-way ANOVA test and for the Chi-Square test. The 5-point Likert scale rating the effectiveness of each of the 11 educational methods was dichotomised into high effective (scale of 4 to 5) and low ineffective (scale of 1 to 3). Chi-Square analysis was used to test the significant difference between pharmacy

and nursing students' rating of effectiveness and across year of study. In addition, the 'no rating' responses were removed for the interest of robustness of the analysis as students who rated the methods in this way based their rating on an assumption of the effectiveness of the method.

Research Question 3*:* "Do perceptions of the adequacy of patient safety education vary across classroom and clinical settings? Do these perceptions vary according to factors such as year of study, profession and country?"

Several statistical tests were used to measure perceptions in these areas, as follows:

1. The One-way ANOVA test with post-hoc test (for the Saudi Arabia sample) was used to indicate whether there are significant differences in the mean scores on the dependent variable across years of study for pharmacy and nursing students. Post-hoc tests were used to find out where these differences lie.

2. The Kruskal-Wallis test was used for the UK sample as it is a small sample.

It is the non-parametric alternative to a one-way between groups' analysis of variance. It compares the scores of a continuous dependent variable for years of study in pharmacy and nursing students (Pallant, 2013).

3. Paired samples t-test (for Saudi Arabia and UK samples)

This test was used to indicate whether there is a significant difference in confidence in learning between classroom and the clinical settings. This was conducted separately for each profession, and for each country. The level of significance was set at 0.05.

Open-ended and Frequency Questions

As mentioned above, open-ended and frequency questions were used. The open-ended questions were analysed using content analysis, while it is a quantitative study. Qualitative content analysis uses a pre-defined coding system and produces counts or frequencies that may be tabulated and analysed using standard statistical techniques (Pope & Mays, 2006). The open-ended questions were as follows:

1. Which are the best methods for teaching medication safety?

2. What modules or topics have helped you to understand medication safety?
3. What knowledge do you believe a qualified pharmacist will need to practise medication safety?
4. What skills do you believe a qualified pharmacist will need to practise medication safety?
5. What attitudes do you believe a qualified pharmacist will need to practise medication safety?
6. Define medication safety in your own words?

The following frequency questions were analysed using frequency tests and percentages:

1. Who teaches medication safety at the college?
2. In which setting do students learn the most about medication safety?
3. Does the current medication safety education support students' understanding?
4. In what mode should medication safety be integrated?
5. Is the time allocated for medication safety education enough?

5.3.9 Ethical Issues

Ethical approval was obtained from the Imperial College Ethics Committee in the UK (see Appendix 21), and from the King Abdullah International Medical Research Center (KAIMRC) in King Abdulaziz Medical City (KAMC) at Riyadh and from the Institutional Review Board (IRB) at Imam Abdulrahman bin Faisal University (previously University of Dammam) in Dammam city in Saudi Arabia (see Appendices 11 and 12). Ethical considerations were ensured as follows:

1. All participants were assured that they were under no pressure to take part in the study by the school administration or a manager (power relation).
2. All participants were informed that completion of the questionnaire indicated their agreement to participate in the study (this statement was given at the beginning of the questionnaire).

3. All participants were informed that they could withdraw from the study at any point. An incomplete questionnaire indicated their decision to withdraw.
4. All participants were assured of confidentiality and anonymity. Questionnaires were anonymous and so no-one, not even the research team, could identify respondents.

5.4 Results

Pharmacy and nursing schools at six universities in the UK and five universities in Saudi Arabia respectively participated in the study. Current years of degree in the UK sample were years one to four and years one to six in Saudi Arabia.

5.4.1 Demographic Information of the Observed Sample

Table 5.1 shows the demographic data of the UK and Saudi Arabia samples after cleaning and removal of incomplete responses. The table includes information about the questionnaire format, whether electronic or paper, where a differentiation can be seen in the use of the two questionnaire formats between the two countries due to personal preference of the students and the universities. There were a number of respondents, both from pharmacy and nursing schools, who did not answer the clinical experience section in the patient safety education part (H-PEPSS) for reasons such as not having been exposed to clinical training yet or missing this section. Sixty (16.13 per cent) respondents out of 372 from Saudi Arabia did not complete the clinical experience section. Fourteen (35.0 per cent) respondents out of 40 from the UK did not answer the clinical experience section. In addition, failing to answer the clinical experience section was not always due to not being exposed to clinical training in the hospital, but could be due to failing to fill out the section or refusal to answer.

Table 5. 1 Demographic Data

Demographic Characteristics	Categories		Frequencies & Percentage (%)	
	UK	**Saudi Arabia**	**UK**	**Saudi Arabia**
Questionnaire format	Electronic Paper Total		39 (97.5%) 1 (2.5%) 40 (100%)	47 (12.6%) 325 (87.4%) 372 (100%)
University	Bradford Birmingham Cardiff Queens Uni. Belfast Robert Gordon Uni. UCL Not mentioned Total	KSAU-HS* UOD* KSU* PNU* RCDP* Not mentioned	10 (25%) 7 (17.5%) 8 (20%) --- 6 (15%) 2 (5%) 7 (17.5%) 40 (100%)	130 (27.9%) 198 (42.4%) 52 (11.2%) 5 (1.1%) 2 (0.4%) 79 (17%) 372 (100%)
Current status	Pharmacy student Nursing student Missing Total		21 (52.5%) 19 (47.5%) --- 40 (100%)	212 (57%) 155 (41.7%) 5 (1.3%) 372 (100%)
Current year of degree	1st year 2nd year 3rd year 4thyear 5th year 6th year Missing Total		**Pharmacy:** Y1=1 Y2=6 Y3=4 Y4=10 Total = 21 **Nursing:** Y1=4 Y2=8 Y3=7 Total = 19	**Pharmacy:** Y1=24 Y2=24 Y3=81 Y4=49 Y5=23 Y6=11 Total = 212 **Nursing:** Y1&Y2=N/A Y3=42 Y4=56 Y5=57 Total = 155
Previous educational level before starting degree	GCSEs A Levels Diploma Bachelor degree Master degree Other Total	High school cert. Diploma Bachelor degree Master degree Other Missing	1 (2.5%) 24 (60%) 7 (17.5%) 2 (5%) 1 (2.5%) 5 (12.5%) 40 (100%)	363 (97.6%) 4 (1.1%) --- --- --- 5 (1.3%) 372 (100%)

Demographic Characteristics	Categories		Frequencies & Percentage (%)	
	UK	Saudi Arabia	UK	Saudi Arabia
Age	Less < 20		5 (12.5%)	9 (2.4%)
	20 – 30		26 (65%)	355 (95.4%)
	31 – 40		8 (20%)	3 (0.8%)
	More >40		---	---
	prefer not to say		1 (2.5%)	---
	Missing		---	5 (1.3%)
	Total		40 (100%)	372 (100%)
Gender	Female		32 (80%)	260 (69.9%)
	Male		7 (17.5%)	107 (28.8%)
	Prefer not to say		1 (2.5%)	---
	Missing		---	5 (1.3%)
	Total		40 (100%)	372 (100%)
Previous experience working in clinical setting	Yes		28 (70%)	83 (22.3%)
	No		12 (30%)	271 (72.8%)
	Unsure		---	8 (2.2%)
	Missing		---	10 (2.7%)
	Total		40 (100%)	372 (100%)
Current experience in a clinical setting as part of your current degree	Yes		37 (92.5%)	230 (61.8%)
	No		1 (2.5%)	121 (32.5%)
	Unsure		2 (5%)	11 (3%)
	Missing		---	10 (2.7%)
	Total		40 (100%)	372 (100%)

*KSAU-HS= King Saud bin Abdulaziz University for Health Science, KSU= Kind Saud University, PNU= Princess Norah University, RCDP= Riyadh College of Dentistry and Pharmacy, UOD= University of Dammam (Imam Faisal bin Abdulrahman University currently).

5.4.2 Response Rate

As shown in table 5.2, it was not possible to establish the number of questionnaires distributed in electronic format both in the UK and Saudi Arabia due to logistical difficulties (i.e. questionnaires were distributed via the internal e-mail system by the administration staff at each university). However, a total of 248 electronic questionnaires were returned from respondents, in contrast to 810 paper questionnaires. Moreover, there were 68 (63per cent) incomplete questionnaires, 7 (6.5 per cent) partially completed questionnaire and 33 (30.55 per cent) complete questionnaires from the UK, and 139 (27.2per cent) incomplete questionnaires, 43 (8.41 per cent) partially completed questionnaires and 329 (64.38 per cent) complete questionnaires from Saudi Arabia. Moreover, percentages of incomplete, partially complete, and complete questionnaires were calculated in relation to the total number of questionnaires collected from respondents in both electronic and paper

formats. Incomplete questionnaires were excluded from further analysis. Therefore, a total of 412 completed questionnaires from both countries and both disciplines were analysed.

Table 5. 2 Questionnaire Response Rate

Country	Number of Electronic Format Questionnaires		Number of Paper Format Questionnaires		Number of Incomplete Questionnaires Rejected	Number of Partially Completed Questionnaires Included	Number of Completed Questionnaires included
	Distributed	Returned	Distributed	Collected			
UK	Unable to provide the number as questionnaires were distributed online through the administration staff in each university	**107**	**200**	**1**	**68** (63%) (EF* only)	**7** (6.5%) (EF* only)	**33** (30.55%) (32 EF* + one PF**)
Saudi Arabia		**141** (Distributed to pharmacy and nursing students)	**610**	**370**	**139** (27.2%) (94 EF* + 45 PF**)	**43** (8.41%) (42 EF* + 1 PF**)	**329** (64.38%) (5 EF* + 324 PF**)
Total	**Not available**	**248**	**810**	**371**	**207**	**50**	**362**

*Electronic format = EF, **Paper format = PF

The following section focusses on answering the three-research question

5.4.3 Research Question (1) 'How **is medication safety education delivered in the UK and Saudi Arabia?'**

This question combined pharmacy and nursing students. Twenty-seven (67per cent) UK and 270 (76.5 per cent) Saudi Arabian students answered that medication safety is explicitly taught and that it is clearly identified as such; eight (20 per cent) UK and 36 (10.2per cent) Saudi Arabian students answered 'no', while five (12.5 per cent) UK and 47 (13.3 per cent) Saudi Arabian students answered 'unsure'. A chi square test revealed that there was no significant difference between groups, χ^2 (N=373) = 3.48, p = .175.

Table 5.3 indicates that the Chi-Square tests for both the UPL and other methods selected by students were not significant, whereas there was a significant difference in responses between the two countries to the question about IPL methods, χ^2 (n=392) = 6.10, p = .014.

Table 5. 3 Frequencies of Medication Safety Taught as UPL or IPL

Teaching Method	Country	Not Used (Not ticked)	Used (Ticked)	Total	χ^2	*p*
UPL	UK	7 (17.5%)	33 (82.5%)	40 (100%)	0.102	.750
	Saudi Arabia	69 (19.6%)	283 (80.4%)	352 (100%)		
IPL	UK	28 (70%)	12 (30%)	40 (100%)	6.096	**.014**
	Saudi Arabia	300 (85.2%)	52 (14.8%)	352 (100%)		
Other	UK	39 (97.5%)	1 (2.5%)	40 (100%)	0.815	.367
	Saudi Arabia	331 (94%)	21 (6%)	352 (100%)		

"What are the Educational Methods Used in the UK and Saudi Arabia?"

Table 5.4 shows the frequency and percentage of using 11 methods to deliver medication safety education across the UK and Saudi Arabia and consists of 'yes' and 'no' answers. The table below indicates that the Chi-Square tests for problem-based learning, E-learning/online courses, IPL, clinical placement and self-directed learning methods were significant, whereas the other teaching methods were not significant.

Table 5. 4 Educational Methods Used in the UK and Saudi Arabia

Method	Country	Yes	No	Total	χ^2	*P*
Lectures	UK	37 (92.5%)	3 (7.5%)	40 (100%)	1.98	.159
	Saudi Arabia	340 (91.4%)	11 (3%)	372 (100%)		
Simulation	UK	18 (45%)	22 (55%)	40 (100%)	2.28	.131
	Saudi Arabia	195 (52.4%)	144 (38.7%)	372 (100%)		
Role play	UK	21 (52.5%)	19 (47.5%)	40 (100%)	0.30	.585

Method	Country	Yes	No	Total	χ^2	*P*
	Saudi Arabia	163 (43.8%)	177 (47.6%)	372 (100%)		
Case-based study	UK	33 (82.5%)	7 (17.5%)	40 (100%)	0.78	.410
	Saudi Arabia	264 (71%)	80 (21.5%)	372 (100%)		
Problem-based learning (PBL)	UK	25 (62.5%)	15 (37.5%)	40 (100%)	9.37	.002
	Saudi Arabia	128 (34.4%)	214 (57.5%)	372 (100%)		
Interactive (workshops)	UK	21 (52.5%)	19 (47.5%)	40 (100%)	2.69	.108
	Saudi Arabia	134 (36%)	207 (55.6%)	372 (100%)		
E–learning/ Online courses	UK	23 (57.5%)	17 (42.5%)	40 (100%)	20.88	.001
	Saudi Arabia	80 (21.5%)	259 (69.6%)	372 (100%)		
Observation	UK	19 (47.5%)	21 (52.5%)	40 (100%)	0.10	.776
	Saudi Arabia	153 (41.1%)	186 (50%)	372 (100%)		
IPL	UK	17 (42.5%)	23 (57.5%)	40 (100%)	14.53	.001
	Saudi Arabia	58 (15.6%)	281 (75.5%)	372 (100%)		
Clinical placement	UK	36 (90%)	4 (10%)	40 (100%)	11.40	.001
	Saudi Arabia	216 (58.1%)	125 (33.6%)	372 (100%)		
Self-directed learning	UK	30 (75%)	10 (25%)	40 (100%)	9.82	.002
	Saudi Arabia	167 (44.9%)	175 (47%)	372 (100%)		

5.4.4 Research Question (2) What are the most effective methods of teaching according to students?

This question was answered in relation to preference by country, profession and year of study.

What are the most Effective Methods of Teaching According to Students (Do Preferences Vary by Country)?

As shown in table 5.5, the UK respondents perceived that the most effective method of teaching medication safety is interactive learning, followed by clinical placement, then problem-based learning while the least effective method perceived to be IPL, simulation, self-directed learning (e.g. research) and E-learning/online. However, respondents in Saudi Arabia perceived that the most effective method of teaching medication safety is clinical placement followed by simulation and role play. According to these respondents, the least effective method are lectures, observation, and IPL.

T-tests indicate that there was a significant difference in the ratings of effective methods between UK and Saudi students in the following: lectures, simulation, role play, case-based study, E-learning / online, IPL, clinical placement and self-directed learning, while there was no significant difference in the effectiveness of the remaining three methods between the UK and Saudi Arabia samples.

Table 5. 5 Independent Samples T-test for Perceived Effectiveness of Methods Used to Deliver Medication Safety Education in the UK and Saudi Arabia

Method	UK Mean (SD)	Saudi Arabia Mean (SD)	*t*	*p*
Lectures	3.19 (1.13)	3.83 (0.87)	- 3.33	**.002**
Simulation	3.11 (1.60)	4.32 (0.80)	- 3.15	**.006**
Role play	3.24 (1.55)	4.13 (0.83)	- 2.60	**.016**
Case-based study	3.39 (1.43)	4.12 (0.81)	- 2.85	**.007**
Problem-based learning (PBL)	3.40 (1.53)	3.92 (0.92)	- 1.64	.112
Interactive learning	3.57 (1.33)	3.93 (0.90)	- 1.20	.242
E-learning / online	3.04 (1.22)	3.87 (1.10)	- 3.07	**.003**
Observation	3.26 (1.37)	3.73 (0.89)	- 1.44	.164
IPL	3.12 (1.22)	3.70 (0.96)	- 2.05	**.044**
Clinical placement	3.42 (1.61)	4.39 (0.75)	- 3.60	**.001**
Self-directed learning	3.10 (1.30)	4.04 (0.92)	- 3.81	**.001**

Note: the higher the mean the more effective the method as rated by the respondents.

What are the Most Effective Methods of Teaching According to Students in the UK and Saudi Arabia (Do Preferences Vary by Profession)?

Pharmacy students perceived that the most effective method of teaching medication safety is interactive learning, followed by role-play, case-based study, while the least effective three method was E-learning, simulation and finally self-directed learning. In addition, nursing students perceived that the most effective method of teaching medication safety is clinical placement, followed by simulation and observation, while the least effective method is interactive learning and E-learning, IPL and finally role play. There was no statistically significant difference in ratings of effectiveness between the pharmacy and nursing students in the UK sample (see Appendix 24).

As shown in table 5.6, pharmacy students in Saudi Arabia perceived that the most effective method of teaching medication safety was clinical placement, followed by case-based study, problem-based learning. while the least effective method was lectures, observation and finally IPL. However, nursing students perceived that the most effective method of teaching medication safety is simulation, followed by clinical placement, role play, while the least effective method is lectures, then observation and finally problem-based learning.

T-tests indicate that there was a significant difference in the ratings of effective methods between pharmacy and nursing in Saudi students in the following methods: lectures, simulation, role play, observation, clinical placement and self-directed learning, while there was no significant difference in the effectiveness of the remaining four methods between pharmacy and nursing students in Saudi Arabia samples.

Table 5. 6 Independent Sample T-test for the Pharmacy and Nursing Students' Rating of Effectiveness of Methods in Saudi Arabia

Methods	Pharmacy Mean (SD)	Nursing Mean (SD)	t	p
Lectures	3.71 (0.91)	3.96 (0.81)	-2.69	**.008**
Simulation	3.79 (0.93)	4.57 (0.60)	-6.05	**.001**
Role play	3.85 (0.96)	4.34 (0.66)	-3.63	**.001**
Case-based study	4.13 (0.88)	4.11 (0.70)	0.16	.871
Problem-based learning	3.93 (1.00)	3.89 (0.67)	0.24	.814
Interactive (workshop)	3.79 (0.94)	4.08 (0.85)	-1.84	.067
E learning/online	3.73 (1.24)	4.03 (0.89)	-1.20	.231
Observation	3.57 (0.94)	3.93 (0.80)	-2.55	**.012**
IPL	3.36 (0.99)	4.24 (0.62)	-3.60	**.001**
Clinical placement	4.20 (0.87)	4.49 (0.66)	-2.54	**.012**
Self-directed learning	3.91 (0.99)	4.32 (0.70)	-3.05	**.003**

What are the Most Effective Methods of Teaching According to Student (Do Preferences Vary by Year of Study per Profession)?

Table 5.7 shows results relating to the effectiveness of methods used in delivering medication safety education per year of study and shows no significant differences for the majority of teaching methods. However, there was a significant difference for self-directed learning, F (2, 209) =6.47, p = .002. (Students reported that effectiveness of self-directed learning was greater in the early years of their studies.)

Table 5. 7 The Effectiveness of Methods Used in Delivering of Medication Safety Education per Year of Study as Perceived by Pharmacy Students in Saudi Arabia

Methods used in Delivery of Medication Safety	Early Years (n=48)	Middle Years (n=130)	Late Years (n= 34)	ANOVA	
	Mean (SD)			F	*p*
Lectures	3.57 (1.07)	3.78 (0.83)	3.67 (0.92)	0.91	.406
Simulation	3.94 (1.11)	3.72 (0.83)	3.80 (1.09)	0.36	.698
Role play	3.78 (1.08)	3.86 (0.90)	4.50 (0.70)	0.51	.602
Case-based study	4.24 (0.93)	4.14 (0.83)	3.86 (0.96)	1.33	.268
Problem-based learning (PBL)	4.00 (1.06)	4.00 (0.94)	3.63 (1.15)	0.91	.405
Interactive learning (workshop)	3.69 (0.95)	3.81 (0.98)	3.86 (0.70)	0.12	.883
E-learning/online courses	4.00 (1.33)	3.66 (1.26)	3.50 (0.71)	0.31	.735
Observation	3.41 (1.05)	3.65 (0.85)	3.50 (2.12)	0.59	.557
IPL	3.20 (1.48)	3.52 (0.82)	2.33 (1.15)	2.13	.137
Clinical placement	4.38 (0.65)	4.11 (0.97)	4.20 (0.84)	0.73	.484
Self-directed learning (personal research)	4.13 (1.01)	4.00 (0.93)	3.07 (0.92)	6.47	**.002**

Early years = Y1and Y2, Middle years = Y3 and Y4, Late years = Y5 andY6

Table 5.8 presents the results relating to effectiveness of methods used in medication safety education per year of study. There were significant differences for simulation, observation and self-directed learning methods. Post-hoc tests reveal significant differences between third and fourth years for the simulation method, between third, fourth and fifth years for observation, and between third and fifth years for self-directed learning.

Table 5. 8 The Effectiveness of Methods Used in Delivering of Medication Safety Education Per Year of Study as Perceived by Nursing Students in Saudi Arabia

Methods used in Delivery of Medication Safety	Y3 (n= 42)	Y4 (n= 56)	Y5 (n= 57)	ANOVA	
	Mean (SD)			F	*P*
Lectures	3.93 (0.67)	4.05 (0.98)	3.89 (0.70)	0.60	.551
Simulation	4.76 (0.49)	4.43 (0.62)	4.56 (0.62)	3.52	**.033**
Role play	4.43 (0.50)	4.32 (0.78)	4.29 (0.69)	0.42	.658
Case base study	4.16 (0.60)	4.21 (0.74)	3.97 (0.76)	1.15	.321
Problem-based learning (PBL)	3.83 (0.60)	4.07 (0.73)	3.70 (0.67)	0.96	.391
Interactive learning (workshop)	3.96 (0.84)	4.11 (0.76)	4.18 (0.96)	0.41	.667
E-learning/online courses	3.90 (1.30)	4.20 (0.77)	3.90 (0.57)	0.47	.629
Observation	3.63 (0.60)	4.31 (0.76)	3.65 (0.81)	6.89	**.002**
IPL	4.50 (0.70)	4.36 (0.67)	4.00 (0.53)	0.97	.396
Clinical placement	4.51(0.55)	4.55 (0.54)	4.42 (0.83)	0.51	.603
Self-directed learning (personal research)	3.80 (0.80)	4.38 (0.57)	4.53 (0.72)	4.04	**.024**

The Chi-square test was used for pharmacy and nursing students' rating of effectiveness of methods, and rating of effectiveness across year of study in the UK. The Chi-Square analysis showed that any differences were not statistically significant, (see Appendix 25). Results were as follows: case-based study, then lectures and problem-based learning, role play, interactive learning and clinical placement, and simulation and self-directed learning, while IPL, observation and E-learning were perceived as less effective methods of teaching. Moreover, nursing students' rating of the effectiveness of methods was lower than pharmacy students. Results were as follows: clinical placement, followed by E-learning and self-directed learning, then lectures, case-base study, and observation. Methods perceived as less effective were simulation and problem-based learning, then role play and interactive learning. In addition, IPL was not rated by nursing students as an effective method of teaching medicine safety.

Results relating to rating the effectiveness of educational methods across year of study for pharmacy and nursing students in the UK indicated no significant difference for majority of teaching methods. However, the p value was statistically significant for lectures in the Chi-Square analysis $X^2 = 8.19$, $p = 0.044$, (see Appendix 25. Results were as follows: clinical placement, case-based study, lectures, problem-based learning, self-directed learning, role-play and interactive learning, simulation, E-learning/ online courses and observation and finally IPL.

5.4.5 Research Question (3) 'Do perceptions of the adequacy of patient safety education vary across classroom and clinical settings? (part 3) Do these perceptions vary according to year of study, profession and country?'

Confidence in Learning in Classroom and Clinical Settings Per Year of Study by Pharmacy Students

As shown in table 5.9, there is a significant difference between year of study in confidence when learning about working in teams in the classroom and managing safety risks, addressing broader patient safety issues and feeling comfortable speaking up in a clinical setting. The mean difference between years of study is shown between early and middle years for the independent variable (working in teams in classroom setting), between early and middle years, and between early and late years for the independent variable (managing safety risks in clinical setting).

Table 5. 9 Comparison of Confidence in Learning in Classroom and Clinical Settings Per Year of Study by Pharmacy Students in Saudi Arabia

Dimensions of patient safety	Classroom setting					Clinical setting				
	Early years (n=48)	Middle years (n=130)	Late years (n=34)	ANOVA		Early years (n=48)	Middle years (n=130)	Late years (n=34)	ANOVA	
	Mean (SD)			F	*p*	Mean (SD)			F	*p*
Clinical safety	3.62 (0.60)	3.78 (0.74)	3.74 (0.63)	0.93	.397	3.82 (0.65)	3.81 (0.71)	3.80 (0.87)	0.00	.996
Culture of safety	3.47 (0.66)	3.63 (0.75)	3.63 (0.69)	0.82	.441	3.64 (0.74)	3.69 (0.63)	3.75 (0.69)	0.12	.889
Working in teams	3.15 (0.64)	3.59 (0.75)	3.59 (0.75)	5.57	.005	3.16 (0.69)	3.51 (0.77)	3.54 (0.91)	2.58	.079
Communicating effectively	3.63 (0.81)	3.82 (0.86)	3.85 (1.03)	0.82	.440	3.46 (0.81)	3.74 (0.82)	3.84 (0.91)	1.78	.171
Understanding human and environmental factors	3.90 (0.63)	3.76 (0.86)	3.58 (0.88)	1.18	.309	3.50 (0.43)	3.64 (0.70)	3.46 (0.44)	0.98	.376
Adverse events and near misses	3.69 (0.77)	3.46 (0.89)	3.17 (0.83)	2.77	.065	3.36 (0.73)	3.47 (0.85)	3.28 (0.65)	0.45	.635
Managing safety risks	3.36 (0.80)	3.57 (0.91)	3.46 (0.71)	0.99	.373	3.02 (0.70)	3.67 (0.85)	3.69 (0.82)	8.93	**.01**
Addressing broader patient safety issues						3.06 (0.38)	3.58 (0.60)	3.50 (0.70)	7.77	**.01**
Feeling comfortable speaking up						2.96 (0.43)	3.50 (0.77)	3.48 (0.60)	4.87	**.01**

Early years = Y1+Y2, Middle years = Y3 +Y4, Late years = Y5 + Y6

Confidence in Learning in a Classroom and Clinical Setting Per Year of Study by Nursing Students

As shown in Table 5.10, there is a significant difference between year of study in confidence when learning about culture of safety, working in teams, communicating effectively, understanding human and environmental factors, adverse events and near misses and managing safety risks dimensions in both the classroom and clinical setting. Similarly, there was a significant difference in confidence when learning about addressing broader patient safety issues in the clinical setting.

The mean difference between years of study is shown between the third, fourth and fifth years for independent variable (culture of safety, working in teams,

communicating effectively, understanding human and environment factors, adverse events and near misses and managing safety risks). The mean difference between years of study is shown between third and fourth years.

Table 5. 10 Comparison of Confidence in Learning in the Classroom and Clinical Settings Per Year of Study by Nursing Students in Saudi Arabia

Dimensions of Patient Safety	Classroom Setting					Clinical Setting				
	Y3 (n=42)	Y4 (n=56)	Y5 (n=57)	ANOVA		Y3 (n=42)	Y4 (n=56)	Y5 (n=57)	ANOVA	
	Mean (SD)			F	*p*	Mean (SD)			F	*p*
Clinical safety	4.22 (0.82)	4.39 (0.54)	4.34 (0.56)	0.86	.424	4.22 (0.52)	4.24 (0.57)	4.34 (0.63)	0.61	.545
Culture of safety	3.46 (0.82)	3.91 (0.76)	3.70 (0.82)	3.72	**.027**	3.41 (0.60)	3.78 (0.51)	3.94 (0.38)	12.80	**.001**
Working in teams	3.13 (0.87)	3.82 (0.88)	3.60 (0.86)	7.71	**.001**	3.13 (0.63)	3.59 (0.68)	3.70 (0.53)	10.91	**.001**
Communicating effectively	3.41 (0.80)	3.97 (0.85)	3.95 (0.79)	6.75	**.002**	3.71 (0.57)	3.95 (0.55)	4.04 (0.50)	4.90	**.009**
Understanding human and environmental factors	3.51 (0.76)	4.04 (0.86)	3.52 (0.90)	6.61	**.002**	3.71 (0.36)	4.03 (0.42)	4.24 (0.60)	14.59	**.001**
Adverse events and near misses	3.18 (0.71)	3.80 (0.80)	3.62 (0.82)	7.65	**.001**	3.13 (0.64)	3.54 (0.59)	3.48 (0.60)	5.97	**.003**
Managing safety risks	3.18 (0.91)	3.88 (0.85)	3.48 (0.93)	7.27	**.001**	3.09 (0.82)	3.71 (0.64)	3.60 (0.63)	9.79	**.001**
Addressing broader patient safety issues						3.59 (0.58)	3.96 (0.61)	3.71 (0.65)	4.52	**.012**
Feeling comfortable speaking up						3.19 (0.52)	3.49 (0.76)	3.40 (0.57)	2.70	.071

Confidence in Learning about Patient Safety in the Classroom and Clinical Setting Dimensions Per Year of Study using the Kruskal-Wallis Test for Pharmacy and Nursing Students in the UK

Table 5.11 shows no significant difference in confidence between pharmacy and nursing students when learning about different dimensions of patient safety in classroom and clinical setting. However, there is a significant difference across years of study in the nursing students' sample for clinical safety dimension in clinical setting **(**$X^2 = 0.023$).

Table 5. 11 Comparison of Confidence in Learning in Classroom and Clinical Settings Per Year of Study by Pharmacy and Nursing Students in the UK

Dimensions of Patient Safety	Pharmacy Students			Nursing Students		
	X^2	df	*p*	X^2	df	*p*
Clinical safety-A	0.70	3	.880	0.43	2	.805
Clinical safety-B	1.23	3	.744	**0.023**	2	.988
Culture of safety-A	3.21	3	.359	0.55	2	.759
Culture of safety-B	0.40	3	.946	1.58	2	.454
Working in teams-A	2.40	3	.495	5.30	2	.070
Working in teams-B	1.50	3	.687	0.99	2	.608
Communicating effectively - A	0.10	3	.992	1.12	2	.572
Communicating effectively - B	3.89	3	.285	0.41	2	.816
Understanding human and environmental factors - A	3.1	3	.383	1.80	2	.406
Understanding human and environmental factors – B	0.44	2	.800	0.46	2	.796
Adverse events and near misses - A	3.14	3	.370	0.64	2	.726
Adverse events and near misses - B	0.32	2	.853	2.38	2	.304
Managing safety risks - A	2.10	3	.557	0.84	2	.656
Managing safety risks - B	2.10	2	.356	0.43	2	.807
Addressing broader patient safety issues - B	1.40	2	.505	0.77	2	.679
Feeling comfortable speaking up -B	1.72	2	.433	0.47	2	.789

A=classroom, B=clinical setting

Investigating the Level of confidence in the Patient Safety Dimensions in Saudi Arabia and the UK

In the following pages, the Paired T-test was used to investigate level of confidence in learning about the patient safety dimensions in the two settings in Saudi Arabia and the UK. The results were presented in the following three (3) tables:

Table 5.12 shows the mean and standard deviations of the confidence ratings of pharmacy students in two learning settings in Saudi Arabia. There were statistically significant differences in student's confidence in the dimension of 'human and environmental factors' as they were more confident in the class room. However, there were no significant differences in ratings of confidence in the remaining dimensions.

Table 5. 12 Comparisons of Pharmacy Students' Confidence Ratings in Two Learning Settings in Saudi Arabia

	Learning Setting	N	Mean	S.D.	*t*	*p*
Clinical Safety	Classroom	142	3.71	0.68	-1.62	.107
	Clinical setting		3.82	0.71		
Culture of Safety	Classroom	136	3.57	0.70	-1.56	.121
	Clinical setting		3.68	0.66		
Working in Teams	Classroom	132	3.48	0.78	0.32	.750
	Clinical setting		3.45	0.78		
Communicating Effectively	Classroom	141	3.74	0.87	0.64	.522
	Clinical setting		3.68	0.83		
Human and Environmental Factors	Classroom	143	**3.79**	0.80	2.81	**.006**
	Clinical setting		**3.59**	0.62		
Disclosing Adverse Events	Classroom	145	3.52	0.84	1.40	.163
	Clinical setting		3.43	0.80		
Managing Safety Risks	Classroom	138	3.56	0.84689	.45	.656
	Clinical setting		3.52	0.83626		

Table 5.13 shows the mean and standard deviations of the confidence ratings of nursing students in two learning settings in Saudi Arabia. There were statistically significant differences in students' confidence between the two dimensions of 'human and environmental factors' in the clinical setting and 'disclosing adverse events' in the class room. However, there were no significant differences in ratings of confidence in the remaining dimensions.

Table 5. 13 Comparisons of Nursing Students' Confidence Ratings in Two Learning Settings in Saudi Arabia

	Learning Setting	N	Mean	S.D.	*t*	*p*
Clinical Safety	Classroom	151	4.32	0.64	1.06	.291
	Clinical setting		4.27	0.58		
Culture of Safety	Classroom	138	3.68	0.82	-0.76	.451
	Clinical setting		3.72	0.55		
Working in Teams	Classroom	142	3.51	0.90	0.23	.821
	Clinical setting		3.49	0.66		
Communicating Effectively	Classroom	147	3.80	0.85	-1.59	.115
	Clinical setting		3.92	0.55		
Human and Environmental Factors	Classroom	149	**3.70**	0.88	-4.85	**.001**
	Clinical setting		**4.02**	0.52		
Disclosing Adverse Events	Classroom	145	**3.55**	0.82	2.18	**.031**
	Clinical setting		**3.40**	0.63		
Managing Safety Risks	Classroom	141	3.54	0.95	0.61	.542
	Clinical setting		3.50	0.74		

Table 5.14 shows the mean and standard deviations of the confidence ratings of pharmacy and nursing students in two learning settings in the UK. There were statistically significant differences in students' confidence in the two dimensions of 'working in teams' and 'human and environmental factors' as they were more confident in the clinical setting for the both dimensions. However, there were no significant differences in ratings of confidence in the remaining dimensions. In addition, pharmacy and nursing students' groups were combined in the UK sample, as the sample is small

(40 responses only).

Table 5. 14 Comparisons of Pharmacy and Nursing Students' Confidence Ratings in Two Learning Settings in the UK

	Learning Setting	N	Mean	S.D.	*t*	*p*
Clinical Safety	Classroom Clinical setting	33	4.10 4.32	0.64 0.43	-1.88	.069
Culture of Safety	Classroom Clinical setting	33	4.08 4.15	0.62 0.67	-0.50	.623
Working in Teams	Classroom Clinical setting	33	**3.63** **3.93**	0.66 0.60	-2.63	**.013**
Communicating Effectively	Classroom Clinical setting	33	4.37 4.40	0.50 0.57	-0.21	.835
Human and Environmental Factors	Classroom Clinical setting	32	**3.52** **3.84**	0.80 0.65	-2.46	**.019**
Disclosing Adverse Events	Classroom Clinical setting	32	3.72 3.73	0.73 0.78	-0.10	.939
Managing Safety Risks	Classroom Clinical setting	32	3.84 3.86	0.76 0.72	-0.16	.875

5.4.6 Open Ended Questions

The following pages presents tables showing the findings relating to the open-ended questions.

'Which are the Best Methods for Teaching Medication Safety?'

The following table 5.15, presents methods preferred and the number of responses per each method. In Saudi Arabia 146 (67.3 per cent) pharmacy students responded to this question The majority of pharmacy students preferred case-based study and clinical placement methods and the least preferred methods were E-learning/online courses, interactive and IPL. IPL is not preferred or not known by pharmacy students, as IPL is not an educational method in the pharmacy curriculum. In addition, 137 (88.4 per cent) nursing students responded to this question. Role-play and case-based

study methods were always included in simulation. SDL is not preferred by nursing students as the culture of self-directedness was not present in the nursing curriculum. Furthermore, IPL was not preferred or not known by nursing students, as IPL was not an educational method in the nursing curriculum. E-learning/online courses scored zero as it is not mentioned or preferred by nursing students.

In the UK sample, 21 (100 per cent) pharmacy students responded to this question. The most preferred methods were: case-based study, clinical placement, PBL, lectures, role-play, interactive learning, simulation and IPL. However, IPL is not preferred or not known by pharmacy students, as IPL is not an educational method in the pharmacy curriculum. E-learning/online courses scored zero, which is the same as the result of nursing students in Saudi Arabia. In addition,19 (100 per cent) nursing students responded to this question. The most preferred methods were: clinical placement, lectures and E-learning/online courses, observation and SDL, simulation, role-play and case-based study. Case-based study and role-play methods are part of the simulation method of teaching medication safety. IPL is not preferred or not known by nursing students, as IPL is not an educational method in the nursing curriculum.

Table 5. 15 Students' Responses on Methods Preferred

Method	Saudi Arabia		UK	
	Pharmacy Students	Nursing Students	Pharmacy Students	Nursing Students
Lectures	23	18	5	4
Simulation	11	80	4	2
Role-play	11	29	5	2
Case-based study	57	23	8	2
PBL*	27	1	6	0
Interactive (workshop)	5	20	5	0
E-learning/online courses	7	0	0	4
Observation	15	9	1	3
IPL**	3	4	3	1
Clinical placement	53	74	8	18
SDL***	27	6	1	3

*PBL= problem-based learning, **IPL= inter-professional learning, ***SDL=self-directed learning

'What Modules or Topics have Helped you to Understand Medication Safety?'

The following table 5.16, presents a sample of modules or topics which includes a medication safety component and helped students to understand medication safety

topics and include the number of responses per module or topic. More examples of the modules are shown in Appendix 26.

Eighty-four (38.7 per cent) pharmacy students in Saudi Arabia responded to this question. The students gave high scores mostly to pharmacology, medicinal chemistry, therapeutics, pharmaceutical care and pharmacy practice. Ninety-four (60.6 per cent) nursing students in Saudi Arabia responded to this question. The students gave high scores mostly to pharmacology, fundamentals of nursing, Adult 1 and 2 courses, medication administration and medication rights (5,6 and 10). In addition, 21 (100 per cent) pharmacy students in the UK responded to this question. The students gave high scores mostly to pharmacy practice, clinical pharmacology and therapeutics, pharmaceutical care, the role of the pharmacist in professional practice and therapeutics. Similarly, 16 (84.2 per cent) nursing students in the UK responded to this question. The students gave high scores mostly to medication management, safe medicate, pharmacology, then medication administration rights and calculation. Moreover, nursing students in Saudi Arabia and the UK, in addition to pharmacy student in Saudi Arabia, referred to some of the educational methods (i.e. lectures, clinical placement, case-based study, self-directed learning and E-learning/online courses) as methods or modules which helped them to understand medication safety. This might be a mistake or misunderstanding of the question which asked for topics or modules not methods used to deliver medication safety education.

Table 5. 16 Modules which Helped Students in Understanding Medication Safety

Group	Modules	Responses
Pharmacy students in Saudi Arabia	Pharmacology	26
	Medicinal chemistry	21
	Therapeutics	18
	Pharmaceutical care	10
	Pharmacy practice	9
Nursing students in Saudi Arabia	Pharmacology	47
	Fundamentals of nursing	24
	Adult 1and Adult 2	21
	Medication administration	14
	Medication rights (5,6 and 10)	14
Pharmacy students in the UK	Pharmacy practice	13
	Clinical pharmacology and therapeutics	7
	Pharmaceutical care	7
	The role of the pharmacist in professional practice	4
	Therapeutics	3
Nursing students in the UK	Medication management	6
	Safe Medicate	6
	Pharmacology	3
	Medication administration	1
	Calculation	1

The following questions are about knowledge, skills and attitudes and domains about which students were asked their opinion. The following definitions are provided to facilitate understanding of the knowledge, skills and attitudes domains:

- Knowledge is defined as facts, information, and skills acquired through experience or education; the theoretical or practical understanding of a subject, (Oxford dictionary).
- Skills are defined as the ability to do something well; expertise, (Oxford dictionary).
- Attitudes are defined as a settled way of thinking or feeling about something, (Oxford dictionary).

'What Knowledge do you believe a Qualified Pharmacist and Nurse will need to Practise Medication Safety?'

The following table 5.17, presents knowledge needed to practise medication safety and the number of responses per category. More examples of the knowledge needed are shown in the Appendix 27.

Ninety-three (42.9 per cent) pharmacy students in Saudi Arabia responded to this question. Pharmacology, therapeutics, medication errors and safety topics, drug-drug interaction and Medication system and policy were the most important areas of knowledge needed to practise safely as perceived by pharmacy students. Similarly, 84 (54.2 per cent) nursing students in Saudi Arabia responded to this question. Pharmacology, calculation, medication administration rights, medication errors and safety topics and therapeutics were the most important areas of knowledge needed. In addition, 20 (95.2 per cent) pharmacy students in the UK responded to this question. Pharmacology, medication errors and safety topics, therapeutics, medication preparation, administration and dispensing, drug information and resources were the most important areas of knowledge needed. Moreover, 17 (89.5 per cent) nursing students in the UK responded to this question. Pharmacology, medication administration technique, therapeutics, medication errors topics and reporting and drug information and resources were perceived by nursing students as being the most important areas of knowledge needed to practise safely.

Table 5. 17 Knowledge Needed as Perceived by Students

Group	Knowledge Needed	Response
Pharmacy students in Saudi Arabia	Pharmacology	55
	Therapeutics	31
	Medication errors and safety topics	21
	Drug-drug interaction*	14
	Medication system and policy	7
Nursing students in Saudi Arabia	Pharmacology	58
	Calculation	21
	Medication rights (5 rights = 14, 6 rights = 1, 10 rights = 6)	21
	Medication errors and safety topics (including double checking-and medicine disposal)	18
	Therapeutics	10
Pharmacy students in UK	Pharmacology	13
	Medication errors and safety topics	12
	Therapeutics	11
	Medication preparation, administration and dispensing	2
	Drug information and resources	2
Nursing students in the UK	Pharmacology	16
	Medication administration technique	5
	Therapeutics	4
	Medication errors topics and reporting	3
	Drug information and resources (BNF)	3

*Pharmacology related topics

'What Skills do you Believe a Qualified Pharmacist and Nurse will need to Practise Medication Safety?'

The following table 5.18, presents skills needed to practise medication safety and the number of responses per category. More examples of the skills needed are shown in the Appendix 28.

Eighty-one (37.3 per cent) pharmacy students in Saudi Arabia responded to this question. Communication skills, critical thinking, medication safety topics, medication preparation, administration and dispensing skills, clinical judgment and reasoning are perceived by pharmacy students as the most important skills needed to practise safely. Similarly, 81 (52.3 per cent) nursing students in Saudi Arabia responded to this question. Medication administration skills, communication skills, calculation skills, critical thinking, safety related issues are the most important skills needed. In addition, 20 (95.2 per cent) pharmacy students responded to this question. Medication errors and safety related issues (including double checking), medication preparation, administration and dispensing skills, communication skills, patient

education and counselling, drug information and resources, researching skills were the most important skills needed. Moreover, 16 (84.2 per cent) nursing students in the UK responded to this question. Medication administration skills, calculation skills, medication safety topics, and communication skills were seen as the most important skills needed. However, nursing students referred to confidence and other personal attitudes as skills, which may be a misunderstanding of the question which asked for skills needed to practise medication safely.

Table 5. 18 Skills Needed as Perceived by Students

Group	Skills Needed	Response
Pharmacy students in Saudi Arabia	Communication skills	36
	Critical thinking*	17
	Medication safety topics (including double checking)	12
	Medication preparation, administration and dispensing skills	10
	Clinical judgment and reasoning*	9
Nursing students in Saudi Arabia	Medication administration skills	37
	Communication skills	33
	Calculation skills	21
	Critical thinking*	10
	Safety related issues (including double checking)	6
Pharmacy students in UK	Medication errors and safety related issues (including double checking)	9
	Medication preparation, administration and dispensing skills	7
	Communication skills	6
	Patient education and counselling	4
	Drug information and resources and research skills	4
Nursing students in the UK	Medication administration skills	8
	Calculation skills	5
	Medication safety topics	4
	Communication skills	2

*Decision making skills

What Attitudes do you believe a Qualified Pharmacist and Nurse will need to Practice Medication Safety?'

The following table 5.19, presents attitudes needed to practise medication safety and the number of responses per category. More examples of the attitudes needed are shown in the Appendix 29.

Sixty-six (30.4 per cent) pharmacy students in Saudi Arabia responded to this question. Medication errors topics, then questioning attitude, professionalism, assertiveness, patient care and education were the most important attitudes needed to practice

safely as perceived by pharmacy students. Similarly, 63 (40.6 per cent) nursing students responded to this question. Reporting of medication errors, learning from errors and admitting errors, listening and tolerance towards patient, then calm and friendly, followed by questioning attitude and speaking up, and medication double checking were the most important attitudes needed. In addition, pharmacy and nursing students in the Saudi Arabia sample referred to decision making skills and critical thinking skills as attitudes, which might be a mistake or misunderstanding of the question which asked for attitudes needed to practise medication safely. Additionally, 20 (95.2 per cent) pharmacy students in the UK responded to this question. Patient-centred care and patient safety, calm, friendly and patient, up to learning, improving and up-to-date, and being positive, responsibility and accountability were the most important attitudes needed. Moreover, 15 (78.9per cent) nursing students in the UK responded to this question. Confident and competent, admitting errors and learning from errors, communication with patient, sitter and colleagues, and careful and cautious were perceived by nursing students as the most important attitudes needed to practise safely.

Table 5. 19 Attitudes Needed as Perceived by Students

Group	Attitudes Needed	Response
Pharmacy students in Saudi Arabia	Medication errors topics (including double checking)	8
	Questioning attitude	7
	Professionalism	7
	Assertiveness	7
	Patient care and education	7
Nursing students in Saudi Arabia	Reporting of medication errors, learning from errors and admitting errors	20
	Listening and tolerance towards patient	17
	Calm and friendly	12
	Questioning attitude and speaking up	10
	Double checking	8
Pharmacy students in UK	Patient-centred care and patient safety	9
	Calm, friendly and patient	4
	Up to learning and improving and up to date	3
	Positive	3
	Responsibility and accountability	2
Nursing students in the UK	Confident and competent	5
	Admit errors and learn from errors	3
	Communication with patient, sitter and colleagues	3
	Careful and cautious	2

Define Medication Safety in your Own Words?

The following table 5.20, provides some examples of various definitions of medication safety as perceived by pharmacy and nursing students and the number of responses per definition category/theme, in addition, example definitions will be presented for each definition category or theme. Full list of themes and definitions are shown in Appendix 30.

Providing a definition of medication safety was not meant to test students' knowledge about medication safety, but to understand how students conceptualised the concept 'medication safety'.

The results were showed with several definitions having related and harmonised concepts, whilst others were a combination of unrelated concepts. Themes emerged from categorising and coding of medication safety definition answers and a number of responses are presented in the following table. Very rich data/definitions were obtained which include a number of terms which define medication safety. Moreover, medication safety definitions written by students in the UK sample were characterised by being long, more complex and comprehensive than those obtained from respondents in Saudi Arabia.

Eighty-two (37.8 per cent) pharmacy students in Saudi Arabia sample who participated in this study answered this question. The most commonly defined medication safety terms are (1) safe use of medication, (2) prevention of harm, (3) prevention of errors, (4) side effects, (5) medication administration five rights and semi-five rights, (6) efficiency and (7) safety. However, a few students provided unclear or wrong definitions. Similarly, 96 (62 per cent) nursing students in Saudi Arabia who participated in this study answered this question. Nursing students' definition of medication safety concentrated mostly on medication administration rights (five, six and ten rights). It is interesting that nursing students had no agreement on the number of medication administration rights. The most commonly defined medication safety terms are (1) medication administration rights; five rights, six rights, ten rights

and semi five rights, (2) prevention of harm to patient (3) safe use, correct and effective (4) prevention of errors, (5) reducing errors (6) prevent side effects and contra-indication (7) no errors (8) and checking for allergy. In addition, 20 (95.2 per cent) pharmacy students who participated in study answered this question. The most commonly defined medication safety terms were (1) prevention of harm (2) semi-five rights (3) safe and effective use of medication (4) pharmacology terms such as side effects and interactions (5) therapeutics and clinical pharmacy practices (6) patient counselling (7) prevention of errors (8) reducing errors, (9) patient-centred care (10) patient adherence and compliance. Moreover, 18 (94.7 per cent) the nursing students who participated in this study answered this question. The most commonly defined medication safety terms were (1) safe use, correct and effective (2) pharmacology terms (3) the medication administration rights (semi-five rights, five and ten rights) (4) prevention of errors (5) patient education and counselling (6) allergy (7) therapeutics terms (8) patient-centred-care (9) medication errors and (10) medication use process.

Table 5. 20 Definition of Medication Safety by Students

Group	**Definition Category/Theme**	**Response**	**Example of** Definition
Pharmacy students in Saudi Arabia	Safe use	18	*"the **use of medication in safe** way"* *"Appropriate and **safe use** of medication in all steps to ensure positive patient outcome and decrease incidence of adverse effects"*
	Harm	15	*"using medication with less possible **harm**"* *"do no **harm** to the patient"*
	Prevention of errors	13	*"should **prevent** any unexpected errors"*
	Side effects	12	*"Minimise the **side effect**"* *"best use of medication with lower **side effects**"*
	Five Rights of medication administration (right patient, medication, dose, route and time)	8	*"doing the Five **Rights**; right dose, time, patient, medication and route"*
Nursing students in Saudi Arabia	Five Rights of medication administration (*right patient, medication, dose, route and time*)	38	*"protecting patient from medication errors by applying **five-Rights**"* *"give the right medication to right patient in right route, dose and time"* *"administer medication safely using **Five-Rights**"*
	Harm	16	*"administer medication safely to patient without causing **harm**" ….. "do*

Group	Definition Category/Theme	Response	Example of Definition
			*no **harm** to patient"*
	Ten-Rights (Six-*Rights + history and assessment, drug approach and right to refuse, drug-drug interaction and evaluation, education and information*)	11	*"administer the medication without making errors following the **Ten-Rights**"*
	Six-Rights (*Five-Rights + documentation*)	9	*"follow the **Six-Rights** when giving medication"*
	Safe use, correct and effective	9	*"it is how to use medication **correctly** and **effectively** in right and **safe way** without side effect"*
Pharmacy students in the UK	Harm	12	*"Minimising **harm** to the patient".* *"The use and dispensing of medicines **without harm** coming to the patient or others".* *"Ensuring that **no harm** is done to patients due to incorrect medications being administered or dispensed, and minimising any damage and errors that may have occurred"*
	Semi-Five Rights (mentioning some parts of the definition)	7	*"Medication safety is ensuring that medicines get to the right patient, with the right medicine, at the right dose, at the right time".* *"The safe and effective practice of making sure the medicines prescribed for a patient are the right drug, dose, at the right time".*
	Safe use, effective	7	*"The **safe** and **effective** practice of making sure the medicines prescribed for a patient are the right drug, dose, at the right time".* *"Ensuring the **safe use** of medicines"*
	Pharmacology terms (side effects and interactions)	5	*"use and monitor for **side effects** for medications correctly causing the least amount of harm".*
	Therapeutics and clinical pharmacy practices	3	*"medicines are effectively **monitored**"*
Nursing students in the UK	Safe use, correct and effective	11	*"Medication safety is the notion of being able to **safely**, **correctly** and **effectively**"* *"Prescribe/administer medication for a patient ensuring all medication given is **correct** and **safe** at all times"* *"Assuring medication is given to patients in a **safe**, **accurate** and **effective** way".*
	Pharmacology terms	4	*"Medication safety is being aware of*

Group	Definition Category/Theme	Response	Example of Definition
			correct doses, interactions, side effects *and purpose of drugs".* *"It is a combination of* ***pharmacology knowledge*** *combined with skills gained via practising with a suitable mentor".*
	Semi-Five Rights (mentioning some parts of the definition)	3	*"Looks at giving the right drug, in the right form and dose, to the right patient at the right time"*
	Prevention of errors	3	*"To* ***prevent*** *drug errors".*
	Patient education and counselling	3	*"Patients have* ***knowledge of the medication*** *they are being given".* *"give* ***patient advice*** *about medications"*

5.4.7 Frequencies Questions

In the following pages, the findings of frequencies questions will be presented.

'Who teaches Medication Safety at the College?'

Table 5.21 presents who teaches medication safety to pharmacy and nursing students as perceived by students in Saudi Arabia and the UK. Pharmacy students in Saudi Arabia were mostly taught by internal teaching staff, then by practising pharmacists, then by teaching staff from other colleges such as a college of medicine. Finally, some respondents were unsure who taught pharmacy students. Nursing students were mostly taught by internal teaching staff, then by teaching staff from other colleges like colleges of medicine and pharmacy, and then by nurses who practise in a clinical setting. Finally, some respondents stated that they were unsure who taught them. While, pharmacy students in the UK are taught by practising pharmacists who practise in a clinical setting, followed by those respondents who stated that they were taught by internal teaching staff, a few students responded that they were taught by teaching staff from other colleges such as a college of medicine. In addition, it is shown that nursing students are mostly taught by internal teaching staff, then taught by practising nurses who practise in clinical setting, and one respondent stated that they were unsure.

Table 5. 21 Responses of Pharmacy and Nursing Students Regarding who Teaches Medication Safety at the College.

Options	Saudi Arabia		UK	
	Pharmacy students	Nursing students	Pharmacy students	Nursing students
Internal teaching staff	129 (60.8%)	113 (72.9%)	18 (85.7%)	16 (84.2%)
A practicing pharmacist or nurse	71 (33.5%)	46 (29.7%)	21 (100%)	5 (26.3%)
Teaching staff from other colleges	29 (13.7%)	69 (44.5%)	5 (23.8%)	0*(0.0%)
Unsure	25 (11.8%)	12 (7.7%)	0*(0.0%)	1 (5.3%)

0*=option not ticked

'In which Setting do Students Learn the Most about Medication Safety?'

In Table 5.22, results are presented for settings in which pharmacy and nursing students learn most about medication safety as perceived by students in the Saudi Arabia and the UK samples. As shown, pharmacy students in Saudi Arabia mostly selected classroom/lecture theatre, then clinical placement, followed by skills/simulation lab and finally a few respondents stated that they learned about medication safety in another setting. Moreover, nursing students in Saudi Arabia mostly selected clinical placement as the setting in which they received their medication safety training, then skills/simulation lab, followed by classroom/lecture theatre. One respondent stated that they received medication safety training in another setting. In addition, pharmacy students in the UK selected and gave the classroom/lecture theatre and clinical placement settings the same score, followed by skills/simulation lab setting, while nursing students in the UK mostly selected a clinical placement setting as the environment in which they learned most about medication safety, then classroom/lecture theatre, then 'other setting' and finally skills/simulation lab.

Table 5. 22 Responses of Pharmacy and Nursing Students regarding Setting which Students Learn the Most about Medication Safety

Options	Saudi Arabia		UK	
	Pharmacy students	Nursing students	Pharmacy students	Nursing students
Classroom/lecture theatre	147 (69.3%)	86 (55.5%)	16 (76.2%)	7 (36.8%)
Skills lab/simulation lab	59 (27.8%)	90 (58.1%)	10 (47.6%)	2 (10.5%)
During clinical	69 (32.5%)	104 (67.1%)	16 (76.2%)	17 (89.5%)

placement				
Other	7 (3.3%)	1 (0.6%)	0*(0.0%)	3 (15.8%)

0*=option not ticked

'Does the Current Medication Safety Education Support Students Understanding?'

In Table 5.23, results are presented for how current medication safety education supports pharmacy and nursing students' understanding of medication safety related topics as perceived by students in the Saudi Arabia and the UK samples. As shown, pharmacy students in Saudi Arabia mostly selected the causes of medication safety errors' topic, then types of medication errors, followed by definition of medication errors, then strategies to reduce medication errors, how to manage after medication errors happen and finally a few respondents were unsure. In addition, nursing students in Saudi Arabia mostly selected the causes of medication safety errors topic as supporting their understanding, then types of medication error, strategies to reduce medication errors, definition of medication errors, then how to manage after medication errors happen. A few respondents were unsure how medication safety training supported their learning. Moreover, all pharmacy students in the UK agreed and gave causes of and types of medication errors the same scores, followed by definition of medication errors and strategies to reduce medication errors, with the 'how to manage after medication errors happen' topic seen as supporting their understanding least. Similarly, nursing students in the UK mostly selected the causes of medication safety errors topic as supporting their understanding most, followed by strategies to reduce medication errors, then definitions and types of medication errors and how to manage after medication errors happen. One respondent answered that they were unsure.

Table 5. 23 Responses of Pharmacy and Nursing Students regarding Current Medication Safety Education supporting Students' Understanding

Options	Saudi Arabia		UK	
	Pharmacy students	Nursing students	Pharmacy students	Nursing students
Definition of medication errors	115 (54.2%)	79 (51.0%)	20 (95.2%)	14(73.7%)
Causes of medication errors	137 (64.6%)	117 (75.5%)	21 (100%)	18(94.7%)
Types of medication errors	121 (57.1%)	99 (63.9%)	21 (100%)	14(73.7%)

Options	Saudi Arabia		UK	
	Pharmacy students	Nursing students	Pharmacy students	Nursing students
Strategies to reduce medication errors	90 (42.5%)	90 (58.1%)	20 (95.2%)	16(84.2%)
Managing situation after medication error happens	62 (29.2%)	47 (30.3%)	16 (76.2%)	7 (36.8%)
Unsure	14 (6.6%)	6 (3.9%)	0* (0.0%)	1 (5.3%)

0*=option not ticked

'In What Mode should Medication Safety be Integrated?'

In Table 5.24, results are presented for the mode or type of integration for medication safety courses that should be considered as perceived by pharmacy and nursing students in Saudi Arabia and the UK. As shown, pharmacy students in Saudi Arabia mostly selected both types of integration (which means that medication safety should be taught to students as a combination of stand-alone course and incorporated in existing courses such as pharmacology course), the score of both types, some respondents felt that medication safety should be integrated as part of an existing course, and a few respondents felt that the topic should be taught as a stand-alone course. Similarly, nursing students in Saudi Arabia selected options in a similar order to pharmacy students. Nursing students mostly selected both types of integration, then integrated as part of existing course, while a few respondents felt that medication safety should be taught as a stand-alone course. Moreover, pharmacy students in the UK mostly felt that this topic should be integrated as part of an existing course, then a lower score was given to the 'both' type of integration (meaning that respondents felt medication safety should be taught to students as a combination of stand-alone course and included in existing courses such as pharmacology). Few respondents felt that medication safety should be taught as a stand-alone course. In addition, nursing students in the UK mostly selected 'both' as their preferred type of integration and then integrated as part of an existing course. The lowest score was given for teaching medication safety as a stand-alone course.

Table 5. 24 Responses of Pharmacy and Nursing Students regarding the Mode of Integration of Medication Safety Education

	Saudi Arabia		UK	
	Pharmacy students	Nursing students	Pharmacy students	Nursing students
A stand-alone course	29 (13.7%)	15 (9.7%)	3 (14.3%)	2 (10.5%)
Part of existing courses	58 (27.4%)	61 (39.4%)	14 (66.7%)	5 (26.3%)
Both	103 (48.6%)	76 (49.0%)	4 (19.0%)	12 (63.2%)

'Is the Time Allocated for Medication Safety Sufficient?'

In Table 5.25, results are presented relating to time allocated for medication safety education as perceived by pharmacy and nursing students in Saudi Arabia and the UK. Pharmacy students in Saudi Arabia mostly selected 'just about right' option, then 'unsure', 'too little and a low score was given to the option 'too much'. In addition, nursing students in Saudi Arabia gave a high score to both options 'too little' and 'unsure', then selected 'just about right', and a low score was given to 'too much'. Moreover, pharmacy students in the UK mostly selected the 'just about right' option, then 'too little', then a lower score was given to the 'unsure' option. In addition, nursing students in the UK mostly selected the 'too little' option, then 'just about right' option, and a low score was given to the 'unsure' option. However, no selection was provided for 'too much' option in both professions.

Table 5. 25 Responses of Pharmacy and Nursing Students regarding Time Allocated for Medication Safety Education

Time allocated	Saudi Arabia		UK	
	Pharmacy students	Nursing students	Pharmacy students	Nursing students
Too much	16 (8.3%)	13 (7.6%)	0*(0.0%)	0*(0.0%)
Too little	50 (25.9%)	58 (33.9%)	7 (33.3%)	11 (57.9%)
Just about right	71 (36.8%)	42 (24.6%)	13 (61.9%)	5 (26.3%)
Unsure	56 (29.0%)	58 (33.9%)	1 (4.8%)	2 (10.5%)

0*=option not ticked

5.5 Discussion

It is believed that this is one of few studies to examine a number of aspects of medication safety education such as how explicitly it is taught, how it is taught as UPL or IPL and the educational methods used to deliver medication safety education, who teaches it, what modules or topics helped students in understanding medication safety and which settings allow students to learn most about medication safety. This study also examined how the current methods of medication safety education support students' understanding of it and how medication safety courses should be delivered. Factors such as the knowledge, skills, and attitudes needed for pharmacists and nurses to practise medication safely are presented from students' perceptions. This study also looks at the perceived adequacy of time allocated for medication safety education and how medication safety is conceptualised and defined by students. Discussion of this chapter is divided into three sections: the three main research questions, the six open-ended questions which form the qualitative part of the questionnaire study, and then the five remaining questions which were analysed using a frequency test.

5.5.1 The three Main Research Questions

Research Question 1: 'How is Medication Safety Education Delivered in the UK and Saudi Arabia?'

The result of this question reveals that medication safety is clearly and explicitly labelled to students across the UK and Saudi Arabia samples. This finding supports Alkatheri (2017), who noted that medication safety was clearly and explicitly labeled to pharmacy students. In contrast, it disagrees with Attree (2008) and Kirwan (2019), who reported that patient safety was not explicitly addressed in the nursing curriculum, (see Chapter 3). This change might be due to the improvement in medication and patient safety teaching throughout the years.

This study also found whether medication safety is taught using UPL or IPL methods. The results revealed that there was a similarity between the UK and Saudi Arabia samples, in that medication safety is taught using a UPL method ensuring that the

same group of students learns together in both pharmacy and nursing professions. This finding supports, what was found in the interview study of this thesis, that UPL is mostly used method in pharmacy and nursing programmes. In addition, it was found that the IPL method is used in some UK universities. However, it is not used in the Saudi Arabia universities which were examined. As a result, the IPL method score was significantly different between the UK and Saudi Arabia.

In relation to the question of the most used educational methods in delivering medication safety education to students, the scores revealed that the use of lectures, clinical placement and case-based study methods were very common across the UK and Saudi Arabia samples, and these methods were considered frequently used methods in both countries. In addition, the SDL method was considered as a frequently used method in the UK. However, frequency of use of other methods varied across both the UK and Saudi Arabia samples. The values of Pearson Chi-Square for problem-based learning, E-learning/online courses, IPL, clinical placement and self-directed learning methods were significant which indicates that there is a difference in use of the mentioned methods.

The result revealed the differences in perception of students regarding methods used to deliver medication safety education and educational practices between the UK and Saudi Arabia.

Research Question 2: 'What are the Most Effective Methods of Teaching According to Students? Do Responses Vary by Country, Profession and Year of Study?'

The findings suggested that there is variation in rating of effectiveness of methods between the two countries. In the UK, the three most effective methods as perceived/rated by pharmacy and nursing students were the Interactive learning method, followed by clinical placement and then problem-based learning. The lowest-rated methods of learning were E-learning, self-directed learning, simulation and IPL.

In Saudi Arabia, the three most effective methods of learning as perceived/rated by pharmacy and nursing students were clinical placement, simulation and role-play. The methods perceived as least effective were observation and IPL.

in view of the above, clinical placement and case-based study were given a higher score in both countries, and a lower score was given to IPL in both countries. IPL is a neglected method, but it should be implemented and given more attention as it is one of the educational strategies recommended to improve communication between different healthcare professions and understanding of different roles leading to improvement in practice and reduction of medication errors. In addition, there is differentiation in educational methods used to teach medication safety and a large difference in students' perception of the effectiveness of methods which agrees with the literature reviewed and the interview studies.

In the UK sample, there was no significant difference in perceived effectiveness of methods between pharmacy and nursing students' groups, which may have been due to the small sample size.

There was a diversity in rating of effectiveness of methods between the two professions. Case-based study, problem-based learning and clinical placement were given a higher score by both professions in the UK sample, and lower scores were given to IPL by both professions. Simulation was perceived as one of the least effective methods in the pharmacy sample, but was seen as one of the most effective learning methods by nursing students.

In the Saudi Arabia sample, there was a significant difference in rating of the effectiveness of lectures, simulation, role-play, observation, IPL, clinical placement and self-directed learning methods between the pharmacy and nursing student groups indicating diversity in rating of effectiveness of methods between the two professions. Clinical placement was rated highly as a teaching method by both professions, whereas IPL is not favoured by pharmacy students but is rated more highly by nursing students. In both countries, nursing students were exposed to the

simulation method earlier and more frequently throughout their programme. These findings disagree with the interview study findings which indicated that teaching staff and students in both professions and countries preferred to have more simulation, IPL and clinical placement methods when learning about medication safety. This might be due to the nature of the two studies (qualitative and quantitative), as in the interview study the participants explored their perceptions freely, while in the questionnaire study there were specific questions and options that the participants should answer and select from. In addition, their rating of effectiveness of the methods depended on whether they were taught using these methods or not.

The perceived effectiveness of the 11 educational methods was investigated across years of the study for each profession in both countries, and the findings were as follows:

In the Saudi Arabia pharmacy students' sample, there was a mean difference in the perceived effectiveness of self-directed learning as rated by students shown between early years and later years and between middle years and later years. In addition, in early and middle years the effectiveness of methods, as perceived by pharmacy students, is similar due to high level of motivation of pharmacy students in early and middle years and their high assumptions regarding the effectiveness of methods. In the later years of study, pharmacy students' interest and confidence in methods decreased as they were exposed to clinical placement training, real life situations, and were more knowledgeable about medication and patient safety issues, which may explain why they gave a high rating to role-play and clinical placement methods.

In the Saudi Arabia nursing students' sample, there was a mean difference between years of study shown between third and fourth years for the simulation method, between third, fourth and fifth years for the observation method and between third and years for self-directed learning. In addition, in the third, fourth and fifth year of study the effectiveness of methods perceived by nursing students varied, this might be due to the change of interest of nursing students throughout the nursing programme. However, nursing students in these three years could have high

expectations regarding effectiveness of methods, which might explain their similar ratings.

The methods rated most highly by the three years were simulation, clinical placement, role-play and IPL. In addition, self-directed learning was rated highly by fourth and fifth year students. Nursing students are exposed to simulation, clinical placement and role-play methods earlier in their training, which may explain why they rate these methods as highly effective. This finding supports the finding in the interview study that nursing students were exposed earlier to clinical experience and simulation methods, (interview study – chapter 4).

In the UK sample, pharmacy and nursing students perceived the three most highly effective methods per year of study as being clinical placement, case-based study and lectures. The least effective method was felt to be IPL. There was a significant difference between years of study in rating of effectiveness of lectures as students become more aware and knowledgeable about medication safety throughout the training programme which may explain the difference in rating of methods across years of study. Year One students are not yet exposed to all methods and in most cases, they have only been exposed to lectures which could explain why there is a low or no rating of effectiveness in year One. Year Two students are exposed to different educational methods and in pharmacy and nursing schools they experience more exposure to interactive methods, including clinical placement in a hospital from year two, especially in nursing programmed. This explains why year 2 students give a higher effectiveness rating for teaching methods and show more satisfaction with them. Year Three and Four students provided a lower effectiveness rating for methods used as their exposure to clinical training increases and they gained more knowledge about medication safety and other related topics. They may have had more concerns and questions about what they observe in the hospital (clinical reality).

Research Question 3: 'Do Perceptions of the Adequacy of Patient Safety Education Vary across Classroom and Clinical Settings? Do these Perceptions vary According to Country, Year of Study and Profession?'

This research question focused on understanding the extent to which pharmacy and nursing students feel confident in learning about patient safety in classroom and clinical settings. The results provided insights into students' confidence in learning about patient safety domains across year of study and between classroom and clinical settings. As mentioned in the introduction, several studies used the H-PEPSS tool (Ginsburg et al. 2012, Duhn et al. 2012, Bressan et al. 2016, Lukewish et al. 2015, Stevanin et al. 2015, Weatherford et al. 2015, Hwang et al., 2016 and Suliman, 2019).

Confidence in Learning in Classroom and Clinical Setting by Year of Study among Pharmacy Students

A significant difference was found for patient safety domains; working in teams in the classroom and managing safety risks in the clinical setting for the years of study. In addition, there was a significant difference for the patient safety domains addressing broader patient safety issues and feeling comfortable specking up for the years of study. This indicates that there was a variation in perception of adequacy of patient safety education across years of study. Pharmacy students' confidence, in learning about working in teams in a classroom setting, changed across early and middle years as students in the middle years were exposed to clinical training in a hospital which enabled them to link theory learned in the classroom to practice seen or observed in the clinical setting and as a result, confidence changed. Moreover, pharmacy students' confidence, about learning how to manage safety risks in a clinical setting, changed across early, middle and later years with increased maturity, knowledge and exposure to real situations. In addition, confidence when learning about addressing broader patient safety issues and feeling comfortable speaking up in a clinical setting changed across early and middle years as students' knowledge and experience increased. The findings of this study support Duhn's (2012) and Stevanin's (2015) findings which indicated that confidence in learning about patient safety domains changed across the years of study for pharmacy and nursing students. Similarly, Duhn et al. (2012) and Ginsburg et al. (2013) reported that upper-year students progressed in their learning.

Moreover, Lukewich (2015) reported the confidence of nursing students when learning about 'working in teams' in clinical setting, while confidence declined in later years in 'managing adverse events' and 'responding to adverse events' domains. It was found, that the majority of students did not feel comfortable speaking up about patient safety issues, as noted in this study.

Confidence in Learning in Classroom and Clinical Setting by Year of Study among Nursing Students

A significant difference was found for patient safety domains in a classroom setting. In addition, there was a significant difference for patient safety domains in a clinical setting. Moreover, there was a significant difference for the patient safety domain addressing broader patient safety issues in a clinical setting for the years of study. This indicates that there was a variation in perception of adequacy of patient safety across years of study. This finding supports that of Duhn (2012) and the perception reported by teaching staff in Chapter 4.

In addition, confidence in learning about patient safety domains in both classroom and clinical settings changed across third, fourth and fifth years of the nursing programme as students' knowledge and experience of students increased.

These results suggested that it is necessary to examine the consistency of patient safety teaching across year of study to bridge the gap. Duhn (2012) noted the importance of consistently engaging students in safety principles early in and throughout their healthcare programmes.

Confidence in earning about Patient Safety Domains in the Classroom and Clinical Setting per Year of Study by Pharmacy and Nursing students in the UK

No significant difference was found across years of study in the UK sample of pharmacy students. However, a significant difference across years of study was found in the nursing students' sample for the clinical safety domain in a clinical setting. This finding supports the findings of Duhn (2012) regarding nursing students scoring high in the clinical safety domain, which was mentioned in the introduction of this chapter.

Confidence in Learning about Patient Safety Domains between Classroom and Clinical Setting

A significant decrease was noted in the means of confidence relating to learning about human and environmental factors between classroom and clinical settings for pharmacy students in Saudi Arabia There was also a significant decrease in the means of confidence relating to learning about the human and environmental factors and disclosing adverse events domains between classroom and clinical settings for nursing students in Saudi Arabia. A similar decrease was also seen in means of confidence relating to the working in teams and, human and environmental factors domains from classroom to clinical setting for pharmacy and nursing students in the UK. These findings disagree with Colet (2015) which reported higher patient safety competence in both classroom and clinical settings in the following domains; 'working in teams' , 'communicating effectively', 'managing safety risks' and 'understanding human and environmental factors'

A general expectation that knowledge may be transferred from classroom to clinical setting does not allow for the fact that confidence in learning about patient safety domains may decline with exposure to real life situations in a clinical setting especially in the later years of study. This finding supports that of Duhn (2012) which noted that fourth year nursing students reported reduced confidence in their knowledge about patient safety domains compared to the earlier years of study. Moreover, Liane Ginsburg (2013) reported increased confidence when learning about patient safety domains in the clinical setting more than the class room.

5.5.2 Open-Ended Questions

'Best Methods for Teaching Medication Safety'

In Saudi Arabia, pharmacy and nursing students preferred case-based study and clinical placement, and simulation including role-play was most preferred by nursing students. Pharmacy and nursing students in Saudi Arabia all perceived IPL as the least preferred method. This can be explained as students were not exposed to IPL throughout their training. IPL was not an educational method used in pharmacy and

nursing curricula. Similarly, In the UK pharmacy and nursing students' preferred clinical placement and lectures, and case-based study, role-play and interactive learning were preferred by pharmacy students, while E-learning/online courses were preferred by nursing students. Pharmacy and nursing students in the UK similarly reported on perceiving simulation as the least preferred method. This can be explained for pharmacy students as they are exposed to fewer or no simulation sessions regarding medication safety. However, nursing students are exposed to clinical placement and real-life practice earlier in their nursing training which might explain why clinical placement was less attractive to them. IPL is not preferred or not known by pharmacy and nursing students in the UK, as IPL is not an educational method used in pharmacy and nursing curricula. Similarly, nursing students in the UK and Saudi Arabia agreed that self-directed learning (SDL) method was the least preferred method as the culture of self-directedness was not instilled in the nursing curriculum.

These results broadly agreed with those of the interview study as there was diversity in preference for different methods. Most of the students indicated that the least preferred methods were IPL and simulation. This result disagreed with the finding in the interview study (Chapter 4), which reported the preference of teaching staff and students to IPL and simulation methods.

'**Modules or Topics have helped you to Understand Medication Safety'**

Pharmacy and nursing students in the UK and Saudi Arabia perception of topics helped them to understand medication safety were diverse due to the difference in content between pharmacy and nursing programmes. In contrast, pharmacy and nursing students reported similarly some topics such as pharmacology and therapeutic, which were seen as topics that helped them to understand medication safety. These results indicated that—strengthening and improving the content of medication safety component by including it in the topics students felt most helped them to understand medication safety. These results supported those of the interview study.

‘**Knowledge, Skills and Attitudes Needed to Practise Medication Safety’**

Pharmacy and nursing students in Saudi Arabia and the UK perceived a range of knowledge, skills and attitudes as essential (see the result section of this chapter). These results agreed with the interview study (Chapter 4) findings. These results indicated that the knowledge, skills and attitudes domains perceived by students as essential should be reviewed, strengthened and stressed as they played a role in helping students to practise medication safety once qualified.

‘Definition of Medication Safety’

Definitions presented by pharmacy and nursing students focused mainly on the definition given by the National Coordination Council (2015) which was discussed in Chapter 1. Numerous categories, themes, and definitions emerged when respondents were asked to define medication safety in their own words. This finding indicated that understanding of the term ‘medication safety’ was very diverse, and was conceptualised differently from student to student. This finding agreed with what was observed from the interview study (Chapter 4). This result suggested that medical education departments and relevant bodies in healthcare professional education should look at the definition of medication safety and use a reliable source to define what is meant by medication safety, such as the WHO Curriculum Guide, National Coordination Council or other sources. In addition, from evidence obtained, it is apparent that medication safety definitions and terms should be unified and standardised. Yu et al (2005) mentioned that “*there is an urgent need for a universal language that allows health professionals to understand and communicate all aspects of medication safety. This language needs to be operationalised, combing a standardised set of carefully worded, succinct, clearly qualified, and easy to comprehend definitions.*”

Some students directly connected the term ‘medication safety’ with medication errors (e.g. from the pharmacy definitions’’medication safety is about reducing medication errors’’).

5.5.3 Frequency Questions

In this section the remaining questions, which were analysed, using frequency test will be discussed.

'Who teaches Medication Safety at the College?'

It is important to understand who teaches medication safety to pharmacy and nursing students and to explore whether there is a relation between who teaches it and the quality of teaching, as well as understanding if the current teaching staff are qualified enough to teach the subject or whether they need further training to improve their teaching skills in the area.

It was found that pharmacy and nursing students in the Saudi Arabia sample were taught mostly by internal teaching staff and staff practising in a clinical setting. This finding supported those of Alkatheri (2017) who noted that pharmacy students were taught by pharmacy practice educators who have substantial higher knowledge about medication safety compared with their non-practicing counterparts. Furthermore, nursing students, interviewed in this thesis, recommended to be trained by practising nurses (interview study - Chapter 4). In addition, nursing students were taught by teaching staff from other colleges like medicine and pharmacy for pharmacology and medication safety related topics. Pharmacy students in the UK sample were taught solely by staff practising in a clinical setting, then by internal teaching staff and least frequently by teaching staff from other colleges such as colleges of medicine. Similarly, nursing students in the UK were taught by internal teaching staff and then practising nurses in a clinical setting. Moreover, no responses were selected by nursing students to indicate that they were taught by external staff. These results cannot be generalised as the UK sample was small. These findings indicated that educators with clinical practice were preferred to teach medication safety as they were thought to have more experience and knowledge about medication safety.

'In Which Setting do Students Learn the Most about Medication Safety?'

It is important to understand in which setting students learned the most about medication safety; the classroom, skills/simulation lab or in a clinical setting. This

information is important in order to explore the options of improving medication safety education and redesigning of the medication safety topic.

It was found that pharmacy students in the Saudi Arabia sample felt that they learned most about medication safety in the classroom/lecture theatre compared with clinical placement and skills/simulation lab settings**.** This result may be explained as pharmacy students had no or little exposure to a skills/simulation lab, especially for medication safety related topics. Pharmacy students also generally had no exposure to clinical placement in the early years of the pharmacy programme. In contrast, nursing students perceived that they learned most about medication safety in a clinical placement setting as they had early exposure in their nursing programme. Learning in skills/simulation lab and classroom settings were given relatively close scores, as nursing students used a skills/simulation lab more frequently throughout the nursing programme.

Pharmacy students in the UK sample, indicated that they felt they learned more about medication safety in classroom/lecture theatre and clinical placement settings rather than in a skills/simulation lab This result may be explained by the fact that pharmacy students had less exposure to a skills/simulation lab especially for medication safety related topics. Moreover, pharmacy students generally have no exposure to clinical placement in the early years of the pharmacy programme. In addition, nursing students felt that they learned most about medication safety in a clinical placement setting as they have early exposure to this environment in their nursing programme, while a lower score was given to the classroom/lecture theatre setting. Moreover, learning in a skills/simulation lab setting was also given a low score. This result was interesting and somewhat contradictory as nursing students used a skills/simulation lab frequently during their training. As the UK sample was small, it is not possible to generalise these results. These findings supported Tella (2015), who reported that British nursing students provided a positive view about patient safety learning in the classroom compared with Finnish nursing students who provided a different view. In addition, British and Finnish students' views varied when measured for learning in clinical setting, as Finnish nursing students highlighted the weakness of learning about

patient safety in the clinical setting. These variations reported in this thesis and the literature, might be due to the different education, training and methods of medication safety provided in each setting in pharmacy and nursing programmes.

'Does Current Medication Safety Education Support Students' Understanding?'

It is important to explore the extent to which current medication safety education supported students' understanding of medication safety topics such as medication error definitions, causes, types, strategies to reduce medication errors and how to manage the situation when a medication error occurs. Understanding will help identify whether current medication safety education is adequate to cover all important aspects of medication safety.

It was found that pharmacy students in the Saudi Arabia sample, felt that current medication safety education supported them in understanding causes and types of medication errors, followed by definitions and strategies to reduce medication errors, with the lowest score given to how to manage after a medication error occurs. In addition, nursing students broadly reported similar results to pharmacy students, as follows; causes and types of medication error, followed by strategies to reduce medication errors, then definitions. The lowest score was given to how to manage after a medication error occurs.

Pharmacy students in the UK sample, indicated causes and types of medication errors, definitions of medication errors and strategies to reduce medication errors, with the lowest score being given to how to manage after a medication error occurs. Moreover, nursing students ranked causes of, strategies to reduce medication errors, definitions and types of medication errors topics equally, with the lowest score being given to how to manage after a medication error occurs.

It is interesting to note, that how to manage after a medication error occurs scored lowest in both professions, which is something that needs to be considered and included in the medication safety component/curriculum. These findings were

consistent with Chapter 4 (interview study) and only reported by this study as best to our knowledge.

'**In what Mode should Medication Safety be delivered?'**

It is very important to explore the perception of pharmacy and nursing students regarding which mode of integration is most appropriate to the teaching of medication safety so that it can be delivered in a way which is preferred by students and which they perceive to be most beneficial. For example, would students prefer it to be delivered as a stand-alone course or as part of existing courses as is the current situation or a combination of the two modes.

It was found that, pharmacy and nursing students in the Saudi Arabia sample revealed a preference for both types of integration of medication safety education, then infusion of, followed by inclusion of a medication safety component in existing courses, with the least preferred method being integration as a stand-alone course.

Most pharmacy students in the UK sample, expressed a preference for the inclusion of a medication safety component in existing courses**,** then both types of integration of medication safety, with the least preferred method being the integration of stand-alone course. Nursing students revealed a preference mostly for both types of integration of medication safety education, then inclusion of a medication safety component in existing courses, with least preference given to the integration of a stand-alone course. These findings among pharmacy and nursing students, are consistent with findings in Chapter 4 (students interview study) and with Alkatheri (2017), who reported that most pharmacy educators indicated that medication safety topics should be integrated within existing pharmacy courses such as pharmacy practice, with few educators selecting teaching these topics in separate courses (stand-alone).

'Is the Time Allocated for Medication Safety Education Enough?'

It is important to investigate if the time allocated for medication safety teaching is adequate or whether it needs to be changed to satisfy the needs of students. It was found that pharmacy students in Saudi Arabia mostly selected the 'just about right'

option. However, nursing students gave a low score to 'just about right' option. In contrast, pharmacy and nursing students in Saudi Arabia gave a high score to 'too little' and 'unsure' options. In addition, pharmacy students in the UK sample mostly selected the 'just about right' option, then 'too little' option, and a low score was given to the other options, while nursing students mostly selected the 'too little' option, and a low score was given to the 'just about right' option. These findings disagreed slightly with the findings noted by teaching staff interviewed in this thesis as they reported that more time is needed to be allocated for teaching of medication safety (students' interview study –Chapter 4). This result indicated that the time allocated to teach medication safety was not felt to be adequate and should be increased. Lee et al. (2020) agreed, as he mentioned that patient safety education is limited in hours of training and scope of content.

5.5.4 Strengths and Limitations

This study has various strengths, such as the fact that it is one of a few studies that looked at a number of aspects relating to medication safety education. The medication safety education section of this questionnaire (H-PEPSS) was carefully developed and was based on the earlier studies presented in this thesis (systematic narrative review and interview studies), to ensure internal and content validity. This study is one of few studies which has used a validated instrument - the Canadian tool Health Professional Education for Patient Safety Survey (H-PEPSS, Ginsburg, 2012; Duhn et al., 2012; Bressan et al., 2016; Lukewish et al., 2015; Stevanin et al., 2015; Weatherford et al., 2015; Hwang et al., 2016, Suliman, 2019). Moreover, it could be the first study using H-PEPSS for pharmacy undergraduate students after Ginsburg, 2012. In addition, there was a good sample size in Saudi Arabia.

The small sample size in the UK was a challenge and whether findings for UK sample can be generalised to the UK nursing and pharmacy student population. The nursing students' sample in Saudi Arabia lacked responses from years one and two(as they were not exposed to clinical training). The difference in degree (duration of studies) varies between nursing and pharmacy degrees in the UK and Saudi Arabia as professions and between the UK and Saudi Arabia as countries. This fact makes it

difficult to use the same statistical analysis tests. The transferability of the results for the UK sample need to be checked and evaluated as the UK sample was small and few pharmacy and nursing schools participated in the study. The transferability and generalisability of the results for the Saudi Arabia sample need to be carefully considered as two nursing schools and five pharmacy schools participated regardless of the reasonable sample size. This may lead to sampling bias where the sample size may not reflect the population. The fact that English is a second language in Saudi Arabia could affect pharmacy and nursing students' understanding of medication and patient safety questions and this might have affected the quality of answers.

5.5.5 Implication

Findings indicated that educators and decision makers in medical education arena were needed to review medication and patient safety curricula and develop strategies to improve and strengthen them. Moreover, there was a need to review methods used to teach medication and patient safety. In addition, there was a need to consider more IPL method earlier and throughout pharmacy and nursing programmes. There is was a need to integrate more explicit medication safety curriculum, with a prerequisite to integrate both types which were a medication safety stand-alone course and to strengthen medication safety component in existing courses provided to students.

Findings of the open-ended questions and frequency questions need to be considered when designing and updating medication and patient safety curriculum in relation to teaching.

This questionnaire can be used and distributed on a greater scale to explore more views of pharmacy, nursing and students from other healthcare professions. In addition, it can be used for pre-test and post-test educational intervention (such as one- day inter-professional simulation workshops with pre-course online materials) to assess students' knowledge, perceptions - pre and post the intervention. Finally, more research is needed to cover more aspects of medication safety topic as it still needs

more exploration and understanding such as why students have reported these perceptions in this study.

5.5.6 Summary

There was a difference in perception of undergraduate pharmacy and nursing students on current medication safety education. Medication safety topic was labelled clearly in the current undergraduate pharmacy and nursing curricula. The medication safety topics were delivered using different methods. There was a variation in professions of teaching staff (i.e. pharmacist, physician, nurse, other healthcare professional), all of who teach medication safety across pharmacy and nursing students in the two countries. Students' perceptions varied among the settings in which they learned the most about medication safety. Students' perceptions varied on degree of satisfaction of their current medication safety education. Integration of stand-alone and part of existing courses' types of course were preferred. Students' perceptions for knowledge and skill (KSA) domains needed also varied. The time allocated for teaching of medication safety topic was perceived to be insufficient. Students' confidence in learning about patient safety domains provided in classroom and clinical setting, varied across year of study, and between classroom and clinical setting.

Next, in the final chapter (chapter 6), I summarise the overall findings of my research, its strengths and limitations, areas for further research, and implications for patient and medication safety education for pharmacy and nursing students in the UK and KSA.

6.1 introduction to Research Findings

In this chapter, the research findings of emergent themes and their subthemes are synthesised and examined from the perspective of existing literature. These findings are contextualised and studied through the lens of the original research question that drove this study; “What is the current situation of medication and patient safety education in undergraduate pharmacy and nursing schools?”, and they are related to the objectives that were outlined in the introduction section. Following the summarisation and examination of the findings of the study, I will discuss the research’s strengths and limitations, the contribution of this study to the literature, practical recommendations for the development of educational interventions, the implications of the thesis and finally, the conclusion.

The rationale for the selection of the study’s two locations (the UK and Saudi Arabia), was justified as it was to obtain both perspectives on patient and medication safety education in different aspects (i.e., content of the curriculum, educational methods and learning outcomes, etc.) and to widen my knowledge and insights. In addition, the internationalisation of the curriculum in healthcare extends beyond borders, requiring students and professionals to develop a global perspective on healthcare systems and practices. This involves incorporating international, intercultural, and global dimensions into content, teaching methods, and learning outcomes at both programme and institutional levels. (Davey, 2023).

As the core of this thesis is medication and patient safety education, recommendations will be presented to improve patient and medication safety education in the form of suggested interventions that address the elements that were explored and analysed throughout the thesis (i.e., content, methods, curriculum guides, and educational frameworks).

Furthermore, this thesis has sought to establish the perceptions of current medication safety education among undergraduate pharmacy and nursing students and teaching staff in the UK and Saudi Arabia. The motives behind this study were to explore perceptions, outline content, delineate the educational methods, define the guidelines and educational frameworks currently used, explore the curriculum used in teaching, and assess the students' confidence in learning about medication and patient safety in classroom and clinical settings. A number of methods were used in the collection of data from the target population. The methods included document review, semi-structured interviews, focus group discussions and questionnaires.

6.2 Discussion of Research Findings in the Context of Prior Research

In this section, the discussion focuses on the three experimental studies mentioned in 6.1. conducted in this thesis. A summary of the main findings obtained in each experimental study are provided, then these findings are discussed in the context of other literature. Finally, interpretations to the findings are provided.

6.2.1 The Systemic Narrative Review

This review revealed that there is limited evidence that the current medication and patient safety educational practice provided to pharmacy and nursing students are effective and sufficient and that there are different views and perceptions regarding the practices. This finding supports Milligan et al. (2006), who mentioned that there is a significant need to improve patient safety education and to include the human factors theory in healthcare education. Coombers et al. (2005) and Taxis (2003) suggested that changes to the nursing and pharmacy education were urgently required. Similarly, Tsegaye et al.'s (2020) study found a high number of medication administration errors, suggesting the need for guidelines, training, and strategies to minimise distributions and reduce errors. Moreover, Usher et al. (2018) found that teaching patient safety in universities varies significantly, with it often being integrated into undergraduate nursing courses rather than taught separately. Furthermore, Mbuthia et al. (2018) found that patient safety content is implicit within the curriculum, consisting of statements and inferences related to patient safety. Another study from pharmacy agreed with the others, Alwhaibi et al. (2020), who

emphasised the importance of including patient safety courses in pharmacy programmes to enhance patient care quality. Furthermore, in a review study, El-Awaisi et al. (2021) pointed out the lack of standardisation on how patient safety is incorporated into the pharmacy curricula. In another review study, Lee et al., (2021) noted that educational interventions (i.e., the framework a course is based on, course content, course structure, teaching modalities and duration or frequency of the intervention) were either presented as stand-alone courses or as lessons embedded in an existing course. In addition, Creswell et al. (2013) also explained various gaps in the nursing and pharmacy education, including its lack of educational capacity and difficulty in certain areas. The finding of this thesis also builds on previous researches conducted in the field as shown from the authors' views.

Similarly, it was found that the content of patient and medication safety taught to pharmacy and nursing students is diverse. Some authors reported dissatisfaction about the content such as Page et al. (2007), who reported that both lecturers and students expressed dissatisfaction with both current pharmacology education in nursing programmes, and how effective this content is for preparing nursing students for their role in preventing medication errors when they are qualified. Bohomol (2019) emphasised that the undergraduate course's patient safety content lacks crucial areas, such as understanding patient safety, considering human factors and learning from mistakes to avoid harm.

Similarly, Lee et al. (2020a) stressed that patient safety is a crucial aspect of nursing courses, yet its education is limited in terms of content and hours of instruction. However, Alkatheri et al., (2017) reported that specific content of medication safety should be included such as human errors, medication errors, quality improvement, error reporting and near miss error. This suggests that medication and patient safety content needs revisions to indicate what aspects should be included in the curriculum. There are a range of educational methods used to deliver patient and medication safety education. This finding supports the literature review findings regarding the use of a range of educational methods. Medication safety simulation scenarios need to be emphasised in nursing schools, (Mariani et al., 2015). Moreover, simulation training

has been shown to greatly improve effective communication between health workers and patients, which may lead to prevention medication errors, (Blackmore et al., 2017). In a review study, Alanazi et al. (2017) reported that evidence demonstrates that the use of simulation in student education significantly improves knowledge, skills, and self-confidence. In another review, Rocha et al. (2021) emphasised how the simulation method was utilised to instruct nursing students about patient safety. In a study that supports the use of simulation, Komperda and Lempicki (2019) emphasised the importance of incorporating simulated learning exercises in pharmacy education for improving medication reconciliation skills. In contrast to these, was the perspective of Lee et al. (2016) who concluded, based on students' reports that patient safety education during coursework was delivered primarily by lecture rather than during laboratory or simulation sessions. Similarly, researchers reported the effectiveness of interprofessional learning methods in delivering patient and medication safety education, where Ernawati et al. (2015); Hwang et al. (2016); Lapkin et al., 2012; Thom et al. (2016); Ragucci et al. (2016); Bridgeman et al. (2018); lee et al. (2020); Popkess et al. (2017; Rotz et al. (2021) and Seaman et al. (2018), all indicated the need for and effectiveness of inter-professional learning methods, although from different perspectives. This finding indicates a shift towards relatively new methods, which are experientially active methods (i.e., simulation and IPL). This finding agreed with views perceived by the teaching staff and students in Chapter 4, in addition to students' perceptions in Chapter 5. Significantly, Bohomol, E. (2019) identified that different teaching methodologies and evaluation strategies, both traditional and innovative, were used in teaching medication safety.

Furthermore, it is evident that no unified curriculum guides were referred to although several educational frameworks were used, a finding which supports the literature which revealed that no specific framework was used. Educational frameworks such as the Quality and Safety Education for Nurses (QSEN) framework was widely used (Armstrong et al., 2013; Bush et al., 2015; Chenot et al., 2010; Cooper, 2013; Day et al., 2007; Debourgh et al., 2012a and 2012b; Dolansky et al., 2013; Jarzemsky et al., 2010; Lee et al., 2016; Masters, 2016; Mawhirter et al., 2016; Sherwood et al., 2007; Smith et al., 2007; Sullivan et al., 2009; Alwhaibi, M., et al. 2020; Bridgeman, M. B., et

al. 2018), while the use of a curricula guide such as the WHO Curriculum Guide (2011) was very limited as only six studies used the guide explicitly as found in the literature review study, (Hwang et al., 2016; Mansour, 2013; Bohomol, E. 2019; Kirwan et al. 2019; Mansour et al. 2018; Svitlica et al. 2021).

6.2.2 The Teaching Staff and Students Interview Studies

The findings of these studies concentrated on the four themes presented in the document review (i.e., medication safety as a stand-alone course, medication safety components of other courses, is it mandatory or optional, and the curriculum guide used), and the three themes of medication safety education as presented in Chapter 4; medication safety curriculum (structure), the teaching process (process) and evaluation of medication safety (outcomes). It was anticipated that these findings might lead to more solutions and strategies for the improvement of medication safety education with patient safety as a significant goal (outcome). In the interview studies, the views of the teaching staff and students were explored.

The interview results were obtained from the data collected during document review, individual and focus group sessions. Most of the respondents were found to feel strongly about medication safety. The interview sessions also led to the discovery that students preferred case-based study to classroom lectures. Moreover, students felt that they need to have longer clinical placement experience in the hospital, and they thought that it is beneficial to use more simulation in their learning and to integrate the IPL method. In addition, students preferred exposure to medication safety learning earlier in their curriculum as well as throughout the course.

The results of the curriculum reviews in the UK and Saudi Arabia are based on responses from interviews and information from university web pages. Of the universities that took part in this study in the UK, five offer pharmacy courses and three of these included medication safety as a mandatory stand-alone course, whereas the other two integrated this in their existing courses. Similarly, of the universities that took part in this study in Saudi Arabia, three pharmacy schools

offered medication safety studies as a stand-alone and as part of existing courses, and two pharmacy schools as part of existing courses.

In the UK, two of the four universities offering nursing courses were found to have medication safety as part of existing courses. None of the nursing schools in the UK offered medication safety as a mandatory stand-alone course. In contrast, in Saudi Arabia one of the two nursing schools took part in the study had medication safety as a mandatory stand-alone course and as part of an existing course and the other school had medication safety as part of existing course.

The medication safety curriculum theme revealed several findings: the content of medication safety curriculum was diverse and not explicitly labelled, which supports the literature review study findings. Similarly, Attree et al. (2008) and Mbuthia et al. (2018) argued that patient safety content was not explicitly addressed in the undergraduate nursing curriculum. This finding indicates that the concept of medication safety should be introduced earlier and continued throughout the programme, and the content of medication and patient safety needs to be specified. For this reason, the topics which need to be included in the medication safety curriculum need to be specified for improved educational outcomes. Similarly, Aboumatar et al. (2015) identified eight categories of patient harm avenues (i.e., harms by: misidentification, suboptimal patient education and preparation for self-management, diagnostic errors, missed preventive and therapeutic measures (for example, pulmonary embolism), tests and procedures, medication errors, falls and healthcare associated infections). Medication safety theories (i.e., Reason's human errors) were rarely used in some nursing and pharmacy programmes, even though they are needed to improve patient safety education. This finding supports Milligan et al. (2006) who reported the importance of including a human errors theory in patient safety education as mentioned in 6.2.1. This finding indicates that medication safety theories, like the human errors theory, needs to be integrated in medication safety.

There is no specific curriculum guide and framework used when designing or teaching medication safety, and each nursing or pharmacy programme uses different

guidelines or frameworks. This finding supports the literature review study as mentioned earlier in 6.2.1. This finding also indicates that the medication safety curriculum guide, whether international or national, needs to be specified, standardised and monitored by educational bodies and universities, in order to have a unified curriculum guide which will help in the designing and teaching of medication safety.

There were no protocols (i.e., specific approach, aim and objectives) recommended by the curriculum advisers to teach medication safety and each educator selected their own approach when teaching medication safety. This indicates that a great deal of work is required to improve internal protocols and guides to include clear medication safety aims and objectives, instructions, learning outcomes specific to the medication safety component, and particular recommendations regarding medication safety education need to be included in pharmacy and nursing curricula. This study identified the KSA domains required to practise medication safety and presented a wide range of these domains. The inclusion of medication safety in the curriculum would raise the knowledge and skill level among nurses and pharmacists prior to their graduation and subsequent release into the job market, (Aboumatar et al., 2012). This finding was unique to this thesis. In addition, it revealed that students had a good knowledge regarding medication errors related issues (i.e., definition, causes and strategies to prevent error), while most teaching staff and students found it somewhat difficult to define medication or patient safety. This finding indicates that there was a need to develop a specific and explicit definition for medication and patient safety to be able to have a common understanding of the subject. A definition is a statement of the meaning of a term such as word, phrase, or other set of symbols, (Bickenbach et al., 1996). This finding was also unique to this thesis.

The teaching process theme revealed several findings: underlying teaching theories (e.g., Kolb's experiential learning and Bloom 's taxonomy) were rarely used by teaching staff. This finding supports the literature review study which revealed that few studies used teaching theories (Chapter 3, Table 3.6). This finding indicates that teaching theories should be specified and unified to achieve specific outcomes.

Several teaching styles were indicated such as didactic, experiential, mixed and interactive styles. There was a preference for experiential and interactive styles, as teaching staff thought these teaching styles were most effective to use when teaching students. This finding indicates that it is better to use more experiential and interactive teaching styles, and that they should be identifiable for the lecturers and clearly written in pharmacy and nursing curricula. This finding was unique to this thesis. Moreover, it was found that the time allocated for teaching of medication safety was not sufficient. This finding supports the finding in the literature review study, where it was reported that nurses need to dedicate more time to the whole area of pharmacology and medication safety in the nursing curriculum, (Adhikari et al., 2014; Holdforth et al., 2013; Lee et al. 2020). This finding indicates time allocated must be reviewed and improved to allow for proper coverage of the medication safety component. Furthermore, it was reported that medication safety education was mostly integrated as part of existing courses such as therapeutics, pharmacy practice and pharmacology, with few participants preferring the integration of medication safety as a stand-alone course. In addition, many participants preferred both types of integration as they think it will strengthen the teaching of medication safety. This finding supports the finding of Alkatheri et al. (2017), who reported the high preference of pharmacy educators for the integration of medication safety as part of existing courses. This finding indicates that the mode of integration should be indicated and unified across pharmacy and nursing programmes.

The results obtained from the study show that teaching staff and students have diverse perceptions concerning the explicitness of the current medication safety education. This can be widely attributed to the differences in the two countries' curricula when it comes to medication safety. The research findings indicate that medication safety is emphasised to students in both the UK and Saudi Arabia.

Moreover, it was found that there were some issues which prevent students from having an effective clinical training such as preoccupied trainers and brief bouts of hospital experience for the students. This finding indicates that the issues of shortage of qualified trainers and busy preceptors should be addressed, and solutions found to

improve students' hospital experience during clinical placement. This finding was unique to this thesis.

Furthermore, this study identified the range of educational methods currently used when delivering medication and patient safety education. In addition, there was a preference for using some educational methods such as clinical placement, IPL and simulation as the participants thought these methods would improve medication safety teaching. Similarly, Kiersma et al., (2011) noted a variety of educational methods and strategies such as plenary, small-group learning, experiential learning, simulation, role-plays with standardised patients, case-based learning, individual and team-based learning, and supportive audio-visual materials. Moreover, Mariani et al. (2015) suggested that medication safety simulation scenarios need to be emphasised in medical schools. Additionally, inter-professional learning and practice need to be introduced in the medical field (Ernawati et al., 2015). Furthermore, it was suggested that inter-professional learning (IPL) would promote the appreciation of specialisations by students. Similarly, the appreciation of other fields would, in turn, increase consultation incidences among various medical practitioners. Augmented consultation would, in turn, lead to reduced incidences of medication error (Bressler et al., 2016). Examiners need to make medication process learning as practical as possible. Objective, structured, clinical examinations need to be incorporated into curricula. Moreover, inter-profession patient management needs to be emphasised within the learning institutions to enhance the feasibility of easing and enhancing relationships in the workplace in the future. Simulation training has been shown to greatly improve communication skills between health workers and patients, (Blackmore et al., 2017; Lee **et al.** (2020) and **Popkess et al.,** 2017).

In contrast, some studies highlighted the limitations and difficulties to integrating inter-professional learning method. Cresswell et al. (2013) noted the consequence that there were only limited opportunities for inter-professional learning and bridging the gaps between educational practice and policy contexts. Lapkin et al. (2012) identified timetabling restrictions and a lack of appropriate teaching and learning resources as the main barriers to implementation of IPE. Also, Hardisty et al. (2014)

highlighted there are considerable organisational challenges to arranging inter-professional groups when students come from different organisations with different placement arrangements in practice, and curricular demands sometimes act as a barrier. Moreover, simulation training is faced with numerous challenges. Among them are insufficient evidence to show the patients' benefits, (Reime et al., 2016). Trauma arising during stimulation affects students negatively. Students who do poorly during simulation training then fear they will make the same mistakes in real life, (Mawhirter et al., 2016). This finding indicates that methods should be updated, and effective methods should be considered and integrated in the curriculum such as simulation, inter-professional learning and increased time spent on clinical placement issues which need to be addressed to achieve better learning outcomes. This study supports the literature review finding regarding the use of educational methods as presented above. In addition, students revealed their experience in different training sites, and mostly indicated that they learn more medication safety in simulation labs and clinical placement settings, compared to classroom. This finding supports the finding of Tella et al. (2015) which reported that British and Finnish students' views varied when measured for learning in the clinical setting and classroom, (Chapter 5).

The evaluation of the medication safety theme revealed several findings: participants felt that current medication safety education is not adequate and need to be updated, enhanced, and strengthened in many aspects. In addition, they indicated that pharmacy and nursing schools' curricula should e revised to include innovation in patient safety techniques. Additionally, most students, who pursue pharmacy or nursing programmes, ended up graduating without even clearly understanding patient safety, (Creswell et al., 2013; Alwhaibi et al. 2020). Moreover, Neale et al. (2001) mentioned the increasing number of medication errors resulting from a lack of appropriate patient safety education in pharmacy programmes. As a result of these findings, the barriers which prevent positive learning outcomes should be investigated, and the strategies suggested should be evaluated and monitored to ensure their quality. However, Mansour et al (2018) highlighted the opportunities and challenges for integrating and building faculty capacity, with finding experts in patient safety teaching remaining a key challenge. There is also a need to conduct more

studies on a larger population size to enable generalisation of the findings as well as addressing associated challenges.

6.2.3 The Student's Questionnaire Study

The findings of this study concentrated on the following four sections: (1) Exploration of medication safety education teaching as perceived by pharmacy and nursing students; (2) Description of the perceived effectiveness of methods used in delivering medication safety education; (3) Evaluation of the perceived effectiveness of topics, teaching settings, and educators; and (4) Assessment of students' confidence in patient safety education provided in classroom and clinical settings using the H-PEPSS tool.

The findings revealed that medication safety was clearly and explicitly labelled to students across the UK and Saudi Arabia samples. This finding disagrees with those of the literature review and the interview studies, which revealed that medication safety education was not clearly labelled. In contrast, it supports the findings of Alkatheri et al. (2017,) who noted that medication safety education is clearly labelled to pharmacy students. This difference in results may be due to using different approaches (i.e., qualitative vs quantitative), different samples and different experiences of the participants. It was revealed that the UPL method was the most used methods across the UK and Saudi Arabian samples, while the IPL method was least used in both professions and countries as it was not one of the educational methods currently used.

Methods used in delivering medication safety were diverse and there was a differentiation in the rating effectiveness of methods. Students highly rated clinical placement and case-based study methods in both countries as being the most effective methods, however, a a lower rate was given to IPL in both countries, as the IPL method is not used for delivering medication safety education in both specialties and countries, which explains the lower rate. These findings regarding rating educational methods were specific and unique to this study. The variation in the views regarding some elements such as educational methods, observed between

interview and questionnaire studies were because of the nature of each approach, as in the interviews the participants' responses were spontaneous and immediate, and maybe the participant did not fully understand the question which led to different views on the same element, compared with views obtained from the questionnaire, where participants might have felt more comfortable when answering an anonymous questionnaire along with having sufficient time to read and think about the meanings of the questions.

The students identified a range of topics which helped them to understand medication safety. Pharmacy students in the UK and Saudi Arabia perceived (1) therapeutics, (2) pharmacy practice, (3) pharmacology, and (4) medicinal chemistry as the most important topics to assist them. However, nursing students in the UK and Saudi Arabia perceived (1) pharmacology, (2) fundamentals of nursing, (3) adult One & Two (4) medication administration rights and (5) calculation. This finding was understandable as students react differently and their preference to topics vary. Moreover, in Saudi Arabia pharmacy students learned most about medication safety in the classroom compared to the clinical setting and skills/simulation lab. This finding might be due to late exposure to clinical placement and no exposure to simulation methods as most of the pharmacy programmes lack simulation labs. However, nursing students learned most in clinical settings compared to classroom and skills/simulation lab. This finding might be due to nursing students' early exposure to clinical placement and hospital visits. In the UK, pharmacy students learned most about medication safety in the classroom and clinical setting and less in the skills/simulation lab, while nursing students learned most in the clinical setting, with less learning in the classroom, and least learning in the skills/ simulation lab compared with their colleagues in Saudi Arabia. Time allocated for teaching of medication safety topic is perceived to be insufficient. This finding supports the finding mentioned in 6.2.2.

This study assessed students' confidence in patient safety education provided in classroom and clinical settings, and several findings were revealed:

1. There is a variation in perception of adequacy of patient safety domains (working in teams in the classroom and managing safety risks in the clinical

setting addressing broader patient safety issues and feeling comfortable speaking up) across year of study in the pharmacy students' sample in Saudi Arabia.

2. There is a variation in perception of adequacy of patient safety domains in classroom and clinical settings: culture of safety, working in teams, communicating effectively, understanding human and environment factors, adverse events and near misses and managing safety risks and addressing broader patient safety issues in clinical setting across the years of study in the nursing students' sample in Saudi Arabia
3. There is no variation in perception of adequacy of patient safety domains across year of study in pharmacy students' sample in the UK. In contrast, there is a variation in perception of adequacy of patient safety domains (clinical safety domain in clinical setting) across year of study in the nursing students' sample in the UK.
4. There was a significant decrease in confidence among pharmacy students in Saudi Arabia in learning about the human and environmental factors' domain from classroom to clinical settings.
5. There was a significant decrease in confidence among nursing students in Saudi Arabia in learning about the human and environmental factors and disclosing adverse events domains from classroom to clinical settings.
6. There was a significant decrease in confidence among pharmacy and nursing students in the UK in learning about working in teams and human and environmental factors domains from classroom to clinical settings.

The research has discovered, then, there are variations in the perception of adequacy of patient safety domains, which involve working in teams, the culture of safety, communicating effectively, understanding near misses, and addressing broader safety issues concerning patients in the hospital setting, (Lee et al. 2016). However, it is evident that there is a lower level of confidence among pharmacy students when in a classroom-based setting compared with when in a clinical based setting and that there was also a variation in confidence across study years in nursing students involved in

the study from the UK. This variation, however, was not observed among pharmacy students in the UK.

In view of the above conditions, students' confidence in learning about patient safety domains provided in classroom and clinical setting varies across year of study and between classroom and clinical settings. Researchers agreed on the variations reported (Bressan et al., 2016; Duhn et al., 2012; Lukewich et al., 2015; Stevanin et al., 2015; Weatherford et al., 2015; Suliman, 2019), and one to nursing and medicine undergraduates, (Hwang et al., 2016).

The variations reported in this study might be because of the change in the knowledge and expectations with the experience gained throughout the pharmacy programme and also, that exposure to real-life practice may lead to changes in perceptions. These findings support several researchers' findings: Duhn et al. (2012) and Ginsburg et al. (2013) reported that upper-year students progressed in their learning and are exposed to more situations, they are more aware of the scope and complexity of patient safety and have more questions than answers. In addition, Ginsburg (2013), in a study on new graduates, found greater confidence in patient safety learning was reported for learning experiences in a clinical setting compared with the classroom setting with one exception: nurses' confidence in learning about working in teams compared with other healthcare professionals deteriorated as they moved from thinking about learning in a classroom setting to thinking about learning in a clinical setting. In addition, Lukewich (2015) reported nursing students were confident in what they were learning in a clinical setting about working in teams, whereas confidence in managing adverse events and responding to adverse events declined in the later years of study. Moreover, Colet (2015) noted that female nursing students reported higher patient safety competence in both classroom and clinical settings within the domains of 'working in teams' and 'communicating effectively' while males reported higher competence in settings such as 'managing safety risks' and 'understanding human and environmental factors' domains. Duhn (2012) noted that "The expectation exists that confidence increases with clinical experience; however, fourth-year nursing students reported less confidence in their knowledge about key domains compared with junior-

year students". In addition, Duhn (2012) noted decreasing levels of confidence in the third year and fourth year students in her study regarding nursing students. Stevanin (2015) had similar findings, noting high patient safety knowledge and competence was reported by first year students, moderate by second year students but then higher at the end of the third year. Furthermore, Duhn (2012) noted that nursing students as a group scored highest in the domain of clinical safety (in both classroom and clinical settings) This domain focuses primarily on hand hygiene and infection control and might be most familiar to students due to public campaigns on healthcare safety contributing to their knowledge base. In a study about using the H-PEPSS in nursing school, Suliman, M. (2019) advised developing a comprehensive framework that incorporates patient safety knowledge and competencies to close the gap between theory and practise in the nursing curriculum.

The open-ended questions assisted considerably as the students outlined the topics that helped them most in building medication safety knowledge and skills, with results being similar in both groups of students from Saudi Arabia and the UK. Students pursuing pharmacy in both countries thought that the most helpful topics to them were therapeutics, pharmacy practice, pharmacology and medicinal chemistry. The students pursuing nursing, however, thought that the most helpful topics to them were pharmacology, the fundamentals of nursing, adult one and adult two (nursing courses), medication administration rights, and calculation. Pharmacology as a topic was also considered to be a commonly helpful subject in relation to medication safety by both nursing and pharmacy students, as depicted by the study. These results agreed with the results accrued from the interview study.

6.3 Research Strengths and Limitations

Key findings in this study reinforce previous research findings regarding medication safety. The teaching staff and students involved in the research thought that medication safety guidelines were deficient. Most of the sample population also felt that the level of preparedness to deal with the administration and management of medication safety education at the undergraduate level is deficient. The content, methods, curriculum guides, and frameworks need to be reviewed and revisited, and

factors that prevent the effective integration of medication and patient safety should be addressed to improve the curriculum. Finally, the student's confidence in learning about medication and patient safety in classroom and clinical settings should be reviewed for better medication and patient safety outcomes. These findings should inform policymakers in the educational and health sectors in the UK and Saudi Arabia to act and prioritise the aim of improving medication and patient safety education.

The current study has numerous strengths as well as weaknesses which are based on the nature of sampling techniques, data collection methods, sampler and sample bias, data analysis techniques and their relation to the study questions, aims, and objectives. 'However, the research findings have attempted to be objective in terms of analysing the presence and nature of patient and medication safety in the nursing and pharmacy students' curricula studied in the UK and Saudi Arabia.'

Research strengths

Firstly, as mentioned previously, this study is the first of its kind as it takes a multifactorial approach in viewing medication safety from the point of how it is taught, the educational methods used by learners, the educational qualifications of tutors and the modules used to foster learner understanding. Apart from that, this study evaluates personal factors such as attitude and skill, which are involved in the teaching and learning of medication safety (Reime et al., 2016). The study also evaluates the time allocated to teaching medication skills, as well as the adequacy of the time allocated. Furthermore, it also assesses the research methods and tools used. The use of questionnaires, interviews, and focused group discussions gave the research a qualitative and quantitative bearing. The qualitative and quantitative approach aided in ensuring validity in a relative international perspective. Internal and content validity was achieved by aligning the medication safety education safety section of the questionnaires with the systematic review and interview studies in the thesis. Similarly, the research tools used are ideal for exploration of student perceptions on medication safety education in both countries. The sample size in Saudi Arabia was also a point of strength in this research. Finally, the circumstance

that this research was conducted across both the UK and Saudi Arabia provides this the study with authenticity, potency, and originality.

Research Limitations

Some research limitations exist, mostly owing to drawbacks of sampling techniques and methods, as well as various sources of bias. Sampling and response bias were both encountered in the research. Sampling bias was encountered due to the limited number of schools involved in the study in Saudi Arabia. Despite the reasonable sample size achieved, only five pharmacy and two nursing schools were involved in the study from a possible seven pharmacy and four nursing schools. The same was observed in the UK, where a small sample size was recruited. The challenge facing the small sample size in the UK, reduced the chances of generalising to the students' populations. Similarly, the reduced number of schools recruited in Saudi Arabia, despite the moderate sample size, questions the generalisability of the results.

Exclusion of important sample elements in Saudi Arabia is also a limitation of this study. The sample from Saudi Arabia had no nursing students in their first and second years of study. who may not have explicit teaching of medication safety, or it may be that the university administration personnel do not follow this up properly with the students. This omission might miss a lot of helpful information that may have aided in the study, in turn leading to the limited generalizability of the results.

Response bias is another limitation of this study. The same language (English) was used in both studies in Saudi Arabia and the UK which might have disadvantaged students in Saudi Arabia as English is not their first language. Accordingly, there is the possibility of inaccurate and misleading responses from the respondents in Saudi Arabia. A few students in Saudi Arabia faced difficulty expressing their views and concerns in English during the focus group discussions. Therefore, this potential language barrier might have led to response bias. However, as English is the language used for teaching at these universities in Saudi Arabia, it was kept as a language of choice for the studies reported in this thesis.

Furthermore, the lack of standardisation of the research is a huge limitation. Students in Saudi Arabia and the UK use different study schedules. The difference in years of studies between the two study populations, therefore, poses a huge challenge when it comes to data analysis as it would be inaccurate to use the same statistical analysis tests to analyse data from both countries.

6.4 Contribution of this Study to the Literature

The findings of this thesis address the research gap and provide practical suggestions to improve medication and patient safety education. The importance of the literature review was to provide an explicit account of the context of this research. The findings of this study also provide an important source for future research related to this topic (examples are provided below with implications for future research into medication and patient safety education). Furthermore, the instructional teaching strategies, reported in the findings above, contribute to the knowledge gaps in the literature. They also review the current nursing and pharmacy programmes in Saudi Arabia and the UK as starting points for future studies.

6.5 Practical Recommendations

6.5.1 Development of IPL- Simulation Workshop

In line with the Miller's (2011) pyramid, the WHO (2011) Medication Safety Curriculum Guide, and Mansour (2018), findings from the empirical studies presented in this thesis indicate that IPL simulation workshops need to be carried out in nursing and pharmacy schools. Such exercises would aim at enhancing the ability of students to handle real-life scenarios of patient safety, (WHO, 2011). The workshops should focus on identifying the principles of medication and how errors could be reduced by following the safety guidelines. The events should also have sessions in which participants are tested using activities which aid in the understanding of patient safety, assessment of patient safety, as well as how to use the internet resources to acquire information on patient safety. The workshops should, therefore, include OSCE stations and summative assessments based on the Miller's triangle, (WHO, 2011). Such an assessment would include active prescribing of medication to tutors and

advising them on how to take the drugs while monitoring toxicity. Multisource feedback activities are also important in enhancing clinical competence, (WHO, 2011).

6.5.2 Development of a Practical Framework/Model

Medication Safety Education based on:

- The WHO Patient Safety Curriculum Guide: Topic 1: What is Patient Safety? Topic 2: Improving Medication Safety
- Miller's Pyramid for Clinical Assessment

The World Health Organization has developed a curriculum guide that aids in the understanding of how medication safety can be integrated into nursing and pharmacy school learning calendar, (WHO, 2011). The WHO Patient Safety Curriculum Guide links patient safety education with other subjects taught in nursing and pharmacy schools. For instance, patient safety application to students pursuing medication administration will find a close link with certain areas such as drug types, disease forms and duration of reactions. As such, a nursing and pharmacy student becomes all-rounded in knowledge hence limiting possible errors and ensuring medication safety of patients, (WHO, 2011). The guide includes assessment of the integration of medication safety into curricula, the principles which ought to be followed by lecturer teaching medication safety, activities which can be done to enhance student understanding, assessment of patient safety and evaluation of learners after being taken through the module, (WHO, 2011). The curriculum guide also encompasses the tools which may aid in learning, such as websites and online resources, as well as the means through which a global approach to safety can be achieved.

The Miller's Pyramid for Clinical Assessment needs to be integrated into the medication safety teaching and evaluation in pharmacy and nursing schools, (see chapter 1, section 1.4.6). The level of skill increases as one moves up the pyramid. Pharmacy and nursing students need to be taught starting from the first year in the college. At the early stage (fact-gathering), students need to be enlightened on the theoretical aspect of medicines, (Miller, 1990). At the theoretical stage, zero patient

simulation occurs. Pharmacy and nursing at the early phase need to concentrate on memorising drug classes, pharmacokinetics and pharmacodynamics.

Students who have passed the early stage, should then move up to the interpretation and application phase, (Miller, 1990). Minimal simulation should occur at this phase in the form of pre-clinical questions. Despite students knowing how drugs operate, they should be able to appreciate the body mechanisms that operate around certain drugs, (Aljadhey et al., 2017). At the interpretation and application phase, students need to appreciate patient contraindications to drugs, as well as the rationale behind such contraindications.

The demonstration of learning phase by students should occur after students pass the interpretation and application phase, (Miller, 1990). Maximum simulation occurs at the demonstration of the learning phase. At this phase, students should have a substantial amount of contact time with real-life patients. Students at the demonstration of learning phase also need to do numerous objective structured clinical examinations to be able to prove their clinical competence, (Lee et al., 2016).
The final phase, according to the Miller's Pyramid, is the performance phase, (Miller, 1990). The candidates at this phase are pre-registration students waiting to be released into the public realm. The assessment module at this phase should not be exclusively Objective Structured Clinical Examinations (OSCEs). Students at the performance phase need to spend the maximum study time in the clinics, observing medication processes.

Apart from the intellectual aspect of clinical competence, students need to cultivate a positive attitude towards medication safety. The professional confidence of students needs to be improved from a point of mere knowledge to one of full passion. Communication skills need to be improved among students. Junior clinical clerkship students need to be asked appropriate communication strategies, while senior clinical clerkship students need to demonstrate communication strategies in OSCE stations by advising actual patients, (Pearson et al., 2009).

6.6 Implication of the Thesis

6.6.1 Implication Statement

The work presented in this thesis has the potential to improve medication and patient safety education (i.e., structure, process and outcomes) specifically in the pharmacy and nursing curricula and can be of practical benefit to other healthcare teaching medication or patient safety curricula as well.

6.6.2 Implications for Future Research

The studies presented in this thesis have confirmed some findings in the field of medication and patient safety education and contributed new knowledge that may guide future research in the UK and Saudi Arabia, or perhaps in the field of medical education related specifically to medication and patient safety. This thesis may impact future research by influencing the attention of medication safety experts to looking at and reviewing medication safety education for the following implications presented in the following Box 6.1:

Box 6. 1 Implications for Future Research

1. Evaluate the content of medication safety (i.e., including more universities in the two countries and different programmes).
2. Appraise the effectiveness of current educational methods used in delivering and teaching medication and patient safety and integrate and strength some of the unused methods as indicated in this thesis, such as IPL and simulation as well as incorporating more self-directed learning.
3. Re-evaluate the teaching guidelines and curriculum guidelines currently used in teaching and designing of medication safety curriculum on a wider scale (i.e., including a higher number of pharmacy and nursing schools).
4. Gauge the adequacy of the time allocated for medication and patient safety education.
5. Use the same questions raised in this study to invite more students from the UK to explore their perception on medication safety education, as the UK students' sample size was small.
6. Expand to include other populations (e.g., clinical laboratory and dentistry) and other countries in the Middle East (e.g., the Gulf Cooperation Council or the European Union (e.g., Spain).
7. Future study by the researcher of this thesis may include other study designs (e.g., Intervention Studies, assess the suggested existing models based on Miller's Pyramid for Clinical Assessment and the WHO Patient Safety Curriculum Guide and evaluation study for the suggested IPL-Simulation workshop).
8. Evaluate the content of medication safety (i.e., including more universities in the two countries and different programmes).

9. Evaluate the adequacy of the time allocated for medication and patient safety education.
10. Investigate the obstacles and barriers that prevent the effective integration of medication and patient safety education and develop strategies to overcome these barriers.

6.6.3 Implications for Educational and Clinical Practice

The empirical results presented in this thesis may interest decision-makers in medical education to focus on medication and patient safety practices in pharmacy and nursing schools and may lead some implications presented in Box 6.2 as follows.

Box 6. 2 The Implication for Educational and Clinical Practice

1. Guide changes and updates in medication safety curricula.
2. Revise the policies and regulations that influence medication safety education.
3. Identify a specific curriculum guide to be used as a framework for medication safety.
4. Standardise medication safety curricula and review their content.
5. Review recommendations and guidelines concerning medication safety education.
6. Appraise learning and training theories used by teaching staff to ensure these are clearer and more explicit.
7. Check the time allocated for teaching medication safety topics and assess the adequacy of time.
8. Evaluate the mode of integration and deciding on the most beneficial mode to deliver the adequate amount of medication safety education as emphasised by both the interview and questionnaire studies. Also assessing what is adequate?
9. Review current educational methods used in delivering and teaching medication and patient safety, and thinking about integrating more effective methods (e.g., Interprofessional simulation learning).
10. Review training and supervision issues in classroom, simulation skills lab and clinical placement settings.
11. Assess the early integration of medication safety teaching into initial years of training and throughout the degree.
12. Monitor the outcomes of medication safety education by regular evaluations of guidelines and policies related to medication safety education.
13. Use the H-PEPSS tool to evaluate student's confidence in patient safety education in the classroom and clinical settings, especially in pharmacy school, as only one study included pharmacy students used the tool (Ginsburg, 2012).
14. Evaluate how medication safety education impacts clinical practice.
15. Review the factors that lead to differences in students' confidence in patient safety education in the classroom and clinical setting.

Note: All these implications are relevant to both countries and both disciplines.

6.7 Conclusion

6.7.1 Summary of Key Findings

Key findings in this study reinforce previous research findings regarding medication safety. The teaching staff and students involved in the research think that medication safety guidelines are deficient. Most of the sample population thought that the level of preparedness to deal with the administration and management of medication safety education at the undergraduate level was deficient. The content, methods, curriculum guides, and frameworks need to be reviewed and revisited, and factors that prevent the effective integration of medication and patient safety should be addressed to improve the curriculum. Finally, the student's confidence in learning about medication and patient safety in classroom and clinical settings should be reviewed for better medication and patient safety outcomes. These findings should inform policymakers in the educational and health sectors in the UK and Saudi Arabia to act and prioritise the aim of improving medication and patient safety education.

6.7.2 Overall conclusion

This study has covered many aspects of medication safety education in pharmacy and nursing programmes in the UK and Saudi Arabia. The aim of the studies reported in this thesis was to identify and describe current medication and patient safety education in the UK and Saudi Arabia, and to analyse the factors that affect medication safety teaching in order to recommend an existing framework to improve medication safety education. All objectives have been achieved through this thesis (see chapter 1, section 1.6) as follows:

1. Objective 1: to describe the current content of medication safety in the curriculum of pharmacy and nursing programmes. The outcome was that the teaching staff and students in several pharmacy and nursing schools described the current content of medication and patient safety curricula, and they identified strategies to improve the content throughout this thesis in Chapter 4 (e.g., strengthening the medication safety component in existing courses such as pharmacology, including more example of medication errors in medication safety teaching, and specifying definitions for medication safety)

2. Objective 2: to identify the current methods used to deliver medication safety education and their effectiveness. The outcome was that the teaching staff and students in both programmes outlined current educational methods used to deliver medication safety teaching, and suggested strategies to improve methods in Chapters 4 and 5 (e.g., using simulation and IPL methods and providing longer clinical placements).

3. Objective 3: to identify the guidelines and educational frameworks currently used in medication and patient safety teaching. The outcome was that the teaching staff reported that there are no standard guidelines or educational frameworks used when teaching and designing the medication safety curriculum. It was concluded that, there is a need to develop or adapt specific guidelines and a framework that organises the curriculum and teaching process in order to achieve the desired learning outcomes, (e.g., the WHO Multi-professional Patient Safety Curriculum Guide and Miller's Pyramid for Clinical Assessment).

4. Objective 4: to understand the barriers and challenges to improving medication safety education. The outcome was that the teaching staff and students identified several barriers to positive medication safety outcomes, and they suggested possible strategies to overcome the situation and improve medication safety outcomes, which was referred to in Chapter 4 (e.g., barriers such as poor calculation skills taught in the classroom, lack of hand-on training for students and strategies to improve medication safety such as teaching medication safety earlier and throughout the programme and allocating more time to teach medication safety).

5. Objective 5: to understand the degree of confidence students feel in learning about medication and patient safety in classroom and clinical settings. The outcome was that the pharmacy and nursing students rated their confidence using the H-PEPSS and reported different views on confidence

which were noted in Chapter 5, (e.g., students feel more confident in learning about patient safety in clinical settings compared to the classroom).

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Appendices

Appendix 1: List of free text words and MeSH used in search strategy

Database	Concept	Free text words	MeSH
Medline	Patient / medication safety	patient* safety or medication* safety or medicine* safety medication* error* or adverse drug* event*	Patient Safety, Medication Errors, adverse drug events, "Drug-Related Side Effects and Adverse Reactions"
	Pharmacy / Nursing	pharmacist* or nurse*	Pharmacy, Nursing
	Education	educat*or curricul* or course* or training or degree* or undergraduate* or facult* or school* or student*	Education, Curriculum
Embase	Patient / medication safety	patient* safety or medication* safety or medicine* safety medication* error* or adverse drug* event*	Patient safety, Medication error, Drug safety
	Pharmacy / Nursing	pharmacy student* or nursing student*, pharmacist* or nurse*	Pharmacy, Pharmacy student, Nursing, Nursing student
	Education	educat*or curricul* or course* or training or degree* or undergraduate* or facult*or school* or student*	Education, Nursing education, Curriculum
Web of Science	Patient / medication safety	''Patient* safety'' or ''medication* safety'' or ''medicine* safety'' or ''medication* error*'' or ''adverse drug* event*''	Patient safety, Medication safety
	Pharmacy / Nursing	pharmacist* or nurse*	Pharmacy Nursing
	Education	educat*or curricul* or course* or training or degree* or undergraduate* or facult*or school* or student*	Education
Cochrane	Patient / medication safety	''patient* safety'' or ''medication* safety'' or ''medicine* safety'' or ''medication* error*'' or ''adverse drug* event*''	Patient Safety Medication Errors Drug-Related Side Effects and Adverse Reactions
	Pharmacy / Nursing	''pharmacist*'' or ''nurse*''	Pharmacy Nursing
	Education	educat* or curricul* or course* or training or degree* or undergraduate* or facult*or school* or student*	Education Curriculum
CINAHL	Patient / medication safety	(patient* safety OR medication* safety OR medicine* safety OR medication error* OR adverse drug* event*)	Patient Safety or Adverse Drug Event or Medication Errors or Medication Side Effects

Database	Concept	Free text words	MeSH
	Pharmacy / Nursing	((pharmacist* or pharmacy or nurse* or nursing) and student*)	Pharmacy Student or Nursing Student Baccalaureate
	Education	(educat*or curricul* or course* or training or degree* or undergraduate* or facult* or school* or student*)	Education or Curriculum or Integrated Curriculum or Medical Education or Pharmacy Education or Nursing Education or Nursing Baccalaureate.
IPA	Patient / medication safety	(patient* safety or medication* safety or medicine* safety or medication* error* or adverse drug* event*)	
	Pharmacy	((pharmacist* or pharmacy or nurse* or nursing) and student*)	
	Education	(educat* or curricul* or course* or training or degree* or undergraduate* or facult* or school* or student*)	

Appendix 2: Data extraction tables – systematic narrative review

Table 1. Nursing studies

#	Author, year& country	Title	Aim	Study design	Method	Framework/ theory	Findings	Quality check/ tool used
1	Adhikari et al. (2014) Scotland	A multi-disciplinary approach to medication safety and the implication for nursing education and practice.	To illustrate two main aspects of medication safety practices that have been elicited from an action research studies.	Qualitative.	An ethnography style observational method, in-depth interviews, with nursing staff and students, informal discussion with HC professional, focus groups.	None.	The Five Rights principle during medication administration is not enough for holistic medication safety. There is a need to strengthen the multi-disciplinary teamwork. Nurses need to have sufficient knowledge of pharmacology and medication safety.	Yes – CASP tool.
2	Armstrong et al. (2013)USA	Fundamentally updating fundamentals.	This article illustrates an effective approach to using quality and safety as an organising framework for any pre-licensure fundamentals of nursing course.	Description of effective approach.	Embedding nursing skills in the national safety initiatives.	Six competencies of the QSEN.	Providing pre-licensure students with a strong foundation in quality and safety in an introductory clinical course facilitates early adoption of quality and safety competencies as core practice values. Embedding basic nursing care skills in the context of national patient safety initiatives explicates the connection of quality nursing care to improving patient outcomes.	No.

#	Author, year& country	Title	Aim	Study design	Method	Framework/ theory	Findings	Quality check/ tool used
3	Attree et al. (2008) UK	Patient safety in an English pre-registration nursing curriculum	To explore the perception of nursing students, educators and stakeholders about patient safety in an English pre-registration nursing curriculum.	Mixed study; quantitative and qualitative approach.	Content analysis of the curriculum was used. Focus group interviews and semi-structured individual interviews using thematic analysis.	Based on the Nursing and Midwifery Council (NMC) 2002 curriculum Guidelines.	Patient safety content: Patient safety was not explicitly addressed in the curriculum. Learning and teaching methods of patient safety integrated into lectures, theory and principles, problem based scenarios, individual rather than systematic approach to learning. Defence and blame culture in both education and clinical practice, do not discuss and learn from patient safety incidents. Learning outcomes of patient safety: students gained most knowledge and experience from clinical practice.	Yes – MMAT.
4	Badir et al. (2015) Turkey	Using High-fidelity Simulation as a Learning Strategy in an Undergraduate Intensive Care Course.	To understand students' perceptions of the use of simulation in nursing courses.	Qualitative: case study used focus groups and interview.	Course instructors wrote three simulation scenarios based on pre-defined learning objectives.	None.	This study revealed that high-fidelity simulation is an ideal method of promoting learning by helping students transfer theory into practice, build confidence and teamwork, and raise professional awareness.	Yes – CASP tool.

#	Author, year& country	Title	Aim	Study design	Method	Framework/ theory	Findings	Quality check/ tool used
5	Bohomol, E. (2019). Brazil	Patient safety education of the graduation in Nursing from the teaching perspective	a) To identify contents related to Patient Safety (PS) contemplated in the curricular units of a Nursing undergraduate course, according to the teachers who work in it, b)And to know the teaching methodologies and evaluation strategies used.	Qualitative: case study.	A descriptive case study was carried out with 15 professors of the nursing undergraduate course of a Brazilian public institution.	World Health Organizatio n (WHO) patient safety curriculum guide.	There are a lack of PS content in the undergraduate course (eight topics as per WHO guide) including 'What is PS', Why applying human factors is important for PS', and 'Learning from errors to prevent harm." However, the use of different teaching methodologies and evaluation strategies, both traditional and innovative, were identified	Yes – CASP tool.
6	Bressan et al. (2016) Italy	Measuring patient safety knowledge and competences as perceived by nursing students: An Italian validation study.	The aim of this study was to assess the validity and the reliability of the H-PEPSS tool in the context of Italian nursing education.	Quantitative, questionnaire (H-PEPSS)	A validation study using a cross-sectional design was undertaken.	None.	The H-PEPS Italian version is a valid tool capable of evaluating the self-perception of nursing students regarding patient safety knowledge and competence.	Yes – Guyatt tool.
7	Bush et al. (2015) USA	Cultivating a Culture of Medication Safety in Pre-licensure Nursing Students.	The objective of this education project was to design comprehensive, engaging, learner-centred, online modules that increase knowledge, skills, and	Design of online instructions for medication safety course.	Design of online instructions that used a stand-alone set of modules. following these steps: 1-Analysis of the problem. 2-Developing of a	QSEN.	Use of the QSEN competency as a guide could ensure that students are given an opportunity for knowledge acquisition, skills practice, and the development of attitudes.	None.

#	Author, year& country	Title	Aim	Study design	Method	Framework/ theory	Findings	Quality check/ tool used
			attitudes about medication safety.		learning task map. 3-Design of learning activities and assessments. 4-Sample learning activities. 5-Evaluation.			
8	Chenot et al (2010) USA	Frameworks for patient safety in the nursing curriculum.	To examine current patient safety education for nursing students and investigate nursing student awareness, skills and attitudes about patient safety.	Quantitative, survey.	Phases I and II: A survey research, the Health Professional Patient Safety Assessment Curriculum Survey (HPPSACS), a 34 item instrument, exploratory factor analysis and alpha reliability Phase III: A content analysis.	QSEN.	1-At least three of the six QSEN competencies: patient-centred care, teamwork and collaboration evidence-based practice, quality improvement, safety, and informatics were included in nursing curricula of participating academic institutions. 2-Method currently used to teach patient safety curriculum= (QSEN). 3-Nursing students' learning about patient safety, sensitivity to their own role, responsibility for patient safety. Themes identified: comfort, error reporting, denial and culture. Evidence was found of characteristics related to demographic variables, race and ethnicity; relationship	Yes – Guyatt tool.

#	Author, year& country	Title	Aim	Study design	Method	Framework/ theory	Findings	Quality check/ tool used
							between type of collegiate and nursing students' perceptions of their patient safety competence. Younger female students were not as comfortable with patient safety issues.	
9	Cooper (2013) USA	From the school of nursing quality and safety officer: nursing students' use of safety reporting tools and their perception of safety issues in clinical settings.	1-Describes the innovative new role of quality and safety officer (QSO) developed by one University. 2-Describes the results of a study about the use of safety tools and identifying the students' perceptions of safety issues, communication, and safety reporting in the clinical setting.	Exploratory survey.	A short survey on the use of error reporting and near miss reporting systems was distributed by e mail to 669 pre-licensure students.	QSEN.	1-Responses of 145 pre-licensure nursing students suggest that it is difficult to get all errors and near-miss events reported. 2-Barriers for nursing students are similar to the barriers nurses and physicians identify in reporting errors and near-miss events. 3-The survey reveals that safety for the patient is the primary concern of the student nurse.	Yes – Guyatt tool.
10	Cooper (2014) USA	Nursing student medication errors: A snapshot from a school on nursing's quality and safety officer.	To discuss nursing student medication errors identified at a university school of nursing.	Case study using medication error reporting method.	The Quality and Safety Officer (QSO) at the nursing school has collected five semesters of error reports from nursing students.	None.	Three possible categories of medication errors were identified: Administration rights, system issues, and knowledge and understanding. These are the three basic categories in	Yes – CASP tool.

#	Author, year& country	Title	Aim	Study design	Method	Framework/ theory	Findings	Quality check/ tool used
							which medication errors fall. This identification can help the faculty know where to add to content and experience for nursing students.	
11	Day et al. (2007) USA	Integrating quality and safety content into clinical teaching in the acute care setting.	To describe innovative approaches to integrating quality and safety content into existing clinical practice.	Description of innovative approaches.	Using three exercises which describe ideas for incorporating quality and safety content into a traditionally constructed clinical experience in an acute care area.	QSEN.	Strategies described require a shift in attention rather than changes in course content and can be included in any clinical rotation in an acute care setting.	No.
12	Debourgh et al. (2012b) USA	Patient manifesto: a professional imperative for pre-licensure nursing education.	A call for the educators to critically review their pre-licensure curricula for inclusion of teaching and learning activities that are focused on patient safety.	Proposal to improve pre-licensure nursing education.	Curriculum revision.	QSEN.	Nurse educators need to revise pre-licensure curricula to include substantive teaching and learning activities focused on nursing care-sensitive patient outcomes and, specifically, patient safety. Instructional strategies focused on human and systems factors implicated in medical error provide opportunities to develop the essential skills of situational awareness,	No.

#	Author, year& country	Title	Aim	Study design	Method	Framework/ theory	Findings	Quality check/ tool used
							clinical reasoning, and judgement.	
13	Debourgh, G, A. (2012a) USA	Synergy for patient safety and quality: academic and service partnerships to promote effective nurse education and clinical practice.	A nursing school and hospital affiliate engaged in a partnership to increase opportunities for students to acquire these competencies.	Quantitative, survey.	A descriptive pilot study design with a convenience sample of students (N = 24), a pre-licensure clinical nursing course measured students' safety and quality knowledge and the students' perceptions of team behaviors and communication effectiveness.	QSEN.	Survey data reveal moderate to large effect sizes in gains for safety and quality knowledge and for students' increased confidence in their impact on patient care outcomes.	Yes – Guyatt tool.
14	Dolansky et al. (2013) USA	Nursing student medication errors: A case study using root cause analysis (RCA).	To present a case study that highlights an undergraduate nursing student medication error and the application of an RCA.	Case study.	Using of RCA to evaluate, identify the causes of medication error incidents.	QSEN.	Factors identified were environmental, personal, unit communication and culture, and education.	Yes – CASP tool.
15	Duhn et al. (2012) Canada	Perspective on patient safety among undergraduate nursing students.	To explore nursing students' perspectives on patient safety and the extent to which patient safety is addressed in the classroom and clinical	Quantitative study, questionnaire. (H-PEPSS)	Cross sectional study included students enrolled on a Bachelor of Nursing course in Canada, using questionnaire.	None.	Responses were favourable, with students reporting confidence in learning about variety of patient safety competencies and the 3rdand 4th year students who reported decreasing levels of confidence. There	Yes – Guyatt tool.

#	Author, year& country	Title	Aim	Study design	Method	Framework/ theory	Findings	Quality check/ tool used
			settings.				was a low to moderate correlation between classroom and clinical responses. It is important to engage students consistently in safety principles early in and throughout their health care programmes	
16	Gantt et al. (2009) USA	Using simulation to teach patient safety behaviours in undergraduate nursing education.	To describe how our college of nursing began to integrate patient safety instruction into simulation experiences for undergraduate nursing students.	Evaluation using a competency checklist.	A system for evaluating and grading students was developed. Data on student safety behaviours were collected before and after implementation of instruction designed to improve adherence to hand washing and patient identification procedures.	None.	In the first semester students did not demonstrate satisfactory performance of either hand hygiene or patient identification 61% of the time. After instruction, students still did not perform these procedures consistently 38% of the time.	No
17	Gregory et al. (2007) Canada	Patient safety: where is nursing education.	1- To encourage educators to contemplate a culture shift whereby student's error is considered from an education systems	Commentary.	Commentary on patient safety in nursing education in Canada	None.	Exclusive focus on individual errors, and not system errors, that is of concern regarding nursing education and patient safety. Educators need to engage in a culture shift whereby	No.

#	Author, year& country	Title	Aim	Study design	Method	Framework/ theory	Findings	Quality check/ tool used
			perspective. 2- Under the rubric of patient safety educators are encouraged to address discontinuities between education and practice sector.				student error is considered from an education systems perspective.	
18	Hanson, J. (2016) Australia	Surveying the experiences and perceptions of undergraduate nursing students of a flipped classroom approach to increase understanding of drug science and its application to clinical practice.	The aim of the study was to elicit undergraduate nursing students' responses to a flipped classroom approach in pharmacology lectures and evaluate the impact on their understanding of drug science and its application to clinical practice.	Quantitative, questionnaire.	A descriptive research method was used that involved an Internet-based self-completion questionnaire.	None.	Students who engaged with digitally recorded lectures (e-Lectures) prior to face-to-face workshops stated that they had greater understanding of the subject and enhanced critical thinking skills. The replay function of the e-Lecture was perceived by some students as most beneficial to independent learning. However, for some students, time constraints meant that they relied on e-Lectures alone, while others preferred traditional teaching methods.	Yes – Guyatt tool.

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19	Hayes et al. (2015) Australia	Nurse interrupted: Development of a realistic medication administration simulation for undergraduate nurses.	This paper describes a simulated role-play experience that was developed to enable undergraduate nurses to experience, reflect on and analyse their responses to interruptions during medication administration.	Description of educational intervention (Simulated role-play experience).	The simulation design presented in this paper was underpinned by both nursing and educational theorists, in combination with established simulation frameworks.	Jeffries Simulation framework (2005)/ educational theorists including; Benner's novice to expert, Tanner's model of clinical judgement, and Kolb's theory of experiential learning (Benner, 2001; Kolb, 1984; Tanner, 2006).	Through exposure to clinical experiences in a safe environment, simulation technologies have been shown to create positive learning experiences and improve deductive reasoning and analysis.	None.
20	Hewitt et al. (2015) Australia	An education intervention to improve nursing students understanding of medication safety.	Examines students' perceived effectiveness of an educational intervention, designed to demonstrate the	Quantitative, survey.	A series of short digital recordings were developed along with discussion points to illustrate multidisciplinary interactions involved	The intervention was underpinne d By adult and experiential	Interventions that highlight systems factors that contribute to medication errors may play an Important role in raising awareness of these issues and encourage students to	Yes – Guyatt tool.

#	Author, year& country	Title	Aim	Study design	Method	Framework/ theory	Findings	Quality check/ tool used
			Complex and multidisciplinary factors of systems related failures in medication administration.		in medication administration. A small sample of second and third year undergraduate nursing students (n. 28) evaluated the effectiveness of the educational resource.	learning concepts and used a problem-based learning approach.	carry this knowledge into clinical practice.	
21	Hickey et al. (2010) USA	Integrating the institute of medicine competencies in a Baccalaureate curricular revision: process and strategies.	To describe the process of a recent baccalaureate curricular revision at one School of Nursing that used the Institute of Medicine competencies as part of an innovative framework to create a new curriculum.	Curriculum revision process.	Curriculum revision using a new developed framework reflecting IOM competencies.	Institute of Medicine competencies (IOM).	All health professionals should be educated to: 1. Provide patient-centered care 2. Work as members of an interdisciplinary team 3. Employ evidence-based practice 4. Apply quality improvement approaches 5. Utilise informatics.	No.
22	Holdforth et al. (2013) Ireland	The strategic role of education in the prevention of medication errors in nursing (part 2).	To illuminate the significant role that education can play in the preparation of nurses for their roles in medication management and the marked reduction in errors and improved	Proposal for change.	Proposal for change.	NMC.	There is a need to integrate more content and dedicate more time to the whole area of pharmacology and medication management, both in terms of theory and skill development in the nursing curriculum.	No.

#	Author, year& country	Title	Aim	Study design	Method	Framework/ theory	Findings	Quality check/ tool used
			patient outcomes in this area of practice that they can yield.					
23	House et al. (2016) USA	Low-Fidelity Simulation to Enforce Patient Safety	The purpose of this study was to identify students' patient safety knowledge and explore learners' perceptions of a safety simulation strategy, specifically focusing on students' (a) Ability to identify patient safety issues, (b) Perception on their ability to identify patient safety issues, and (c) evaluation of a low-fidelity safety simulation strategy.	Quantitative study, questionnaire.	A descriptive design was used with a convenience sample of students enrolled in associate, bachelor, or accelerated bachelor degree programmes.	None.	The results demonstrated that participants struggled to identify patient safety issues. A very small percentage of participants at each station were successful in identifying every safety issue at the station. Participants valued the learning experience and felt it increased their confidence in identifying patient safety issues.	Yes – Guyatt tool.
24	Jarzemsky et al. (2010) USA	Incorporating quality and safety education for nurses competencies in simulation scenario design.	Describe a strategy for systematic planning of simulation-based training that incorporates knowledge, skills, and attitudes as defined by the Quality and	Descriptive.	Systematic planning of simulation-based training.	QSEN.	Five scenarios serving first-year students in medical-surgical settings have been developed using this strategy: patient-centred care, teamwork and collaboration, evidence-based practice, informatics, and safety.	No.

#	Author, year& country	Title	Aim	Study design	Method	Framework/ theory	Findings	Quality check/ tool used
			Safety Education for Nurses (QSEN) initiative.					
25	Ji, Y., et al. (2021). Korea	Developing an integrated curriculum for patient safety in an undergraduate nursing program: a case study	a) To develop an integrated curriculum that incorporates PS factors in the existing curriculum b) And to increase PS competencies in nursing students	Qualitative: case study.	A case study approach was adopted to explain the development processes of a new curriculum integrating PS in the existing outcome-based curriculum of a nursing college.	None.	This study demonstrated that PS topics should be addressed in both theoretical and practical settings across the entire nursing curriculum per the continuity and sequence of education principles.	Yes – CASP tool.
26	Kirwan, M., et al. (2019). Europe - 27 countries	Regulation and current status of patient safety content in pre-registration nurse education in 27 countries: Findings from the Rationing - Missed nursing care (RANCARE) COST Action project	a) To establish how PS teaching is incorporated into pre-registration education of nurses across 27 countries. b) How nursing is regulated within countries was examined, along with national guidelines related to nurse education. (HEIs were asked to provide details of pre-registration nurse training and how	Quantitative, questionnaire	This on-line consultation was carried out within the RANCARE COST Action project	WHO patient safety curriculum guide. (Used as a reference.)	PS as a topic generally remains a hidden element within the curriculum, taught across many subjects. There is also variation in how nursing is regulated across the countries, with nursing professionalism remaining a challenge in some states. There are no guidelines at EU level which address how public safety should be taught to nursing students, and regulatory bodies have not yet advocated criteria on the subject. The WHO	Yes – Guyatt tool.

#	Author, year& country	Title	Aim	Study design	Method	Framework/ theory	Findings	Quality check/ tool used
			patient safety is taught within programs.)				guidelines for teaching PS are evidently underutilized in nurse education.	
27	Lee et al. (2016) South Korea	Patient safety education and Baccalaureate nursing students' patient safety competency: A cross-sectional study.	This study examined current nursing programmes in South Korea in terms of content and teaching methods of patient safety education from nursing students' perceived educational experiences and assessed students' self-reported patient safety competency.	Quantitative study, questionnaire.	Descriptive cross-sectional study examines Baccalaureate nursing programs in South Korea.	QSEN.	The majority of students (81.6%) reported that they had received patient safety education during coursework. Patient safety education was delivered primarily by lecture rather than during laboratory or simulation sessions. The degree of coverage of QSEN competency and the students' self-reported competency in total and attitude scores showed statistical differences among nursing schools. Students' attitude score was significantly higher than skill and knowledge. These results confirm the need to revise the nursing curriculum and to use various teaching methods to deliver patient safety education more comprehensively and effectively. Furthermore,	Yes – Guyatt tool.

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							there is a need to develop an integrated approach to ensuring students' balanced competency.	
28	Lee et al. (2013) Taiwan	The effectiveness of an e-learning programme on paediatric medication safety for undergraduate students: A pre-test–post-test intervention study.	To evaluate the effectiveness of an e-learning program to increase paediatric medication management among students who take paediatric nursing courses.	This intervention study used Qualitative and quantitative methods to evaluate the programme.	Paediatric medication management, including paediatric medication Knowledge and calculation ability was measured at the beginning of the first class, at the completion of the lectures, and at the completion of the clinical practicum. The program was evaluated qualitatively and quantitatively.	None.	Using an e-learning program on paediatric medication management is an effective learning method in addition to sitting in a regular lecture course.	Yes – MMAT.
29	Lee, S. E., et al. (2020). South Korea	Patient safety education in pre-registration nursing programmes in South Korea	a) This study investigated how PS is currently taught in pre-registration nursing programs across South Korea b) And it explored nurse educators' perspectives on curriculum change.	Quantitative, survey.	This descriptive study used data collected during a 2019 accreditation workshop provided by the Korean Accreditation Board of Nursing Education. (A pen and paper based survey was completed	None.	Little consistency was found in approaches to teaching PS. PS topics are addressed throughout various nursing courses, and PS education is limited in hours of instruction and breadth of content. A majority of respondents indicated that additional supports are	Yes – Guyatt tool.

#	Author, year& country	Title	Aim	Study design	Method	Framework/ theory	Findings	Quality check/ tool used
					by 80 nurse educators working in 16 regions throughout Korea.		needed, including a national standardized curriculum for PS education.	
30	Lee, S. E., et al. (2020). South Korea	Assessment of patient safety and cultural competencies among senior baccalaureate nursing students	This study examined nursing students' educational experiences on self-reported perceptions of PS and cultural competence related to curriculum content and learning venues.	Quantitative, survey.	This is a descriptive, correlational, cross-sectional study	None.	The results support the need for curriculum development to include all important aspects of PS and cultural competencies in various teaching/learning venues.	Yes – Guyatt tool.
31	Lukewich et al. (2015) Canada	Undergraduate Baccalaureate nursing students' self-reported confidence in learning about patient safety in the classroom and clinical settings: An annual cross-sectional study (2010–2013).	To explore nursing students' self-reported confidence in learning about patient safety during their undergraduate Baccalaureate nursing program	Quantitative study, questionnaire (H-PEPSS)	The Health Professional Education in Patient Safety Survey was administered annually. The Health Professional Education in Patient Safety Survey captures how the six dimensions of the Canadian Patient Safety Institute Safety Competencies Framework and broader patient safety issues are addressed in health professional education, as well as	The six dimensions of the Canadian Patient Safety Institute Safety Competencies Framework.	In general, nursing students were relatively confident in what they were learning about the clinical dimensions of patient safety, but they were less confident about the socio-cultural aspects of patient safety. Confidence in what they were learning in the clinical setting about working in teams, managing adverse events and responding to adverse events declined in upper years. The majority of students did not feel comfortable speaking up	Yes – Guyatt tool.

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					respondents' self-reported comfort ~~in~~ with speaking up about patient safety issues.		about patient safety issues.	
32	Madhavanp raphakaran (2012) Oman	Patient safety and nursing education.	To comments on patient safety in nursing education.	Commentary.	Commenting on patient safety in nursing education.	QSEN/IOM.	Patient safety can be enhanced through: Evidence based education and practice. Interdisciplinary collaboration in nursing education. Simulation training. Faculty development. Use of informatics in all areas of education and health care to reduce errors and enhance communications. Faculty involvement with inter-professional team on patient care unit and greater communication and collaboration between all parties involved.	No.
33	Mansour, M. (2015) UK	Factors analysis of nursing students' perception of patient safety education.	To investigate the factor structure of the Health Care Professionals Patient Safety Assessment Curriculum Survey (HPPSACS) when	Quantitative, questionnaire.	Principal component analysis was conducted to explore the factors emerging from the students' responses.	None.	Factors identified were: "Willingness to disclose errors", "Recognition and management of medical errors", "The Perceived inter-professional context of patient safety" and "The	Yes – Guyatt tool.

#	Author, year& country	Title	Aim	Study design	Method	Framework/ theory	Findings	Quality check/ tool used
			completed by a group of nursing students from one University in the UK.				perceived support and understanding for improving patient safety".	
34	Mansour, M. J., et al. (2018). Saudi Arabia	Integrating Patient Safety Education in the Undergraduate Nursing Curriculum: A Discussion Paper.	This paper explores the opportunities and challenges for integrating PS education in the undergraduate nursing curriculum	Discussion paper	Four dimensions of undergraduate nursing education are examined: a) National accreditation of nursing programs, b) Building a competency-based nursing education, c) Creating a model of nursing education d) And building faculty capacity in PS education and research.	QSEN & WHO patient safety curriculum guide. (Used as a reference)	Incorporating PS in a nursing curriculum could be "institutionalized" by making it a pre-requisite for granting program accreditation. A key challenge remains building faculty capacity who are experts in both PS teaching and research to enable a shift in the PS "mind-set" for the future nursing workforce.	None

#	Author, year& country	Title	Aim	Study design	Method	Framework/ theory	Findings	Quality check/ tool used
35	Mansour (2013) UK	Examining patient safety education in pre-registration Nursing curriculum: Qualitative study.	To examine the views of nursing students and faculty members on patient safety education in a pre-registration adult nursing curriculum in relation to the WHO' patient safety themes.	Qualitative.	Qualitative method, utilising 20 semi-structured interviews with pre-registration adult nursing students and faculty members. The data were analysed thematically.	WHO patient safety curriculum guide.	Three main themes emerged from the participants' views: 'Not explicitly linked to patient safety', 'Mismatch between theory and practice' and 'The role of the mentor in practice'. The power imbalance between the students and staff in clinical placement appeared to have rendered many students reluctant to challenge unsafe practice.	Yes – CASP tool.
36	Mariani et al. (2015) USA	Improving Students' Safety Practice Behaviours Through a Simulation-Based Learning Experience.	The purpose of this study was to determine whether senior-level undergraduate nursing students' perceptions and comfort level regarding safety principles and practices increased after participating in a safety-focused simulation-based experience (SBE).	Quantitative, the healthcare professionals' patient safety assessment (HPPSA) survey was used to measure students' perceptions and comfort levels regarding patient safety practices.	The study design was a non-experimental pre-test/post-test design. The Healthcare Professionals Patient Safety Assessment (HPPSA) was used to measure students' perceptions and comfort level regarding patient safety practices.	None.	The findings suggest simulation is a teaching strategy that may contribute to increasing undergraduate nursing students' comfort with reporting or investigating errors.	Yes – Guyatt tool.

#	Author, year& country	Title	Aim	Study design	Method	Framework/ theory	Findings	Quality check/ tool used
37	Masters, K. (2016) USA	Integrating quality and safety education into clinical nursing education through a dedicated education unit.	The purpose of this project was to improve nursing students' knowledge of quality and safety by integrating Quality and Safety Education for Nurses into clinical nursing education through development of a dedicated education unit.	Integrating clinical model of nursing education using qualitative and quantitative methods to evaluate the project.	Integrating clinical model of nursing education + 2 sets of questions to assess students' knowledge and focus groups interview to assess nurses experience.	QSEN.	The result of the student's knowledge assessment indicated that students who participated in the dedicated education unit had higher scores than those with traditional clinical rotations. There were five themes emerged from the qualitative data including thirsting for knowledge, building teamwork and collaboration, establishing trust and decreasing anxiety, mirroring organisation and time management skills, and evolving confidence in the nursing role.	Yes – MMAT.
38	Mawhirter et al. (2016) USA	Expect the Unexpected: Simulation Games as a Teaching Strategy.	The aim of this project was to have students engage in a fun simulation game atmosphere to reduce their fears about unexpected patient events.	Pilot teaching strategy using two methods of evaluation.	The gamified simulation was designed as an innovative teaching strategy. three gaming scenarios were written with increasing complexity in patient safety and environment of care.	QSEN assessment and constructivi st learning theory.	One hundred percent of the participants expressed that the learning experience was beneficial, engaging, and reduced their fears of the unexpected. All students expressed increased readiness for the clinical setting based on this experience. The	None.

#	Author, year& country	Title	Aim	Study design	Method	Framework/ theory	Findings	Quality check/ tool used
					Groups divided themselves into teams for the sessions; each team consisted of two or three similar-level students. Each team participated in all three rounds of real-time, gamified high-fidelity simulation exercises using a human patient simulator.		gamification of patient safety simulation scenarios was found to be a creative innovation to increase student enthusiasm for learning and self-reflection.	
39	Mbuthia, N. N. and M. M. Moleki (2018). Kenya	Perspectives on Patient Safety Education in the Kenyan Preregistration Nursing Curriculum.	This study aimed at identifying; a) Explicit PS concepts in the Kenyan nursing curriculum b) And exploring the perspectives of the nursing faculty members and clinical nurses on the integration of PS in the curriculum.	Qualitative: document review and semi-structured interviews	A qualitative content analysis was conducted on the relevant curriculum documents from two universities. In-depth, semi-structured interviews were conducted on a purposive sample	None	The curriculum content analysis did not identify any explicit PS content but the content was rather implicit within the curriculum as a series of statements and inferences to PS. To ensure training of a nurse who is competent in PS; a) The concepts must be integrated into the curriculum, b) The academic and clinical faculties need to be well-equipped to teach and assess these concepts, c) The PS culture in clinical placement sites should be	Yes – CASP tool.

#	Author, year& country	Title	Aim	Study design	Method	Framework/ theory	Findings	Quality check/ tool used
							conducive to allow for learning about PS, d) And better collaboration between the academic and clinical settings for integration of PS in nursing education should be realised	
40	Miller et al. (2009) USA	Student learning outcomes after integrating of quality and safety education competencies into a senior- level critical care course.	This pilot study is to test the effects of structured classroom and clinical content-related to safety and quality of health care systems.	Mixed studies, qualitative (focus group) Quantitative (questionnaire including KSA items).	Mixed-method quasi-experimental study, both repeated-measure analysis of variance (ANOVA) for the quant. data and content analysis for qualitative data.	KSAs.	A combination of classroom and clinical learning activities will have a strong impact on student knowledge, skills and attitudes related to safety and quality.	Yes – MMAT.
41	Milligan et al. (2006) UK	Establishing a culture for patient safety – the role of education.	This paper argues that the process of making significant moves towards a patient safety culture requires changes in healthcare education.	A description of the patient safety agenda.	A description of the patient safety agenda.	None.	There is a significant need to improve patient safety education and to include human factors theory to healthcare education.	No.
42	Omura et al. (2015) Japan	Measuring the impact of an inter-professional multimedia learning resource on Japanese nurses and nursing	This study was undertaken to evaluate the impact of an inter-professional learning resource on the intentions of	Quantitative, questionnaire - using a quasi-experimental design.	This study used a quasi-experimental design and convenience sampling. Outcomes of attitude, subjective norms, perceived behavioural	Theory of Planned Behaviour: Medication Safety Questionnaire.	The results demonstrate the potential for inter professional multimedia learning resources to positively impact the behaviours of Japanese registered nurses in relation	Yes – Guyatt tool.

#	Author, year& country	Title	Aim	Study design	Method	Framework/ theory	Findings	Quality check/ tool used
		students using the Theory of Planned Behaviour Medication Safety Questionnaire.	registered nurses and nursing students to practice in a manner promoting medication safety.		control, and behavioural intention in relation to medication safety were measured using the Japanese version of the Theory of Planned Behaviour: Medication Safety Questionnaire.		to safe medication practices.	
43	Page et al. (2006) UK	Addressing medication errors- the role of undergraduate nurse education.	To explore the views of nursing students and lecturers on the current content of undergraduate pharmacology education, and the extent to which this content prepares nurses for their role in the prevention of medication error.	Qualitative (interviews).	Qualitative method interviews were conducted with 46 participants, both students and lecturers.	None.	The lectures and students expressed dissatisfaction with current pharmacology education and strongly indicated that there is a need for further educational initiatives.	Yes – CASP tool.
44	Russell et al. (2013) UK	Safety: an integrated clinical reasoning and reflection framework for undergraduate nursing students.	To describe the integration of clinical reasoning and reflection framework for undergraduate nursing students.	Description of a learning tool.	Designing of a reflective clinical reasoning activity based on the safety template.	Safety is proposed as framework.	SAFETY has proven to be a useful tool for integration of content knowledge, clinical reasoning, and reflection on essential professional practice issues for Baccalaureate nursing students.	No.

#	Author, year& country	Title	Aim	Study design	Method	Framework/ theory	Findings	Quality check/ tool used
45	Ruth-Sahd, L, A (2014) USA	A call to action: nursing education must embrace change and move forward.	Highlights educational challenges, and will compare and contrast these challenges in nursing education with those taking place in medical education and will present creative admission requirements and teaching strategies.	Commentary.	Commentary.	None.	Baccalaureate nursing curriculum requires revision due to the gap between education and practice. There is a need for creative teaching strategies to foster critical thinking, critical analysis and reasoning skills.	No.
46	Sanko et al. (2015) USA	Learning from Simulation-Based Medication Event Reporting: A Mixed Methods Analysis.	The aims of this study were to (a) Study trends in medication-related events as undergraduate students progress through the nursing pro- gram, (b) More fully understand how students' learning from adverse events changes over time, and (c) Finally, explore how students' perceptions of the precipitating factors associated	A mixed methods analysis (Convergent parallel design).	This study used the convergent parallel design and followed three cohorts of students longitudinally. As part of the simulation programme, students were asked to report any adverse events committed or observed during simulation encounters. The reported medication events were analysed using chi-square	None.	A decreasing trend of reported medication events across courses was found. Chi-square analysis showed statistically significant differences in the categories of wrong dose, wrong patient, and failing to ID the patient, communication breakdown, medication handling, knowledge, and personal distraction. Themes identified via content analysis of the open-ended questions included needing to improve communication;	Yes – MMAT

#	Author, year& country	Title	Aim	Study design	Method	Framework/ theory	Findings	Quality check/ tool used
			with adverse events evolve as they gain more nursing experience, knowledge, and skills.		analysis and content analysis.		double checking orders, dosages, and patient identifiers; needing to gain more medical knowledge; deficiencies in assessment skills; poor focus; distraction; and nervousness.	
47	Sears et al. (2008) Canada	The relationship between simulation in nursing education and medication safety.	This experimental study examined whether the use of clinical simulation in nursing education could help reduce medication errors.	Questionnaire.	A randomised control study was conducted.	None.	Students in clinical placement generate fewer medication errors if they have had prior exposure to a related, simulation-based experience.	Yes – Guyatt tool.
48	Sherwood et al. (2007) USA	Quality and safety curricula in nursing education: matching practice realities.	Examines current views of quality and safety, describes application of quality and safety competencies in practice, proposes implications for redesigning nursing education programmes to match patient and practice needs, and issues a call to nurse executives and nurse	Curriculum review.	Curriculum review to redesign nursing education programmes.	QSEN.	Emerging views of quality and safety and related competencies as applied in practice have corresponding implications for the redesign of nursing education programmes.	No.

#	Author, year& country	Title	Aim	Study design	Method	Framework/ theory	Findings	Quality check/ tool used
			educators to work together to address the critical need to transform nursing curricula with quality and safety content.					
49	Smith et al. (2007) USA	Current assessments of quality and safety education in nursing.	To assess current levels of integration of quality and safety content in pre-licensure nursing curricula.	Quantitative.	This descriptive study was conducted using survey methods and an electronic survey management programme.	QSEN.	Patient–centred care was reported as the competency most frequently threaded in the curriculum (95%), followed by safety (89%) and teamwork not be representative of nursing North Carolina. The overall return collaboration (82%). The three lowest rating were evidence based practice (73%), quality improvement (54%) and community college informatics (48%).	Yes – Guyatt tool.
50	Stevanin et al. (2015) Italy	Knowledge and competence with patient safety as perceived by nursing students: The findings of a cross-sectional study.	To describe a) The perceptions of nursing students regarding their own PS knowledge and competence, b) The differences, if any, in the PS perceptions of nursing students	Quantitative study, questionnaire (H-PEPSS)	The Italian version of the Health Professional Education in Patient Safety Survey (HPEPSSIta) and open- ended questions was administered to the students after having	The six dimensions of the Canadian Patient Safety Institute Safety Competenci	A total of 573 students (response rate 92.4%) participated. Around a quarter (28.8%) of students reported having experienced an adverse event or close call during their clinical experience. The settings where they	Yes – Guyatt tool.

#	Author, year& country	Title	Aim	Study design	Method	Framework/ theory	Findings	Quality check/ tool used
			attending the first, the second and third academic year; c) The adverse events or close calls that students have experienced/witnesse d during the clinical placements, and d) the perception of safety in the clinical environments attended.		obtained their informed written consent.	es Framework.	learn were perceived as unsafe by 46.9% of students. PS knowledge and competence as perceived by students, was high (Median=4) in all factors and dimensions of the H-PEPSSIta tool. High PS knowledge and competence was reported by first-year students, moderate by second-year students and higher at the end of the third-year.	
51	Steven et al. (2014) UK	Patient safety in nursing education: contexts, tensions and feeling safe to learn.	To explore the formal and informal ways the pre-registration nursing students learn about patient safety.	A qualitative multi method.	A multi-method design: Scoping of nursing curricula, in-depth case studies, interviews, focus groups, and practice placement observation.	KSAs.	Within academic contexts patient safety was not visible as a curricular theme. In organisational contexts patient safety was conceptualised as a complicated problem, addressed via strategies, systems and procedures. In practice, students learnt by observing staff who acted as variable role models. The study highlights tensions both between and across contexts, which link to formal and informal patient	Yes – CASP tool.

#	Author, year& country	Title	Aim	Study design	Method	Framework/ theory	Findings	Quality check/ tool used
							safety education and impact negatively on students' feelings of emotional safety in their learning.	
52	Suliman, M. (2019). Jordan	Measuring Patient Safety Competence Among Nursing Students in the Classroom and Clinical Settings.	This study examined nursing students perceptions of PS knowledge and competencies	Quantitative study, questionnaire. (H-PEPSS)	An Arabic version of the Health Professional Education in Patient Safety Survey was administered to a convenience sample of 297 nursing students from two governmental universities in Jordan.	None.	The study suggests the need to close the gap between theory and practice in the Nursing curriculum. The adoption of a comprehensive framework that integrates PS knowledge and competencies is recommended.	Yes – Guyatt tool.
53	Sullivan et al. (2009) USA	Assessing quality and safety competencies of graduating pre-licensure nursing students.	To assess students 'perspectives of quality and safety content in their nursing programs along with self-reported levels of preparedness and perceived importance of the 6 QSEN competencies.	Quantitative, survey, descriptive study.	Graduating students (n =565) from 17US schools of nursing completed an electronic student evaluation survey.	QSEN.	Students reported exposure to QSEN knowledge areas, more often in classroom and clinical learning settings than in skills lab/simulation settings. Clinical experience outside of formal education was associated with perceptions of a higher level of preparedness for QSEN skills in several competencies.	Yes – Guyatt tool.

#	Author, year& country	Title	Aim	Study design	Method	Framework/ theory	Findings	Quality check/ tool used
54	Usher, K., et al. (2018). Australia	Patient safety content and delivery in pre-registration nursing curricula: A national cross-sectional survey study.	This survey study examined; a) How Australian nursing curricula address PS b) Identified where and how PS learning occurs; c) And described who is responsible for facilitating this learning.	Quantitative, questionnaire. A cross-sectional study.	An online survey was conducted to evaluate the PS content included and teaching methods used in Australian pre-registration nursing curricula.	None.	Approaches to teaching PS vary considerably between universities, where PS tended to be integrated within undergraduate nursing course subjects rather than explicitly taught in separate, stand-alone subjects. There were differences in: the amount of time allocated, who was responsible for the teaching and learning, and in which setting the learning occurred and was assessed. There was little indication of the existence of a systematic approach to learning PS, with most participants reporting emphasis on learning applied to infection control and medication safety (MS).	Yes – Guyatt tool.
55	Vaismoradi et al (2011) Iran	Patient safety: nursing students' perspectives and the role of nursing education to provide safe care.	To explore Iranian nursing students' perspectives regarding patient safety and the role of nursing education in developing their	Qualitative, semi-structured interviews for students from various academic	Qualitative using a content analysis approach, face to face semi structured interviews, purposive sampling.	None.	Three main themes emerged from data analysis: 1-safety as patient comfort, 2-not being knowledgeable or experienced enough.	Yes – CASP tool.

#	Author, year& country	Title	Aim	Study design	Method	Framework/ theory	Findings	Quality check/ tool used
			capabilities to provide safe care.	semesters.			3-being helped to internalise the principles and values of patient safety by adopting a humanistic approach towards patients and practising carefully in the workplace.	
56	Vaismoradi et al. (2014a) Iran	Nursing students' perspectives and suggestions on patient safety-implications for developing the nursing education curriculum in Iran.	To explore nursing students' perspectives and suggestions on developing patient safety aspects of the nursing curriculum in the context of Iranian culture.	Qualitative.	A qualitative method, focus groups with students, content analysis approach for data collection and analysis.	None.	(1) "Involving students fully in patient care" with subthemes 'building a trusting relationship between education and practice', and 'promoting inter-dependence between health-care providers', and (2) "Structuring patient safety education" with subthemes 'transforming nursing routines to evidence-based care', and 'connecting care to patient safety issues'.	Yes – CASP tool.
57	Vaismoradi et al (2014b) Iran	Nursing students' perspectives of the cause of medication errors.	To describe nursing students perspectives of the causes of medication errors.	Qualitative descriptive design.	Four focus groups were held with 24 nursing students from four different academic semesters. Using a qualitative descriptive design,	None.	Two main themes "Under-developed caring skills in medication management" and "unfinished learning of safe medication management", which was subdivided into	Yes – CASP tool.

#	Author, year& country	Title	Aim	Study design	Method	Framework/ theory	Findings	Quality check/ tool used
					themes and subthemes were identified by content analysis.		"drifting between being worried and being careful", and "contextualizing pharmacology education". All respondents felt that their education programs were leaving them vulnerable to "drug errors''.	
58	Weatherford et al. (2015) USA	Senior Nursing Students' Perspectives on Safety Competencies: An End-of-Program Outcome Evaluation.	To understand student attitudes regarding end-of-programme safety competencies in a BSN programme and to determine if curricular changes related to safety in a pre-licensure programme were achieved in both classroom and clinical areas.	Quantitative study, questionnaire (H-PEPSS)	A cross-sectional study of senior nursing students in a BSN programme was conducted during April 2013.	The survey based on Kirkpatrick's evaluation framework. The six dimensions of the Canadian Patient Safety Institute Safety Competencies Framework.	Results indicated that programme changes resulted in student satisfaction about their safety competencies in both settings. Significant findings included the perception that both classroom and clinical experiences contributed to a high awareness of patient safety in the curriculum. In contrast, previous reports using H-PEPSS with senior nursing students indicated lower mean scores in the classroom versus clinical and lower overall mean subscale scores than were found in this study (Duhn et al., 2012).	Yes – Guyatt tool.

#	Author, year& country	Title	Aim	Study design	Method	Framework/ theory	Findings	Quality check/ tool used
59	Whitehair et al. (2014) Australia	Identification of prescribing errors by pre-registration student nurses: A cross-sectional observational study utilising a prescription medication quiz.	To collect baseline data on pre-registration student nurses' ability to identify prescribing errors.	A cross-sectional observational design utilising a prescription medication quiz was employed. The quiz contained six prescriptions that simulated a national in-patient medication chart, and included common types of prescribing errors, as identified in the literature.	Statistical analysis of the data was performed using descriptive statistics, Pearson's product moment correlation coefficient (Pearson's r) 2-tailed test, and independent sample t-tests.	None.	That student nurses had ~~a~~ difficulty identifying the prescribing errors built into the prescription medication quiz. These results support the need for educators to consider alternative approaches to educating students about medication safety. Recommendations with the potential to address this gap in education through the use of simulation are proposed.	Yes – CASP tool.

Table2: Pharmacy studies

#	Author, year& country	Title	Aim/ Objectives	Study design	Method	Framework/ Theory	Findings	Quality check tool used
1	Alkatheri, A. M., et al. (2017). Saudi Arabia	Pharmacy Educators' Knowledge of Medication Safety and Their Perception Toward Its Integration into the Doctor of Pharmacy Curriculum in Saudi Arabia.	This survey assessed pharmacy educators' knowledge of MS and their perception toward its integration into the PharmD curriculum in Saudi Arabia. methods.	Quantitative.	A survey was administered to pharmacy educators at a college of pharmacy and its affiliate hospital. Knowledge, training, and perception toward integrating medication safety into the PharmD curriculum were evaluated.	None.	Perceptions toward MS integration into the curriculum varied significantly by general discipline, academic degree, years of experience and gender, with more than 50% of respondents indicating that MS should be covered within selected courses, and 65% indicating that such courses should be mandatory. Pharmacy practice educators had significantly higher levels of knowledge about MS than their non-practice counterparts.	Yes – Guyatt tool
2	Alwhaibi, M., et al. (2020). Saudi Arabia	Pharmacy students' attitudes toward patient safety in Saudi Arabia: a cross-sectional study.	This study explored the attitudes toward PS among pharmacy students in Saudi Arabia	Quantitative	A cross-sectional study was conducted among pharmacy students from four different universities using a self-administered questionnaire.	The Attitudes to Patient Safety Questionnaire III (APSQ-III)	There is a need for including PS courses in the curricula of the different pharmacy programs given the PS training importance in improving the quality of patient care. It is notable that around one-half of the surveyed pharmacy students did not receive	Yes – Guyatt tool.

#	Author, year& country	Title	Aim/ Objectives	Study design	Method	Framework/ Theory	Findings	Quality check tool used
							any courses on PS	
3	Atayee et al. (2016) USA	Using Simulation to Improve First-Year Pharmacy Students' Ability to Identify Medication Errors Involving the Top 100 Prescription Medications.	To evaluate first-year pharmacy students' ability to identify medication errors involving the top 100 prescription medications.	Quantitative study, questionnaire to evaluate educational intervention.	In the first quarter of a 3-quarter pharmacy self-care course, a didactic lecture on the most common prescribing and dispensing prescription errors was presented to first-year pharmacy students (P1) in preparation for a prescription review simulation done individually and as a group. In the following quarter, they were given a formal prescription review workshop before a second simulation involving individual and group review of a different set of prescriptions. Students were evaluated based on the number of correctly checked	None.	A prescription review module consisting of a didactic lecture, workshop and simulation-based methods to teach prescription analysis was successful at improving first year pharmacy students' knowledge, confidence, and application of these skills.	Yes – Guyatt tool.

#	Author, year& country	Title	Aim/ Objectives	Study design	Method	Framework/ Theory	Findings	Quality check tool used
					prescriptions and a self-assessment of their confidence in reviewing prescriptions.			
4	Bradly et al. (2011) UK	The role of hidden curriculum in teaching pharmacy students about patient safety.	To examine how hidden and informal curricula shaped pharmacy students' learning about patient safety.	Qualitative multi method design. Based upon Stewart's concept of knowledge contexts.	A preliminary study exploring planned patient safety content in pharmacy curricula at 3 UK schools of pharmacy was conducted. In-depth case studies were carried out at 2 schools to examine patient safety education delivered.	IOM.	Informal learning was assigned high levels of credibility by students. Elements of patient safety not adequately addressed in the formal curriculum such as: safe systems, errors and professionalism.	Yes – CASP tool.
5	Fuji et al. (2010) USA	Pharmacy student attitudes toward an inter-professional patient safety course: an exploratory mixed methods study.	The purpose of this study is to explore attitudes of pharmacy students toward an elective, inter-professional patient safety course.	Exploratory mixed methods.	This study used an exploratory mixed methods design. Quantitative data were collected from course evaluations, case study performance and final examination performance. Qualitative data were collected through interviews with seven	None.	Students through their case studies, demonstrated the ability to apply content knowledge to practical situations. Data from the course evaluation showed that students placed a high value on receiving patient safety education, and felt that the course should continue to be offered. Five major qualitative	Yes – MMAT.

#	Author, year& country	Title	Aim/ Objectives	Study design	Method	Framework/ Theory	Findings	Quality check tool used
					first-year pharmacy students. Qualitative themes were triangulated with descriptive results from quantitative analysis of data using a convergence model.		themes emerged from student interviews: putting a face on patient safety, reframing my role as a gatekeeper of patient safety, realising it is just part of the job, everyone in health care needs to be trained about safe systems and inter-professional learning is needed for safety to work.	
6	Holdford et al. (2011) USA	Teaching the science of safety in US Colleges and schools of pharmacy.	To provides baseline information on integrating the science of safety into the professional degree curriculum at colleges of pharmacy.	Qualitative multi method design.	Multi method examination was conducted including: literature review, interviews with 30 individuals, in depth case studies of 5 colleges.	None.	Areas which need to be improved include educating students about the FDA role in product safety, how to work with the FDA in post marketing surveillance and other safety initiatives, teaching about methods to improve safety, educating students to practice in inter-professional teams.	Yes – CASP tool.
7	Johnson et al. (2002) USA	Medication error instruction in schools of pharmacy curricula: A descriptive study.	Assessing the manner and extent to which the topic of medication error is included in the	Quantitative Descriptive study.	A cover letter and survey were sent to 82 schools of pharmacy.	IOM.	The quality and quantity of medication error instruction in pharmacy curricula varied significantly. A lack of standardization and	Yes – Guyatt tool.

#	Author, year& country	Title	Aim/ Objectives	Study design	Method	Framework/ Theory	Findings	Quality check tool used
			curricula of schools of pharmacy in the United States.				inclusion of key domains was observed. Given the well-documented magnitude and costs of medication errors, it seems imperative that schools of pharmacy incorporate into curricula a meaningful and consistent amount of instruction pertaining to medication errors. This study illustrates the need for schools of pharmacy to articulate and standardise a minimum level of medication error instruction for pharmacy curricula and provides a sample curriculum that could be used.	
8	Komperda, K. and K. Lempicki (2019). USA	Effectiveness of a Medication Reconciliation Simulation in an Introductory Pharmacy Practice Experience Course.	This questionnaire evaluated the effectiveness of a simulated learning exercise on pharmacy students' ability and perception of their ability to perform	Quantitative, questionnaire	Third-year pharmacy students were divided into three groups: Group A attended a 30-minute lecture; group B attended the lecture and participated in a 90-minute workshop;	None.	Simulated learning exercises should continue to be incorporated in pharmacy education (especially exercises for learning pharmacy practice skills such as medication reconciliation as they significantly improved	Yes – Guyatt tool

#	Author, year& country	Title	Aim/ Objectives	Study design	Method	Framework/ Theory	Findings	Quality check tool used
			medication reconciliation		and group C received no training. After groups A and B completed their assigned learning activities, all 9 students participated in a simulated medication reconciliation activity with a standardized patient (SP). Students also completed a pre- and post-intervention survey.		students' ability to perform medication reconciliation); including obtaining an accurate medication list, correctly identifying medication discrepancies, and proposing appropriate resolutions.	
9	Korayem, G. B. and A. M. Alboghdadly (2020). Saudi Arabia	Integrating simulation into advanced pharmacy practice experience curriculum: An innovative approach to training.	This study evaluated the impact of integrating SBE into APPE on students' learning outcomes, training costs, and satisfaction	Description (and evaluation) of a training model.	This study presents a new training model of a 5-week clerkship experience where sixth-year pharmacy students alternate between hospital wards and simulation rooms. Student assessment rubrics were used to measure students' achievements and report faculty feedback. Students	None	SBE integration into APPE can supplement hospital-based experiential training to achieve the best learning outcomes with improved students'	None

#	Author, year& country	Title	Aim/ Objectives	Study design	Method	Framework/ Theory	Findings	Quality check tool used
					completed scenario evaluation forms to assess their simulation satisfaction rate.			
10	Naser, A. Y., et al. (2020). (Jordan, Saudi Arabia, Kuwait, Qatar, India and Indonesia)	Attitudes of pharmacy students towards patient safety: A cross-sectional study from six developing countries.	This study evaluated the attitudes of undergraduate pharmacy students towards PS in six developing countries.	Quantitative, questionnaire.	A cross-sectional study using 14-item questionnaire to measure attitudes towards PS.	None	PS content should be covered comprehensively in pharmacy curricula and reinforced in each year of study. This should be more focused on students in their final year of study and who have started their training. This will ensure that the next generation of pharmacists are equipped with the requisite knowledge, core competencies and attitudes to ensure optimal PS when they practise	Yes – Guyatt tool
11	Noland et al. (2009) USA	Reflection and analysis of how pharmacy students learn to communicate about medication errors.	This study focuses on the socialisation of pharmacy students regarding medication error.	Qualitative, interviews.	In-depth interviews were conducted with 44 students. snowball sampling was used.	None.	5 themes emerged: 1- Pressure to be perfect. 2- Feeling comfortable talking about mistakes. 3-Assuming and	Yes – CASP tool.

#	Author, year& country	Title	Aim/ Objectives	Study design	Method	Framework/ Theory	Findings	Quality check tool used
							communicating responsibility for mistakes. 4-learning how processes can contribute to errors and their prevention. 5- Inadequate and inconsistent training on how to handle medication errors. Study results indicate that pharmacy students experience both incomplete and inconsistent socialisation to the role of communication in medication errors and their prevention.	
12	Rajiah et al. (2016) Malaysia	Pharmacy students' knowledge and perceptions about adverse drug reactions reporting and pharmacovigilance.	The aim of this study was to investigate the knowledge and perception of pharmacy students about adverse drug reaction reporting and pharmacovigilance	Quantitative study, Questionnaire.	A cross-sectional study using a validated questionnaire was conducted among the university students.	None.	The results showed that the pharmacy students had sufficient knowledge and there are significant differences in perception among the students on adverse drug reaction reporting.	Yes – Guyatt tool.

#	Author, year& country	Title	Aim/ Objectives	Study design	Method	Framework/ Theory	Findings	Quality check tool used
			and to study their willingness to report.					
13	Scalese et al. (2015) USA	A case-based approach for teaching medication safety to pharmacy students.	To determine if a three-hour interactive case-based laboratory experience improves attitudes about medication errors and systematic approaches to improve medication safety among pharmacy students in their third professional year.	Quantitative study, questionnaire. Case based approach.	A modified version of the Attitudes to Patient Safety Questionnaire was used to assess the attitudes of pharmacy students toward medication errors before and after the laboratory experience.	None.	The results of 49 matched surveys indicate that students' attitudes significantly improved in response to 15 out of 20 questions. These questions assessed students' attitudes to medication safety as related to their confidence in understanding and preventing medication errors, the effectiveness of pharmacy school training, the human nature of errors, the role of inter-professional teamwork and patient involvement, and inclusion of patient safety issues in the pharmacy curriculum. Students' attitudes did not change significantly for five questions that assessed student willingness to report medication errors.	Yes – Guyatt tool.

#	Author, year& country	Title	Aim/ Objectives	Study design	Method	Framework/ Theory	Findings	Quality check tool used
14	Schafer et al. (2012) USA	A root cause analysis project in a medication safety course.	To develop, implement and evaluate team-based root cause analysis projects as part of required med. safety course for second year pharmacy students.	Course evaluation (Lectures, in-class activities, and out-of-class reading assignments	Students' performance was assessed using a medication errors evaluation rubric.	The RCA followed the approach described by the Institute for Safe Medication Practice (ISMP).	Medication error evaluation and prevention was successfully introduced in a medication safety course using team-based root cause analysis projects.	No.
15	Skoy, E. T., et al. (2018). USA	Use of Simulations to Improve Pharmacy Students' Knowledge, Skills, and Attitudes About Medication Errors and Patient Safety.	This survey focused on the designing and evaluating the use of simulations in preparing students to identify and reduce medication errors and promote PS.	Quantitative survey.	Third-year pharmacy students used methods of root cause analysis (RCA) to determine the cause of a medication error in three simulated pharmacy settings. Before and after the activity, students completed an anonymous survey	None	Students used RCA methods to discover medication errors in three simulated pharmacy settings. Students improved their knowledge, skills, and attitudes regarding medication errors through this process.	Yes – Guyatt tool
16	Sukkari et al. (2008) USA	Development and evaluation of a required patient safety course.	To develop, implement, and assess a required patient safety course for second-year doctor of pharmacy students.	Patient safety course development and evaluation.	A patient safety course was developed that included didactic lectures, case studies, in-class activities, and reading assignments. Written examinations and essays were used to evaluate student	IOM.	The self-assessment course survey indicated major improvements in the students' knowledge and skills, readiness for knowledge application, and commitment to improve patient safety.	No.

#	Author, year& country	Title	Aim/ Objectives	Study design	Method	Framework/ Theory	Findings	Quality check tool used
					learning. In addition, a modified minute paper and a pre- and post-intervention student self-assessment survey were used to assess course outcomes.		The course provided pharmacy students with an increased level of understanding of the principles and concepts of patient safety.	
17	Tegegn, H. G., et al. (2017). Ethiopian	Patient safety attitudes of pharmacy students in an Ethiopian university: A cross-sectional study.	This study assessed the attitude of pharmacy students toward PS.	Quantitative, questionnaire.	A cross-sectional study using a self-administered questionnaire containing 21 items was conducted at the University of Gondar among fourth and fifth year students.	None	Overall, pharmacy students have a good attitude to PS. However, they claimed the culture and attitude within the pharmacy workplace was somewhat lacking in standards in PS for. Moreover, a standardized PS course should be considered in the curriculum for junior pharmacy students to improve their attitude toward PS.	Yes – Guyatt tool
18	Trinkley et al. (2017) USA	Perceived Benefit of Teaching Patient Safety to Pharmacy Students by Integrating Classroom Teaching With Introductory	The purpose of this study was to evaluate the perceived benefit of integrating patient safety education into a pharmacy	Quantitative study, questionnaire.	Second-year pharmacy students (P2s) completed a patient safety self-study, followed by in-class and experiential application of a root	None.	Of the 310 students, 53% responded to the survey. Significantly more P2s reported more confidence to describe patient safety and its purpose (P ¼ .0092), describe factors	Yes – Guyatt tool.

#	Author, year& country	Title	Aim/ Objectives	Study design	Method	Framework/ Theory	Findings	Quality check tool used
		(IPPE) Visits.	curriculum.		causes analysis (RCA). An electronic, anonymous post survey was administered to P2s and third-year pharmacy students (P3s) who had not had formal patient safety education.		that influence patient safety (P ¼ .0055), and conduct an RCA (P < .001). P2s also reported significantly better ability to conduct a RCA compared to P3s (88.9% positive vs 58.7%, respectively; P? .001). Conclusions: Both classes perceived patient safety education to be valuable; however, formal education resulted in some significant improvements in perceived confidence and understanding, including ability to conduct an RCA.	
19	Walpola et al. (2015) Australia	Evaluating the effectiveness of a peer-led education intervention to improve the patient safety attitudes of junior pharmacy students: a cross-sectional study using a latent	To evaluate the effectiveness of a peer-led patient safety education programme for junior pharmacy students.	Quantitative study, questionnaire.	A repeat cross-sectional design utilising a previously validated patient safety attitudinal survey was used to evaluate attitudes prior to, immediately after and 1 month after the delivery of a	None.	Results: A full LGC model was constructed including the intervention as a non-time-dependent predictor of change ($\chi 2$ (51) =164.070, root mean square error of approximation=0.084, comparative fit index=0.913, standardised	Yes – Guyatt tool.

#	Author, year& country	Title	Aim/ Objectives	Study design	Method	Framework/ Theory	Findings	Quality check tool used
		growth curve modelling approach.			patient safety education programme. Latent growth curve (LGC) modelling was used to evaluate the change in attitudes of first-year students using second-year students as a comparator group.		root mean square=0.056). First-year students' attitudes significantly improved as a result of the intervention, particularly in relation to internalising errors (p=0.010), questioning behaviours (p<0.001) and open disclosure (p=0.008). Conclusions: Peer-led education is an effective method that can be adopted to improve junior pharmacy students' attitudes towards patient safety.	
20	Warholak et al. (2011) USA	Perspectives on educating pharmacy students about the science of safety.	To identify opinions about pharmacy graduates' Science of Safety (SoS) educational need.	Qualitative method (semi structured interviews via telephone).	Semi-structured interviews were performed. Purposive and snowball sampling techniques were used for this study.	IOM.	1-Newly graduated pharmacists should meet minimum SoS requirements. 2-Pharmacy colleges and schools are preparing students well in some areas of medication safety and not well in others. 3-SoS education should be "hands on" or interactive.	Yes – CASP tool.

#	Author, year& country	Title	Aim/ Objectives	Study design	Method	Framework/ Theory	Findings	Quality check tool used
							4-There are barriers to Improving SoS curricula at colleges and schools of pharmacy.	
21	West-Strum et al. (2011) USA	The science of safety curriculum in US colleges and schools of pharmacy.	To describe the integration of science of safety (SOS) topics in Doctor of Pharmacy (PharmD) curricula of US colleges and schools of pharmacy.	Quantitative, questionnaire.	A questionnaire that contained items pertaining to what and how SoS topics are taught in PharmD curricula was e-mailed to representatives at 107 US colleges and schools of pharmacy.	FDA/SOS framework.	The majority of the colleges and schools responding indicated that they had integrated SoS topics into their curriculum, however, some gaps (e.g. teaching students about communicating risk, Food and Drug Administration [FDA] Sentinel Initiative, utilising patient databases) were identified that needs to be addressed.	Yes – Guyatt tool.
22	Rickles et al. (2010) USA	Pharmacy Student Knowledge and Communication of Medication Errors.	To describe and evaluate pharmacy students' knowledge of and comfort in communicating, managing and preventing medication errors.	Questionnaire.	Using a cross-sectional design, a survey instrument was administered to fifth-year pharmacy students. The survey instrument included both open and close-ended questions to describe and examine	FDA/SOS framework.	1- The majority of respondents received little or no formal didactic or on-the-job training on how to handle communication of medication errors. 2-Other students reported having learned by observing how others handled medication errors.	Yes – Guyatt tool.

#	Author, year& country	Title	Aim/ Objectives	Study design	Method	Framework/ Theory	Findings	Quality check tool used
					factors associated with knowledge and comfort in communication of medication errors.		3-Those students who reported receiving formal training felt it was insufficient or inadequate. This study identified a clear gap in our curriculum and a possible gap experienced by other schools and colleges of pharmacy.	
23	Vyas et al. (2012a) USA	An Inter-professional Course Using Human Patient Simulation to Teach Patient Safety and Teamwork Skills.	To assess the effectiveness of human patient simulation to teach patient safety, team building skills, and the value of inter-professional collaboration to pharmacy students.	Questionnaire.	Five scenarios simulating semi-urgent situations that required inter-professional collaboration were developed. Groups of 10 to 12 health professions students that included 1 to 2 pharmacy students evaluated patients while addressing patient safety hazards.	None.	Simulation training provided an opportunity to improve pharmacy students' ability to recognise and react to patient safety concerns and enhanced their inter-professional collaboration and communication skills.	Yes – Guyatt tool.
24	Vyas et al. (2012b) USA	Patient Simulation to Demonstrate Students' Competency in	To implement a simulation-based introductory pharmacy practice	Survey.	A 60-hour IPPE that used simulation-based techniques to provide clinical	None.	Simulation is an effective method for assessing the pre-APPE abilities of pharmacy students,	Yes – Guyatt tool.

#	Author, year& country	Title	Aim/ Objectives	Study design	Method	Framework/ Theory	Findings	Quality check tool used
		Core Domain Abilities Prior to Beginning Advanced Pharmacy Practice Experiences.	experience (IPPE) and determine its effectiveness in assessing pharmacy students' core domain abilities prior to beginning advanced pharmacy practice experience (APPE).		experiences was implemented. Twenty-eight students were enrolled in this simulation IPPE, while 60 were enrolled in hospital and specialty IPPEs within the region.		preparing them for real clinical encounters, and for making them more aware of medication errors and other patient safety issues.	

Table 3: Pharmacy, nursing and other profession studies

#	Author, year& country	Title	Aim/ Objectives	Study design	Profession	Method	Framework/ Theory	Findings	Quality check/ tool used
1	Bridgeman, M. B., et al. (2018). USA	Impact of an inter-professional medication error workshop on healthcare student perceptions	This survey aimed to describe the results of a pilot study designed to evaluate the impact of a large-scale inter-professional medication error prevention workshop on student perceptions of team-based patient care in the prevention of medication errors.	Quantitative, survey.	Pharmacy, medical, and physician assistant students'	Pharmacy, medical, and physician assistant students' perceptions of the role of multidisciplinary patient care teams in preventing medication errors were evaluated before and after participating in a three-hour inter-professional medication errors prevention workshop utilizing a modified version of the validated Attitudes Towards Health Care Teams Scale.	Kirkpatrick outcomes was most appropriate for this workshop	Statistically significant differences in student perceptions across the items and subscales (e.g., quality of care/process and physician centrality) captured in the instrument utilized were identified, when comparing student attitudes among the three schools. Additionally, differences in the responses of pharmacy, medical, and physician assistant students were found, highlighting the areas where healthcare education can be targeted to bridge the gap in opinion.	Yes – Guyatt tool
2	Cresswell et al. (2013) UK	Patient safety in healthcare preregistration educational	To investigate the formal and informal ways preregistration	Qualitative multi method.	Medicine, nursing, pharmacy and	38 focus groups with a total of 162 participants were conducted,	Eraut's framework.	Patient safety tended to be either implicit in curricula or explicitly identified in a limited	Yes – CASP tool

#	Author, year& country	Title	Aim/ Objectives	Study design	Profession	Method	Framework/ Theory	Findings	Quality check/ tool used
		curricula: multiple case study-based investigations of eight medicine, nursing, pharmacy and Physiotherapy university courses.	students from medicine, nursing, pharmacy and the allied healthcare professions learn about patient safety.		physiotherapy	undertook 82 observations of practice placements / learning activities and 33 semi-structured interviews, and analysed 44 key documents. The study drew on Eraut's framework on formal and informal acquisition of professional knowledge to undertake a series of phased theoretically informed, in-depth comparative qualitative case studies of eight university courses. policy and course documentation; interviews and focus groups with educators, students, health		number of discrete topic areas. Students were predominantly taught about Safety-related issues in isolation, with the consequence that there were only limited opportunities for inter-professional learning and bridging the gaps between educational, practice and policy contexts. Although patient safety role models were key to student learning in helping to develop and maintain a consistent safety ethos, their numbers were limited.	

#	Author, year& country	Title	Aim/ Objectives	Study design	Profession	Method	Framework/ Theory	Findings	Quality check/ tool used
						service staff, patients and policy makers; and course and work placement Observations were collected. Data were analysed thematically.			
3	East et al. (2015) Australia	Evaluation of a filmed clinical scenario as a teaching resource for an introductory pharmacology unit for undergraduate health students: A pilot study.	The aim of this pilot study was to evaluate a filmed simulated pharmacological clinical scenario as a teaching resource in an undergraduate pharmacological unit.	Pilot cross-sectional quantitative survey.	Nursing and midwifery.	As a part of an undergraduate online pharmacology unit, students were required to watch a filmed simulated pharmacological clinical scenario. To evaluate student learning, a measurement instrument developed from Bloom's cognitive domains was employed to assess pharmacological knowledge conceptualisation	Bloom's Taxonomy of cognitive processes.	Results demonstrated that the majority of nursing and midwifery students found the teaching resource complementary or more useful compared to a lecture although less so compared to a tutorial. Students' self-assessment of learning according to Bloom's cognitive domains indicated that the filmed scenario was a valuable learning tool. Analysis of variance indicated that health science students reported higher levels	Yes – Guyatt tool

#	Author, year& country	Title	Aim/ Objectives	Study design	Profession	Method	Framework/ Theory	Findings	Quality check/ tool used
						and knowledge application within the following fields: medication errors; medication adverse effects; medication interactions; and, general pharmacology.		of learning compared to midwifery and nursing.	
4	Ernawati et al. (2015) Indonesia	Indonesian students' participation in an inter-professional learning workshop.	To assess the attitudinal changes toward IPE among undergraduate health students in Indonesia after attending an IPE workshop on medication safety.	Quantitative study, questionnaire (Readiness for Inter-professional Learning Scale (RIPLS) survey).	Medicine, Nursing and pharmacy.	This was a quasi-experimental study to identify whether participation in an IPL workshop could influence health students' attitudes towards IPE.	None.	This study found that learning with other health students through an IPE workshop improved medical, nursing and pharmacy students' attitudes towards the importance of shared learning, teamwork and communication in the healthcare service	Yes – Guyatt tool
5	Hardisty et al. (2014) UK	Inter-professional learning for medication safety.	To develop undergraduate inter-professional training in medication safety for medicine, pharmacy and	Qualitative and quantitative methods.	Nursing, pharmacy or medical students.	All final-year undergraduate pharmacy and medical students, and a proportion of nursing students in the region were invited to attend a half-day inter-	None.	1- There are considerable organisational challenges in arranging inter-professional groups when students come from different organisations with	Yes – MMAT.

#	Author, year& country	Title	Aim/ Objectives	Study design	Profession	Method	Framework/ Theory	Findings	Quality check/ tool used
			nursing students.			professional medication safety seminar.		different placement arrangements in practice. It was found that building local relationships with course directors is helpful, but curricular demands sometimes act as a barrier. 2- It is clear from this work that the scenarios that are set for groups need to be developed by inter-professional groups, and specifically provide tasks that engage and challenge all of the professions involved. Funding to produce high-quality materials is also beneficial (as in this case, from the SHA' s workforce development fund). 3- Facilitation is an important element, and that facilitators need to come from	

#	Author, year& country	Title	Aim/ Objectives	Study design	Profession	Method	Framework/ Theory	Findings	Quality check/ tool used
								across the professions involved, and to be trained and confident in facilitating inter-professional, rather than uni-professional, learning.	
6	Headrick et al. (2012) USA	Results of an Effort to Integrate Quality and Safety into Medical And Nursing School Curricula and Foster Joint Learning.	To develop and implement innovative methods to integrate health care improvement and patient safety content into existing required curricula.	Retooling (evaluation) for Quality and Safety initiative.	Nursing and medicine.	Multi design methods.	None.	The work generated insights into which learning goals require inter professional education, how to create clinically based improvement learning for all students and how to demonstrate the effects on students' behaviour, organisational practice and benefits to patients. A commonly encountered limiting factor for the programs was the lack of a critical mass of clinically based faculty members who were ready to teach about the improvement of care.	None

#	Author, year& country	Title	Aim/ Objectives	Study design	Profession	Method	Framework/ Theory	Findings	Quality check/ tool used
7	Hwang et al.(2016) South Korea	Patient safety competence for final-year health professional students: Perceptions of effectiveness of an inter-professional education course.	To assess patient safety competencies of final-year health profession students, and the effect of a 1-day patient safety education programme on these competencies.	Quantitative study, questionnaire (H-PEPSS) + an objective patient safety knowledge test	Nursing, medicine and traditional medicine.	A cross-sectional design was employed with a before-and-after study.	The programme design was based on WHO's patient safety curriculum guide.	The 1-day patient safety education curriculum significantly improved H-PEPSS and knowledge test scores. These results indicated that strengthening patient safety competencies, especially teamwork, of students is required in undergraduate healthcare curricula. A 1- day inter-professional patient safety education programme may be a promising strategy. The findings suggest that inter-professional patient safety education needs to be implemented as a core undergraduate course to improve students' safety competence.	Yes – Guyatt tool
8	Lapkin et al.	A cross-sectional survey	(1) Scope the extent to which	A cross-sectional	Nursing, pharmacy or	A web-based cross sectional survey	None.	Timetabling restrictions and lack of	Yes – Guyatt

#	Author, year& country	Title	Aim/ Objectives	Study design	Profession	Method	Framework/ Theory	Findings	Quality check/ tool used
	(2012) Australia & New Zealand	examining the extent to which inter-professional education is used to teach nursing, pharmacy and medical students in Australian and New Zealand universities.	IPE is currently used in Australian and New Zealand nursing, pharmacy and medical programs; (2) scope the extent to which IPE is currently used to teach medication safety and (3) identify barriers and facilitators to curriculum integration of IPE.	survey.	medical students.	was used to gather information from Australian and New Zealand universities offering nursing, pharmacy or medical programmes.		appropriate teaching and learning resources were identified as the main barriers to implementation of IPE. All participants reported that staff development, multi-media and e-learning resources would be beneficial to IPE initiatives and the teaching of medication safety.	tool
9	Lee, W., et al. (2020). Korea	Nursing and medical students' perceptions of an inter-professional simulation-based education: a qualitative	The purposes of this study were to describe the development and implementation of an inter-professional simulation-based	Qualitative	Nursing and medical	Qualitative descriptive design with reflective journal; and keywords writings	None.	The results of this study suggest that the use of high-fidelity team-based simulation in IPE is effective in practicing and developing undergraduate nursing and medical students' inter-	Yes – CASP tool.

#	Author, year& country	Title	Aim/ Objectives	Study design	Profession	Method	Framework/ Theory	Findings	Quality check/ tool used
		descriptive study	education (IPSE) for undergraduate nursing and medical students, their perceptions of the impact of IPSE, and identify their changes in attitudes toward each other's health professions after participating in IPSE in South Korea.					professional collaboration through hands on experience.	
10	Ottis et al. (2016) USA	An inter-professional nursing and pharmacy student simulation in acute pain management,	The goals were to emphasise patient safety in acute pain management, gauge change in attitudes about inter-professional learning, and have students	Quantitative study, survey.	Nursing and pharmacy.	Teams of four students collaborated during the simulation. Learners completed pre- and post-simulation surveys to measure attitudes toward inter-professional learning and	Knowledge, skills and attitudes (KSA) framework.	There was a positive shift among all students in attitudes from pre- to post-simulation. Differences between nursing and a cohort of pharmacy students were found for confidence in clinical skills, with nursing	Yes – Guyatt tool

#	Author, year& country	Title	Aim/ Objectives	Study design	Profession	Method	Framework/ Theory	Findings	Quality check/ tool used
			understand more about the roles of different professions			change in clinical confidence. Students provided reflection regarding their perceptions about the inter-professional simulation.		students gaining more confidence from participating in the simulation. Student reflection demonstrated that 42% had a better understanding of others' roles in patient care post-simulation.	
11	Pearson et al. (2010) UK	Learning about patient safety: organizational context and culture in the education of health care professional.	This study investigated the formal and informal ways pre-registration students from medicine, nursing, physiotherapy and pharmacy learn about keeping patients safe.	Qualitative multiple methods.	Medicine, nursing, physiotherapy and pharmacy.	The study employed a phased design using multiple qualitative methods. Phase 1 employed a convenience sample of 13 pre-registration courses across UK. Curriculum documents were gathered, and course directors interviewed. Phase 2 used 8 case studies, two for each professional group, to develop an in-depth	Special framework was developed and agreed by all researchers.	Patient safety was felt to have become a higher priority for Trusts in recent years. Incident reporting was a key feature of the patient safety agenda within the organisations examined. Staff were often unclear or too busy to report. Students were not engaged and may not be aware of incident reporting schemes. They may not have access to Trust systems. Most did not access	Yes – CASP tool

#	Author, year& country	Title	Aim/ Objectives	Study design	Profession	Method	Framework/ Theory	Findings	Quality check/ tool used
						investigation of learning across university and practice by students and newly qualified practitioners in relation to patient safety, and to examine the organisational culture to which students and newly qualified staff are exposed.		Trust induction programmes. Some training sessions occasionally included students, but this did not appear to be routine.	
12	Popkess, A., et al. (2017). USA	Inter-professional Error Disclosure Simulation for Health Professional Students	The aims of this study were to describe and evaluate an inter-professional simulation training for medical error disclosure including dental medicine, nursing, and pharmacy students	Description of educational intervention	Dental, medicine, nursing, and pharmacy	Students from three health profession sssprograms were required to review a video and content material on error disclosure prior to the simulation. Students were organized into 48 inter-professional teams, Knowledge and attitudes were assessed using a	None	Error disclosure simulation training can be an effective inter professional training event. The simulation training program appeared to be successful in enhancing student knowledge and attitudes about error disclosure as an inter-professional team. Overall, students	None

#	Author, year& country	Title	Aim/ Objectives	Study design	Profession	Method	Framework/ Theory	Findings	Quality check/ tool used
						pre-post simulation design.		perceived the training as a positive experience.	
13	Ragucci et al. (2016) USA	Evaluation of Inter-professional Team Disclosure of a Medical Error to a Simulated Patient.	To evaluate the impact of an Inter-professional Communication Skills Workshop on pharmacy student confidence and proficiency in disclosing medical errors to patients.	Quantitative, using a Likert-scale evaluation tool.	Medicine, nursing, pharmacy and health professions.	Students from up to four different health professions participated in a simulation as part of an Inter professional team. Teams were evaluated with a validated rubric post-simulation on how well they handled the disclosure of an error to the patient. Individually, each student provided anonymous feedback and self-reflected on their abilities via a Likert-scale evaluation tool. A comparison of pharmacy students who completed the workshop (active	None.	The majority of students felt they had adequate training related to communication issues that cause medication errors. However, fewer students believed that they knew how to report such an error to a patient or within a health system. Pharmacy students who completed the workshop were significantly more comfortable explicitly stating the error disclosure to a patient and/or caregiver and were more likely to apologise and respond to questions in an open manner. This data affirms the need to devote more	Yes – Guyatt tool

#	Author, year& country	Title	Aim/ Objectives	Study design	Profession	Method	Framework/ Theory	Findings	Quality check/ tool used
						group) vs all others who did not (control group) was completed and analysed.		time to training students on communicating with patients about the occurrence of medical errors and how to report them.	
14	Reime et al. (2016) Norway	Simulated settings; powerful arenas for learning patient safety practices and facilitating transference to clinical practice. A mixed method study,	To investigate the experiences of nursing and medical students who participated in a simulation-based inter-professional team-training (SBITT) course, and the impact of SBITT on professional and patient safety practices.	Qualitative and quantitative methods.	Medical and nursing.	A concurrent mixed-method design was chosen in which team performance was observed and scored on an observation form, and focus group interviews were used to explore the participants' overall experience.	None.	The results showed that two training sequences the same day improved overall team performance. Making mistakes during SBITT appeared to improve the quality of patient care once the students returned to clinical practice as it made the students more vigilant. Furthermore, the video-assisted oral debriefing provided an opportunity to strengthen inter-professional teamwork and share situational awareness. SBITT gave the students an	Yes – MMAT

#	Author, year& country	Title	Aim/ Objectives	Study design	Profession	Method	Framework/ Theory	Findings	Quality check/ tool used
								opportunity to practice clinical reasoning skills and to share professional knowledge. The students conveyed the importance of learning to speak up to ensure safe patient practices.	
15	Robb, G., et al. (2017). New Zealand	The state of quality improvement and patient safety teaching in health professional education in New Zealand.	The purpose of these interviews were to investigate how quality and PS domains are being taught in the pre-registration curricula of health profession education programs in New Zealand.	Qualitative: semi-structured interviews	Medicine, nursing, midwifery, dentistry, pharmacy, physiotherapy, dietetics and 11 other allied health professions	Interviews were conducted using a semi-structured interview guide to explore nine quality and safety domains.	None.	This national study of multiple health professional pre-registration education programs has identified teaching gaps in PS and improvement science methods and tools. Failure to address these gaps will compromise the ability of new graduates to successfully implement and sustain improvements	Yes – CASP tool.
16	Rotz, M. E. and D. D. O'Neill	Exploring second professional	The purpose of this case study was to explore	Qualitative content analysis	pharmacy & nursing student	This was an exploratory case study using	None.	Inter-professional shadowing combined with reflection can	Yes – CASP tool.

#	Author, year& country	Title	Aim/ Objectives	Study design	Profession	Method	Framework/ Theory	Findings	Quality check/ tool used
	(2021). USA	year pharmacy student reflections after an inter-professional shadowing experience with nursing students in critical care units: a qualitative study	pharmacy student reported reflections from an inter-professional shadowing experience with nursing students through qualitative content analysis of reflective statements.			conventional qualitative content analysis.		enhance learning and thematic analysis of these reflections can be utilized to assess IPE outcomes.	
17	Seaman, K., et al. (2018). Australia	Shifts in nursing and medical students' attitudes, beliefs and behaviours about inter-professional work: An inter-professional placement in ambulatory care.	This study examined students' beliefs, behaviours and attitudes in relation to inter-professional socialisation, and their expectations and experience, before and	Quantitative, A descriptive matched before-after study was conducted.	nursing and medical	Students' completed an online questionnaire before and after their clinical placement.	None.	Relevance to clinical practice Inter-professional clinical placements are essential for students to understand inter-professional practice for better patient outcomes and developing their own perspective of future work within an inter-professional team. A clinical placement in	Yes – Guyatt tool.

#	Author, year& country	Title	Aim/ Objectives	Study design	Profession	Method	Framework/ Theory	Findings	Quality check/ tool used
			after a 2-week clinical placement in ambulatory care.					an ambulatory setting for nursing and medical students resulted in an increase in self-perceived ability to work with others and in valuing working with others. Accordingly, ambulatory care is an ideal environment for nursing and other health professional students to engage in inter-professional clinical placements.	
18	Svitlica, B. B., et al. (2021). Serbia	Patient safety: Knowledge and attitudes of medical and nursing students: Cross-sectional study.	The objective of this study to research medical and nursing students' level of knowledge of PS.	Quantitative, questionnaire.	medical and nursing students	The research instrument was the WHO questionnaire "What is Patient Safety? ", which displayed good psychometric characteristics.	WHO patient safety curriculum guide.	Knowledge and attitudes regarding PS shown by the students in this survey significantly contribute to the comprehension of the necessity of the implementation and development of a PS course into the existing curricula and syllabi of all colleges and universities	Yes – Guyatt tool.

#	Author, year& country	Title	Aim/ Objectives	Study design	Profession	Method	Framework/ Theory	Findings	Quality check/ tool used
								related to health care.	
19	Thom et al. (2016) USA	Advancing inter-professional patient safety education for medical, nursing, and pharmacy learners during clinical rotations.	To describe the development and implementation of an inter-professional course aimed at medical, nursing, and pharmacy learners during their clinical training at a large academic medical centre.	Quantitative, questionnaire. (Readiness for Interprofessional Learning Scale (RIPLS) survey).	Medicine, nursing and pharmacy	A cross-sectional survey of participants to assess readiness for inter-professional learning and a before and after comparison of patient safety knowledge. The course was offered as recurring three 1-hour sessions, including case-based discussions and a mock root cause analysis.	None.	All students reported a high level of readiness for inter-professional learning, indicating an interest in inter-professional opportunities. In general, understanding and knowledge of the four competency domains in patient safety was low before the course and 100% of students reported an increase in knowledge in these domains after participating in the course.	Yes – Guyatt tool
20	Tregunno et al. (2014) Canada	Integrating patient safety into health professionals' curricula: a qualitative study of medical, nursing and pharmacy	To reports on medical, nursing and pharmacy teaching faculty perspectives about factors that influence curricular integration and	Qualitative method (semi structured interview, face to face).	Medical, Pharmacy and nursing.	Qualitative methods were used to collect data from 20 faculty members (n=6 medical from three universities; n=6 pharmacy from two universities; n=8 nursing from four	None.	Faculty perspectives on key challenges to safe practice vary across the three disciplines, and these different perspectives lead to different priorities for curricular innovation. Additionally,	Yes – CASP tool

#	Author, year& country	Title	Aim/ Objectives	Study design	Profession	Method	Framework/ Theory	Findings	Quality check/ tool used
		faculty perspectives	the preparation of safe practitioners.			universities) engaged in medical, nursing and pharmacy education. Thematic analysis generated a comprehensive account of faculty perspectives.		accreditation and regulatory requirements are driving curricular change in medicine and pharmacy. Key challenges exist for health professional students in clinical teaching environments where the culture of patient safety may hinder the preparation of safe practitioners. Seven themes emerged in three areas: (1) Challenges to Safe Practice: (i) Clinical safety areas, (ii) priority setting. (2) Challenges in Preparing Safe Practitioners: (iii) Culture of the practice setting, (iv) Formal versus informal teaching,	

#	Author, year& country	Title	Aim/ Objectives	Study design	Profession	Method	Framework/ Theory	Findings	Quality check/ tool used
								(v) Faculty preparation, (vi) authenticity (3) Faculty Concerns: (vii) academic.	
21	Yoshikawa (2013) Brazil	Comprehension of undergraduate students in nursing and medicine on patient safety.	Identify the understanding of graduate students in nursing and medicine at a public university in São Paulo on human error and patient safety.	Quantitative (questionnaire).	Nursing and medicine.	Prospective and exploratory study in which were investigated variables related with the characterisation of students and attitudinal and conceptual aspects about the theme. The sample consisted of 109 students who responded to a research electronic form.	None.	Most students received formal training on the subject and had attitudes that demonstrated uncertainty as to what would be correct for some practices.	Yes – Guyatt tool

MSE = Medication Safety Education
CASP = Critical Appraisal Skills Programme
MMAT = Mixed Methods Appraisal Tool

Appendix 3: Rating for Qualitative, Quantitative and Mixed Design Papers

Selected papers info.					Qualitative rating (using CASP)												
#	Author & year	Article title	Method	Field of study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13
1	Adhikari et al. 2014	A multi- disciplinary approach to medication safety and the implication for nursing education and practice	An ethnography observational method, interviews, focus groups	Nursing	M	M	M	M	M	N	M	M	M	M			
2	Badir et al. 2015	Using High-fidelity Simulation as a Learning Strategy in an Undergraduate Intensive Care Course	Case study, focus groups interviews and 3 simulation scenarios	Nursing	M	M	M	M	M	M	M	M	M	M			
3	Bradly et al. 2011	The role of hidden curriculum in teaching pharmacy students about patient safety	Exploring patient safety content in the pharmacy, case study, focus groups, observations	Pharmacy	M	M	M	M	M	M	M	M	M	M			
4	Cooper 2014	Nursing student medication errors: A snapshot from a school on nursing's quality and safety officer	Case study	Nursing	M	M	N	N	M	N	N	M	M	M			
5	Cresswell et al. 2013	Patient safety in healthcare preregistration educational curricula: multiple case study-based investigations of eight medicine, nursing, pharmacy ad	Case study, interviews, focus groups, observation and documents review	medicine, nursing, pharmacy and physiotherapy	M	M	M	M	M	N	M	M	M	M			

		physiotherapy university courses															
6	Dolansky et al. 2013	Nursing student medication errors: A case study using root cause analysis	Case study	Nursing	M	M	M	M	M	M	N	M	M	M			
7	Holdford et al.2011	Teaching the science of safety in US Colleges and schools of pharmacy	Interviews, case study	Pharmacy	M	M	M	M	M	M	M	M	M	M			
8	Mansour 2013	Examining patient safety education in pre-registration nursing curriculum: Qualitative study	Semi-structured interviews	Nursing	M	M	M	M	M	M	M	M	M	M			
9	Noland et al. 2009	Refection and analysis of how pharmacy students learn to communicate about medication errors	Interviews	Pharmacy	M	M	M	M	M	M	M	M	M	M			
10	Page et al. 2006	Addressing medication errors- the role of undergraduate nurse education	Interviews	Nursing	M	M	N	N	P	N	N	P	M	P			
11	Pearson et al. 2010	Learning about patient safety: organizational context and culture in the education of health care professional	Documents review, interviews, observation and case study	medicine, nursing, pharmacy and physiotherapy	M	M	M	M	M	N	M	M	M	M			

12	Steven et al. 2014	Patient safety in nursing education: contexts, tensions and feeling safe to learn	A multi-method design: curriculum review, in-depth case studies, interviews, focus groups, observation	Nursing	M	M	M	M	M	M	M	M	M	M			
13	Tregunno et al. 2014	Integrating patient safety into health professionals' curricula: a qualitative study of medical, nursing and pharmacy faculty perspectives	Semi-structured interviews	medicine, nursing and pharmacy	M	M	M	M	M	N	M	M	M	M			
14	Warholak et al. 2011	Perspectives on educating pharmacy students about the science of safety	Semi-structured interviews	Pharmacy	M	M	M	M	M	M	M	M	M	M			
15	Whitehair et al. 2014	Identification of prescribing errors by pre-registration student nurses: Across sectional observational study utilising a prescription medication quiz	Observation	Nursing	M	M	M	M	M	N	M	M	M	M			
16	Vaismoradi et al. 2011	Patient safety: nursing students perspectives and the role of nursing education to provide safe care	Semi-structured interviews	Nursing	M	M	M	M	M	M	M	M	M	M			
17	Vaismoradi et al. 2014	Nursing students perspectives and suggestions on patient safety-implications for	Focus groups	Nursing	M	M	M	M	M	M	M	M	M	M			

		developing the nursing education curriculum in Iran															
18	Vaismoradi et al. 2014	Nursing students perspectives of the cause of medication errors	Focus groups	Nursing	M	M	M	M	M	M	M	M	M	M			
19	Bohomol, E. (2019).	Patient safety education of the graduation in Nursing from the teaching perspective	descriptive case study,	Nursing	M	M	M	M	M	M	M	M	M	M			
20	Ji, Y., et al. (2021).	Developing an integrated curriculum for patient safety in an undergraduate nursing program: a case study	Case study	Nursing	M	M	M	M	M	N	N	M	M	M			
21	Mbuthia, N. N. and M. M. Moleki (2018).	Perspectives on Patient Safety Education in the Kenyan Preregistration Nursing Curriculum.	document review and semi-structured interviews	Nursing	M	M	M	M	M	M	M	M	M	M			
22	Lee, W., et al. (2020).	Nursing and medical students' perceptions of an interprofessional simulation-based education: a qualitative descriptive study	descriptive design	Nursing and medical	M	M	M	M	M	M	M	M	M	M			
23	Robb, G., et al. (2017).	The state of quality improvement and patient safety teaching in health professional education in New Zealand.	semi-structured interviews	medicine, nursing, midwifery, dentistry, pharmacy, physiother	M	M	M	M	M	M	M	M	M	M			

				apy, dietetics and 11 other allied health professions													
24	Rotz, M. E. and D. D. O'Neill (2021).	Exploring second professional year pharmacy student reflections after an interprofessional shadowing experience with nursing students in critical care units: a qualitative study	content analysis	pharmacy & nursing student	M	M	M	M	M	M	M	M	M	M			

					Quantitative Rating (Using Adapted Questions From Guyatt Et Al Users' Guides To The Medical Literature, 1993)												
#	**Author & year**	**Article title**	**Method**	**Field of study**	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**	**Q11**	**Q12**	**Q13**
1	Atayee et al. 2016	Using Simulation to Improve First-Year Pharmacy Students' Ability to Identify Medication Errors Involving the Top 100 Prescription Medications	Questionnaire	Pharmacy	M	M	M	P	M	M	M	M	M	M	M		
2	Bressan et al. 2016	Measuring patient safety knowledge and competences as perceived by nursing students: An Italian validation study	A validation study using a cross-sectional design	Nursing	M	M	M	M	M	M	M	M	M	M	M		
3	Chenot et al 2010	Frameworks for patient safety in the nursing curriculum	Survey	Nursing	M	M	M	M	M	M	M	M	M	M	M		
4	Cooper 2013	From the school of nursing quality and safety officer: nursing students' use of safety reporting tools and their perception of safety issues in clinical settings	Survey	Nursing	M	M	M	N	M	N	M	M	M	N	M		
5	Debourgh 2012	Synergy for patient safety and quality: academic and service	Survey	Nursing	M	M	M	P	M	M	M	M	M	P	M		

		partnerships to promote effective nurse education and clinical practice															
6	Duhn et al. 2012	Perspective on patient safety among undergraduate nursing students	Questionnaire	Nursing	M	M	M	M	M	M	M	M	M	M	M		
7	East et al. 2015	Evaluation of a filmed clinical scenario as a teaching resource for an introductory pharmacology unit for undergraduate health students: A pilot study	Pilot cross-sectional survey	Nursing and midwifery	M	M	M	M	M	P	M	M	M	M	M		
8	Ernawati et al. 2015	Indonesian students' participation in an interprofessional learning workshop	A quasi-experimental study	Medicine, nursing and pharmacy	M	M	M	M	M	P	M	M	M	M	M		
9	Hanson, J. 2016	Surveying the experiences and perceptions of undergraduate nursing students of a flipped classroom approach to increase understanding of drug science and its application to clinical practice	A descriptive research method using internet-based self-completion questionnaire	Nursing	M	M	M	P	M	P (due to low response rate)	M	P (due to low response rate)	M	M	M		
10	Hewitt et al. 2015	An education intervention to improve	Survey	Nursing	M	M	M	M	M	N	M	M	M	N	P (due		

		nursing students understanding of medication safety													to low response rate)		
11	House et al. 2016	Low-Fidelity Simulation to Enforce Patient Safety	A descriptive design	Nursing	M	M	M	N	M	P	M	M	M	M	M		
12	Hwang et al. 2016	Patient safety competence for final-year health professional students: Perceptions of effectiveness of an interprofessional education course	A cross-sectional design	Nursing, medicine and traditional medicine	M	M	M	M	M	M	M	M	M	M	M		
13	Johnson et al 2002	Medication error instruction in schools of pharmacy curricula: A descriptive study	Survey	Pharmacy	M	M	M	N	M	N	M	M	M	M	M		
14	Lapkin et al 2012	A cross-sectional survey examining the extent to which interprofessional education is used to teach nursing, pharmacy and medical students in Australian and New Zealand Universities	Survey	Nursing, Pharmacy and Medical Students	M	M	M	M	M	M	M	M	M	M	M		
15	Lee et al. 2016	Patient safety education and baccalaureate nursing students' patient safety competency: A cross-	A descriptive cross-sectional study	Nursing	M	M	M	M	M	M	M	M	M	P	M		

		sectional study															
16	Lukewich et al. 2015	Undergraduate baccalaureate nursing students' self-reported confidence in learning about patient safety in the classroom and clinical settings: An annual cross-sectional study (2010–2013)	The Health Professional Education in Patient Safety Survey	Nursing	M	M	M	M	M	M	M	M	M	M	M		
17	Mansour 2015	Factors analysis of nursing students perception of patient safety education	Questionnaire	Nursing	M	M	M	M	M	M	M	M	M	M	M		
18	Mariani et al. 2015	Improving students' safety practice behaviors through a simulation-based learning experience	A non-experimental pretest–posttest design	Nursing	M	M	M	M	M	M	M	P	M	M	M		
19	Mika Yoshikawa 2013	Comprehension of undergraduate students in nursing and medicine on patient safety	Questionnaire	Nursing & medicine	M	M	M	M	M	M	M	M	M	N	P (due to low response rate)		
20	Omura et al. 2015	Measuring the impact of an interprofessional multimedia learning resource on Japanese nurses and nursing students using the	A quasi-experimental design	Nursing	M	M	M	M	M	P	M	M	M	M	M		

		Theory of Planned Behaviour Medication Safety Questionnaire															
21	Ottis et al. 2016	An inter-professional nursing and pharmacy student simulation in acute pain management	Pre- and post-surveys	Nursing and pharmacy	M	M	M	M	M	M	M	M	M	P	M		
22	Rajiah et al. 2016	Pharmacy students' knowledge and perceptions about adverse drug reactions reporting and pharmacovigilane	A cross-sectional study using a validated questionnaire	Pharmacy	M	M	M	M	M	M	M	M	M	P	M		
23	Rickles et al 2010	Pharmacy Student Knowledge and Communication of Medication Errors	Questionnaire	Pharmacy	M	M	M	M	M	M	M	M	M	M	M		
24	Scalese et al. 2015	A case-based approach for teaching medication safety to pharmacy students	A modified version of the Attitudes to Patient Safety Questionnaire was used	Pharmacy	M	M	M	M	M	N	M	P	M	M	M		
25	Smith et al. 2007	Current assessments of quality and safety education in nursing	Survey	Nursing	M	M	M	N	M	N	M	M	M	N	P (due to low response rate)		
26	Stevanin et al. 2015	Knowledge and competence with patient safety as	The Health Professional Education in	Nursing	M	M	M	M	M	M	M	M	M	M	M		

		perceived by nursing students: The findings of a cross-sectional study	Patient Safety Survey														
27	Sullivan et al. 2009	Assessing quality and safety competencies of graduating pre-licensure nursing students	Survey	Nursing	M	M	M	N	M	N	M	M	M	M	P		
28	Sears 2008	The relationship between simulation in nursing education and medication safety	Questionnaire	Nursing	M	M	M	M	M	N	M	M	M	M	M		
29	Thom et al. 2016	Advancing interprofessional patient safety education for medical, nursing, and pharmacy learners during clinical rotations	A cross-sectional survey	Medicine, nursing and pharmacy	M	M	M	M	M	N	P	M	M	P (due to low response rate)	M		
30	Trinkley et al. 2017	Perceived Benefit of Teaching Patient Safety to Pharmacy Students by Integrating Classroom Teaching With Introductory (IPPE) Visits	Questionnaire	Pharmacy	M	M	P	M	M	M	M	M	M	N	P		
31	Ragucci et al. 2016	Evaluation of Interprofessional Team Disclosure of a Medical Error to a Simulated Patient	using a Likert-scale evaluation tool	Medicine, nursing, pharmacy and health profession	M	M	P	M	M	P	M	M	M	M	M		

32	Vyas 2012	An Interprofessional Course Using Human Patient Simulation to Teach Patient Safety and Teamwork Skills	Survey	Pharmacy	M	M	M	M	M	N	M	M	M	M	M		
33	Vyas 2012	Patient simulation to demonstrate students' competency in core domain abilities prior to beginning advanced pharmacy practice experience	Survey	Pharmacy	M	M	M	M	M	M	M	M	M	N	M		
34	Walpola et al. 2015	Evaluating the effectiveness of a peer-led education intervention to improve the patient safety attitudes of junior pharmacy students: a cross-sectional study using a latent growth curve modelling approach	A repeat cross-sectional design utilising a previously validated patient safety attitudinal survey was used	Pharmacy	M	M	M	M	M	P	M	M	M	M	M		
35	Weatherford et al. 2015	Senior Nursing Students' Perspectives on Safety Competencies: An End-of-Program Outcome Evaluation	A cross-sectional study using the Health Professional Education in Patient Safety Survey	Nursing	M	M	M	M	M	M	M	P	M	M	M		
36	West-strum et al. 2011	The science of safety curriculum in US colleges and schools of	Questionnaire	Pharmacy	M	M	M	M	M	M	M	M	M	N	M		

		pharmacy															
37	Kirwan, M., et al. (2019).	Regulation and current status of patient safety content in pre-registration nurse education in 27 countries: Findings from the Rationing - Missed nursing care (RANCARE) COST Action project	Questionnaire, This on-line consultation, carried out within the RANCARE COST Action project	Nursing	M	M	M	M	M	N	M	M	M	M	M		
38	Lee, S. E., et al. (2020).	Patient safety education in pre-registration nursing programmes in South Korea	descriptive study used a pencil and paper survey	Nursing	M	M	M	M	M	N	M	M	M	M	M		
39	Lee, S. E., et al. (2020).	Assessment of patient safety and cultural competencies among senior baccalaureate nursing students	descriptive survey	Nursing	M	M	M	M	M	N	M	M	M	M	M		
40	Suliman, M. (2019).	Measuring Patient Safety Competence Among Nursing Students in the Classroom and Clinical Settings.	questionnaire (H-PEPSS)	Nursing	M	M	M	M	M	N	M	M	M	M	M		
41	Usher, K., et al. (2018).	Patient safety content and delivery in pre-registration nursing curricula: A national cross-sectional survey study.	questionnaire	Nursing	M	M	M	M	M	N	M	M	M	M	M		

42	Alkatheri, A. M., et al. (2017).	Pharmacy Educators' Knowledge of Medication Safety and Their Perception Toward Its Integration into the Doctor of Pharmacy Curriculum in Saudi Arabia.	survey	Pharmacy	M	M	M	M	M	M	M	M	M	M	M		
43	Alwhaibi, M., et al. (2020).	Pharmacy students' attitudes toward patient safety in Saudi Arabia: a cross-sectional study.	self-administered questionnaire	Pharmacy	M	M	M	M	M	N	M	M	M	M	M		
44	Komperda, K. and K. Lempicki (2019).	Effectiveness of a Medication Reconciliation Simulation in an Introductory Pharmacy Practice Experience Course.	questionnaire	Pharmacy	M	M	M	M	M	N	M	M	M	M	M		
45	Naser, A. Y., et al. (2020).	Attitudes of pharmacy students towards patient safety: A cross-sectional study from six developing countries.	questionnaire	Pharmacy	M	M	M	M	M	N	M	M	M	M	M		
46	Skoy, E. T., et al. (2018).	Use of Simulations to Improve Pharmacy Students' Knowledge, Skills, and Attitudes About Medication Errors and Patient Safety.	survey	Pharmacy	M	M	M	M	M	N	M	M	M	M	M		

47	Tegegn, H. G., et al. (2017).	Patient safety attitudes of pharmacy students in an Ethiopian university: A cross-sectional study.	self-administered questionnaire	Pharmacy	M	M	M	M	M	N	M	M	M	M	M		
48	Bridgeman , M. B., et al. (2018).	Impact of an interprofessional medication error workshop on healthcare student perceptions	survey	Pharmacy, medical, and physician assistant students'	M	M	M	M	M	N	M	M	M	M	M		
49	Seaman, K., et al. (2018).	Shifts in nursing and medical students' attitudes, beliefs and behaviours about interprofessional work: An interprofessional placement in ambulatory care.	online questionnaire	nursing and medical	M	M	M	M	M	N	M	M	M	M	M		
50	Svitlica, B. B., et al. (2021).	Patient safety: Knowledge and attitudes of medical and nursing students: Cross-sectional study.	questionnaire	medical and nursing students	M	M	M	M	M	N	M	M	M	M	M		

Selected Papers Info.				Mixed Method Rating (Using MMAT By Pierre Pluye 2013)													
#	Author & year	Article title	Method	Field of study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13
1	Attree et al 2008	Patient safety in an English pre-registration nursing curriculum	Case study, semi-structured interviews, focus groups, and content analysis of the curriculum	Nursing	M	M	M	M	M	N	M	M	M	N	M	M	M
2	Fuji 2010	Pharmacy student attitudes toward an interprofessional patient safety course: an exploratory mixed methods study	Quantitative data were collected from course evaluation, case study and final examination performance. Qualitative date were collected through interviews	Pharmacy &Nursing	M	M	M	M	M	M	M	M	M	M	M	M	M
3	Hardisty 2014	Interprofessional learning for medication safety	Pre and post-seminar questionnaire, observation, semi-structured interviews and focus group	Nursing, Pharmacy or Medical Students	M	M	M	N	M	N	M	M	N	N	M	M	M
4	lee et al 2013	The effectiveness of an e-learning program on pediatric medication safety for undergraduate students: A pretest-post-test intervention study	Program was evaluated qualitatively and quantitatively	Nursing	M	M	M	N	M	N	M	M	M	M	M	M	M
5	Masters, K. 2016	Integrating quality and safety education into clinical nursing	Integrating clinical model of nursing education + 2 sets of questions to assess	Nursing	M	M	M	M	M	N	M	M	P	M	M	M	M

		education through a dedicated education unit	student's knowledge and focus groups interview to assess nurses experience														
6	Miller et al 2009	Student learning outcomes after integrating of quality and safety education competencies into a senior- level critical care course	Focus groups and questionnaire	Nursing	M	M	M	M	M	N	M	N	M	M	M	M	M
7	Reime et al. 2016	Simulated settings; powerful arenas for learning patient safety practices and facilitating transference to clinical practice. A mixed method study	A concurrent mixed-method design	Medical and nursing	M	M	M	M	M	N	M	M	P	P	M	M	M
8	Sanko et al. 2015	Learning From Simulation-Based Medication Event Reporting: A Mixed Methods Analysis	Convergent parallel design	Nursing	M	M	M	M	M	N	M	M	M	M	M	M	M

M	MET
N	NOT MET
P	Partially
MMAT	Mixed Methods Appraisal Tool

Appendix 4: The three quality-check tool questions

The three quality-check tool questions

The quality check tool	The questions
Qualitative Method Rating using CASP (Critical Appraisal Skills Program)	1. Did the review address a clearly focused question? 2. Did the authors look for the right type of papers? 3. Do you think all the important, relevant studies were included? 4. Did the review's authors do enough to assess quality of the included studies? 5. If the results of the review have been combined, was it reasonable to do so? 6. What are the overall results of the review? 7. How precise are the results? 8. Can the results be applied to the local population? 9. Were all important outcomes considered? 10. Are the benefits worth the harms and costs?
Quantitative Method Rating using Guyatt (Guyatt et al Users' guides to the medical literature, 1993)	1. Did the study address a clearly focused issue? 2. Did the authors use an appropriate method to answer their question? 3. Were the subjects recruited in an acceptable way? 4. Were the measures accurately measured to reduce bias? 5. Were the data collected in a way that addressed the research issue? 6. Did the study have enough participants to minimize the play of chance? 7. How are the results presented and what is the main result? 8. Was the data analysis sufficiently rigorous? 9. Is there a clear statement of findings? 10. Can the results be applied to the local population? 11. How valuable is the research?
Mixed Method Appraisal Tool Rating using MMAT (MMAT by Pierre Pluye 2013)	1. Are there clear qualitative and quantitative research questions, or clear mixed methods question (or objective)? 2. Do the collected data allow address the research question (objective)? 3. Are the sources of qualitative data relevant to address the research question (objective)? 4. Is the process for analyzing quantitative data relevant to address the research question (objective)? 5. Is appropriate consideration given to how findings relate to the context (the setting in which the data were collected)? 6. Is appropriate consideration given to findings relate to researchers influence (through their interactions with participants)? 7. Is the sampling strategy relevant to address the quantitative research question (quantitative aspect of the mixed methods question)? 8. Is the sample representative of the population under study? 9. Are measurements appropriate (clear origin, or validity known, or standard instrument)? 10. Is there an acceptable response rate (60% or above)? 11. Is the mixed methods research design relevant to address the qualitative and quantitative research questions (or objectives), or the qualitative and quantitative aspects of the mixed methods

	question (or objectives)? 12. Is the integration of qualitative and quantitative data relevant to address the research question (or objectives)? 13. Is appropriate consideration given to the limitations associated with this integration (the divergence of qualitative and quantitative data (or results) in a triangulation design?

Appendix 5: Participant information sheet for pharmacy and nursing teaching staff

Imperial College London

Participant information sheet (version 1.1)

Title: An interview study to explore the perception of teaching staff on medication safety education in pharmacy and nursing undergraduate education.

We would like to invite you to take part in a research study. Please take time to read the following information carefully, and let me know if anything is not clear or if you would like more information. Please take your time in deciding whether you would like to take part in the study.

What is the purpose of the study?

There have been number of recommendations over the recent years about medication safety education, and the need to integrate it into the curricula of health professionals. This study will focus on exploring the perceptions of pharmacy and nursing teaching staff on medication safety education. In addition, it will seek to describe the content of medication safety courses currently being taught, and identify the methods used to teach medication safety.

Why have I been chosen?

You have been chosen to participate in this study because you are a member of the teaching staff in (pharmacy or nursing school), and you may have knowledge about medication safety education.

Do I have to take part?

It is up to you to decide whether or not to take part. We will describe the study and go through the information. We will then invite you to sign a consent form to indicate that you agree to take part. You are free to withdraw at any time, without giving a reason for doing so.

What will happen to me if I take part?

You will be interviewed in person or via telephone for approximately 30 - 40 minutes, and asked about your views on medication safety education. The interview will be recorded and transcribed verbatim by the principal investigator. Notes will be prepared after the interview, and we will send these notes to you for review.

What I will do in the interview?

You will be asked about medication safety issues and your views on medication safety education in general. There are no right or wrong answers. It is your views we are seeking.

What are the possible disadvantages and risks of taking part?

We do not foresee any disadvantages of taking part in the study other than your time. The interview will take 30 - 40 minutes.

What are the possible benefits to taking part?

There are no direct benefits to taking part. However you may benefit from discussions and exchanging opinions and ideas, and may be able to use some of the positive insights and practices to improve your own work.

Appendix 6: Participant information sheet for pharmacy and nursing students

Imperial College
London

What if there is a problem?

We do not foresee any problem. However if you have a concern about any aspect of this study, you should tell me or my supervisors. We will do our best to answer your questions, and you are free to terminate your participation at any time.

Will my taking part in this study be kept confidential?

All information which is collected from you during the research interview will be kept strictly confidential; any record of your identity will be kept separate from anonymised data collected during the study. Audio recording will only be used by the research team to analyse the interviews. Data will not be shown to anyone outside the research team, and audio recordings will be destroyed as soon as they have been transcribed and checked. We may include some quotes from your interview in any reports and publications arising from this work but neither you nor your school will be identifiable from these quotes.

What will happen if I don't carry on with the study?

If you withdraw from the study all the information and data collected from you, will be destroyed.

What will happen to the results of the research study?

The results will be presented in departmental meetings, international conferences and/or peer reviewed journals. All data presented will be anonymous.

Who is funding the research?

The research is part of my PhD study.

Who has reviewed the study?

This study was reviewed by Imperial College Research Ethical Committee (ICREC).

Contact details of investigators:

Hind Al Badali	h.al-badali10@imperial.ac.uk
Dr Maria Woloshynowych	m.woloshynowych@imperial.ac.uk
Prof Bryony Dean Franklin	bryony.deanfranklin@imperial.nhs.uk

Imperial College London

What if there is a problem?

We do not foresee any problem. However if you have a concern about any aspect of this study, you should tell me or my supervisors. We will do our best to answer your questions, and you are free to terminate your participation at any time.

Will my taking part in this study be kept confidential?

All information which is collected from you during the research interview will be kept strictly confidential; any record of your identity will be kept separate from anonymised data collected during the study. Audio recording will only be used by the research team to analyse the interviews. Data will not be shown to anyone outside the research team, and audio recordings will be destroyed as soon as they have been transcribed and checked. We may include some quotes from your interview in any reports and publications arising from this work but neither you nor your school will be identifiable from these quotes.

What will happen if I don't carry on with the study?

If you withdraw from the study all the information and data collected from you, will be destroyed.

What will happen to the results of the research study?

The results will be presented in departmental meetings, international conferences and/or peer reviewed journals. All data presented will be anonymous.

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The research is part of my PhD study.

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Contact details of investigators:

Hind Al Badali	h.al-badali10@imperial.ac.uk
Dr Maria Woloshynowych	m.woloshynowych@imperial.ac.uk
Prof Bryony Dean Franklin	bryony.deanfranklin@imperial.nhs.uk

Appendix 7: Consent form for interview study

Imperial College London

Consent Form

Study number: ..... (Participant identification number for this study)

Title of the project: **An interview study to explore the perception of pharmacy and nursing undergraduate students, and teaching staff on medication safety education.**

Participant information sheet (1.1) must accompany this form

Names of Researchers: Ms Hind Al Badali, Dr Maria Woloshynowych, Prof Bryony Dean Franklin.

	Please tick the box
1. I confirm that I have read and understand the participant information sheet for the above study and have had the opportunity to ask questions.	☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason.	☐
3. I understand that any data or information used in any publications which arise from this study will be anonymous.	☐
4. I understand that all data will be stored securely.	☐
5. I give consent for this interview to be recorded and later transcribed. The transcript will then be de-identified for the purpose of analysis. Findings will be based on the collective contributions of participants, which may include anonymous representative quotes taken from the interviews.	☐
6. I agree to take part in the above study.	☐

Note: you will receive a copy of this document.

Name of the participant	Signature	Date
_____	_____	_____
Name of investigator	Signature	Date
_____	_____	_____

Hind Al Badali (1. May.2015) Version 1.1

Imperial College of Science, Technology and Medicine

Appendix 8: Topic Guide for Semi Structured Interview - Pharmacy and nursing teaching staff

Title of the study: teaching staff perception on medication safety education for pharmacy and nursing programmes.

Topic	Key points/phrases
1. Introduction	• Introduce myself as a medication safety researcher studying for PhD in Imperial College / CPSSQ. • Explain the aim of this interview- to explore the views of teaching staff on medication safety education in pharmacy undergraduates. Objectives: ➢ To describe the views of teaching staff in pharmacy and nursing schools on medication safety education. ➢ To describe the content of medication safety courses being taught to students, and identify the methods used to teach medication safety. • Your views are strictly confidential and there are no right or wrong answers. • If the question is not clear, please ask for clarification. • The interview will take approximately 30 -40 minutes, and will be recorded.
2. Staff profession and background	• What is your profession and what is your background or area of practice? Special interest?
3. Importance of medication safety	• What is your understanding of medication safety? How you define medication safety? • Are you practising pharmacy (or nursing) in a clinical setting? • How are you applying and practising medication safety in your professional practice? • In your school/university is medication safety being taught implicitly or explicitly? • How important is it that medication safety is explicitly taught? • How important for the students to have an explicit label of medication safety teaching? • In your view, in which year of the course should medication safety be taught? • Would you like to elaborate on why you believe it should be taught in that year/ those years?
4. Identify medication safety aspects (content)	• What aspects of medication safety are you teaching? • What aspects of medication safety do you think should be taught to the students? (e.g. look-alike sound alike meds, high alert meds, communication, documentation, ADR and near missed reporting) • What elements of the course are compulsory vs optional?

Topic	Key points/phrases
5. Medication safety teaching methods	• What methods are being used to teach medication safety at your school/university? • Is it interprofessional or uni-professional learning? Can you elaborate more? • Can you tell me if there is any simulation used in medication safety teaching? (Simulation based medical education is defined as any educational activity that utilizes simulation aides to replicate clinical scenarios). • Can you tell me if medication safety is taught in didactic or experiential settings? Or both? • Is there a particular approach when teaching medication safety recommended in the curriculum? (e.g. case study, lectures, reporting of medication errors, opportunity for discussion of personal experience and reflections) • How do you feel about the current methods used to teach medication safety? • How do the students feel about these methods? • Are these methods enabling students to learn about medication safety? • How else could it be taught? • How can you improve the teaching?
6. Identify integration type (mode of delivery)	• How should a medication safety course be integrated into a pharmacy or nursing undergraduate curriculum? • (As a stand- alone course or as a part of existing courses?) • Do you think there is any difference between the two types? • Is the time currently allocated for medication safety teaching enough to cover all aspects of medication safety? • What would be the suitable number of teaching hours allocated for medication safety? Why? • Over how long it should be scheduled (day. Week, month, whole years of study?
7. WHO curriculum guide or other guides (ISMP, FDA, etc.)	• Do you refer to a curriculum guide to consult/review when you design your medication safety lectures? <u>Or</u> • Is there any curriculum guide to consult? • How useful was that guide in helping you when designing/developing your medication safety lectures, workshops or teaching material? • What do you think about the recommendations presented in that guide?
8. Teaching and learning theories	**From your experience in teaching of medication safety** • How would you describe your teaching style? • Are you aware of any teaching theories? • Can you tell me if there is any teaching or learning theories you include when teaching medication safety? <u>Or</u> • When designing medication safety lectures and workshops? (e.g. Bloom's taxonomy, Kolb's cycle, Miller's pyramid of assessments for clinical competence)

Topic	Key points/phrases
9. Expected outcomes/ achievements	• What will be the learning outcomes that you want to achieve? <u>Or</u> • What are you trying to get / achieve from teaching medication safety? • What knowledge should students acquire / develop in order to practice medication safely after graduation? • (e.g. calculation) • What skills should students acquire/ develop in order to practice medication safely after graduation? • (e.g.; good communication skills) • What attitudes should students acquire/ develop in order to practice medication safely after graduation?
10. Feedback on medication safety education	• Do you receive any feedback from the students about medication safety course? • When do you receive such feedback? [Directly after lectures, a few days, weeks or months after]. • Can you tell me about the feedback (if any) you receive about medication safety course in general? [e.g. if the students think it is useful, interesting or boring course] • How can you measure this feedback? (e.g. evaluation form)
11. Identify obstacles	• Can you tell me about any obstacles you face when teaching medication safety? <u>Or</u> • Do you experience any obstacles when teaching medication safety? • How do you overcome these obstacles? • (whether they are able to change things)
12. Further question/s	• Do you have any other comments to add? Or anything to share with me? • If there is anything else you wish to add please let me know?
13. Closing	• Thank you very much for your participation. I will prepare notes after transcribing and analysing the interview, and then I will send these notes to you for review (explain why? To check that what I understand is accurate and the interpretation is correct). Please let me know if you have any comments on these notes. • I may include some of the quotes from your interview. • Finally please let me know if you wish to receive the final results/findings of this study by email (general themes identified not the paper for publication).

Appendix 9: Topic Guide for Semi Structured and Focus Group - Pharmacy and nursing undergraduate students

Title of the study: pharmacy or nursing students' perception on the current medication safety education in pharmacy or nursing programmes.

Topic	Key points/phrases
1. Introduction	● Introduce myself as a medication safety researcher studying for PhD in Imperial College / CPSSQ. ● Explain the aim of this interview- to explore the views of undergraduate students on medication safety education in pharmacy or nursing undergraduates, objectives: ➢ To explore the knowledge of pharmacy (or nursing) undergraduate students on medication safety. ➢ To describe content of medication safety courses being taught to students, and identify the methods used to teach medication safety as reported by students and new graduates. ● Your views are strictly confidential and there are no right or wrong answers. ● If the question is not clear, please ask for clarification. ● The interview will take approximately 30 -40 minutes, and will be recorded.
2. Confirm Students level	● What year are you currently studying in? Or ● when did you qualify?
3. Importance of medication safety	● What is your understanding of medication error? ● Can you tell me about any medication error that you witness (incident happen to you, family member, friend, or you read or hear about)? ● What do you think about this incident? ● Could it be prevented? ● If so how? ● What do you think caused it? ● Do the patients/public have a role in reporting medication errors? ● What is your understanding of medication safety? ● Is it important? Why or why not?
4. Medication safety practice	● Can you tell me about medication safety practices when you were doing your training or during any clinical placement in the hospital? ***[final year students or newly graduate]*** *(any case or story about medication safety or specific medication errors).* Or ● Can you tell me anything about medication safety practices? *(e.g. any case or story about medication safety or specific medication errors in the media)* ● Can you list three examples of how nurses can reduce risk of medication errors in their area of practice? *(e.g. hospital, community pharmacy, primary care, etc)* ● Can you list three causes for medication errors?

Topic	Key points/phrases
5. Medication safety teaching methods	● Can you tell me about how medication safety is taught in your University? Can you give examples? ● Is it interprofessional or uni-professional learning? Can you elaborate more? ● Can you tell me if there is any simulation used in medication safety teaching? *(simulation based medical education is defined as any educational activity that utilizes simulation aides to replicate clinical scenarios)* ● Who teaches medication safety? ● How do you feel about these methods? <u>Or</u> ● what are your thoughts on the methods used to teach medication safety? *(interviewer mean: - is it delivering medication safety concept to you or is it useful methods to understand medication safety)* ● Are these methods enable you to learn about medication safety? ● How else could it be taught?
6. Medication safety KSA domains	● What knowledge, skills and attitudes should students possess in order to practice medication safety after graduation? *(e.g.; good communication skills, calculation, teamwork, etc)*
7. Identify integration type	● How do you think medication safety course should be integrated into a pharmacy undergraduate curriculum? *(as a stand- alone course or as a part of existing courses?)* <u>Depending on the answers</u>, I can ask: ● Should medication safety be made more explicit in the curriculum? *[i.e. Labelled as such if the students didn't recognise that it was being taught]* ● Is medication safety presented explicitly/clearly in your university?
8. Further questions	● Do you have any other comments to add? Or any thing else to share with me? ● If there is anything else you wish to add please let me know?
9. Closing	● Thank you very much for your participation. I will prepare notes after transcribing and analysing the interview, then I will send these notes to you for review. Please let me know if you have any comments on these notes, and on dissemination of study results.

Appendix 10: ICREC 15IC2586 JRCO HOD Full approval – Interview Study - from Imperial College London

Imperial College London

Imperial College Research Ethics Committee

Imperial College London
Room 5L10D, 5th Floor, Lab Block
Charing Cross Hospital
Fulham Palace Road
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researchethicscommittee@imperial.ac.uk

Dr Maria Woloshynowych
Department of Surgery and Cancer
Imperial College London
St Marys Campus
London
W2 1PG

28 May 2015

Dear Dr Woloshynowych,

Study Title: An interview study to explore the perception of pharmacy and nursing undergraduate students and teaching staff on medication safety education.

ICREC reference: 15IC2586.

The above study was approved by your Head of Department on 03/03/15 and by the Joint Research Compliance Office on the 28/05/15.

Under the Imperial College Research Ethics Committee process, a study that has been reviewed by the Joint Research Compliance Office and Head of Division/Department (or Principal), where no significant ethical issues have been identified in the protocol or ethics application, can be approved without requiring it to go to full committee.

Documents
The documents reviewed were:

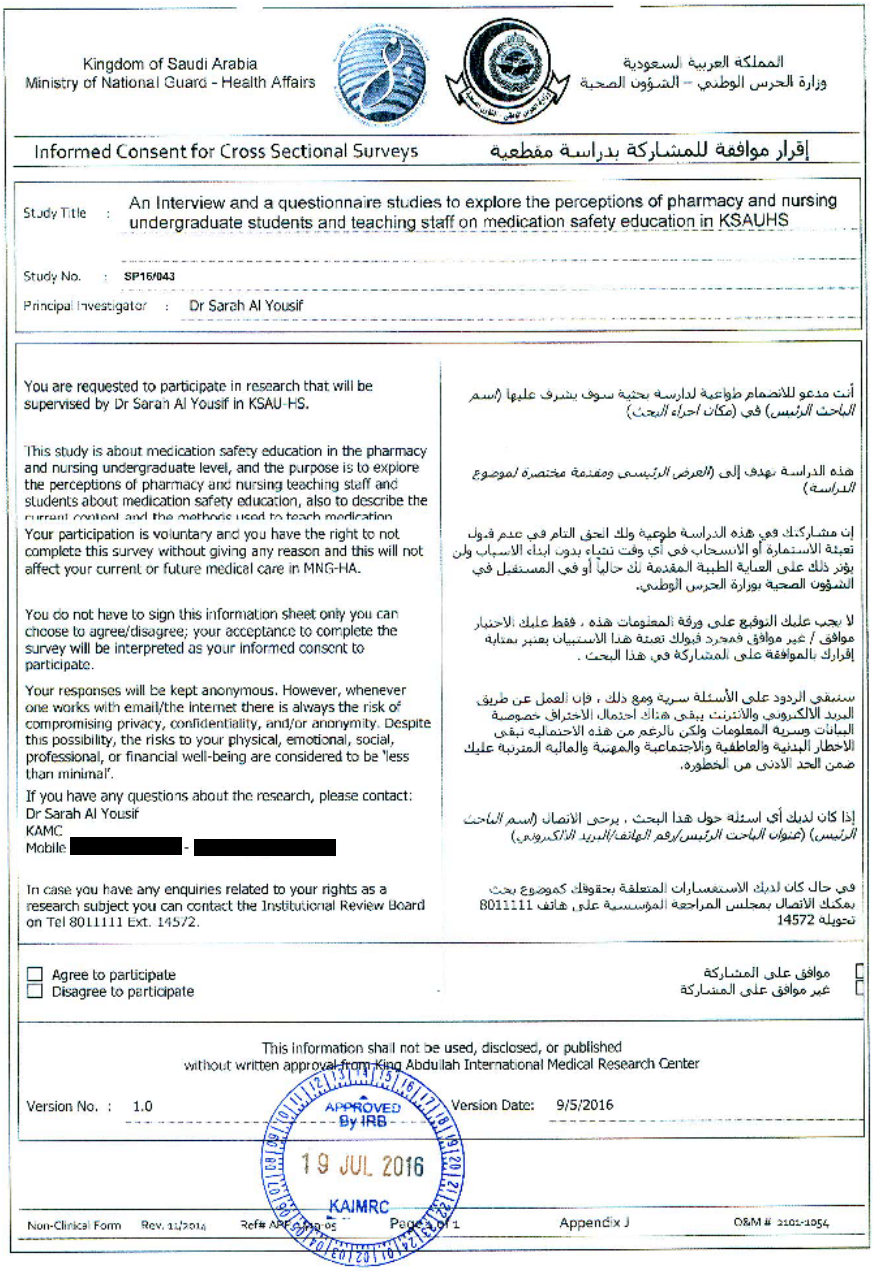
- ICREC Application form
- Protocol (V1.4 20/05/15)
- Consent form (V1.1 05/05/15)
- Participant Info Sheet (V1.1 01/05/15)
- Email Helen McCutcheon (04/12/14)
- Email Ruben Pearce (06/05/15)
- Email Richard Keers (08/01/15)
- Topic Guide (V1 02/03/15)
- Sponsorship and Insurance Form

Yours sincerely,

[redacted]

Gary Roper,
Head of Regulatory Compliance,
Imperial College London

Appendix 11: SP16-043 - approved ICF and SP16-043 - IRB Approval Memo for interview and questionnaire studies from King Abdullah International Medical Research Center



Kingdom of Saudi Arabia
Ministry of National Guard - Health Affairs

المملكة العربية السعودية
وزارة الحرس الوطني – الشؤون الصحية

Informed Consent for Cross Sectional Surveys

إقرار موافقة للمشاركة بدراسة مقطعية

Study Title : An Interview and a questionnaire studies to explore the perceptions of pharmacy and nursing undergraduate students and teaching staff on medication safety education in KSAUHS

Study No. : SP16/043

Principal Investigator : Dr Sarah Al Yousif

You are requested to participate in research that will be supervised by Dr Sarah Al Yousif in KSAU-HS.

This study is about medication safety education in the pharmacy and nursing undergraduate level, and the purpose is to explore the perceptions of pharmacy and nursing teaching staff and students about medication safety education, also to describe the current content and the methods used to teach medication.

Your participation is voluntary and you have the right to not complete this survey without giving any reason and this will not affect your current or future medical care in MNG-HA.

You do not have to sign this information sheet only you can choose to agree/disagree; your acceptance to complete the survey will be interpreted as your informed consent to participate.

Your responses will be kept anonymous. However, whenever one works with email/the internet there is always the risk of compromising privacy, confidentiality, and/or anonymity. Despite this possibility, the risks to your physical, emotional, social, professional, or financial well-being are considered to be 'less than minimal'.

If you have any questions about the research, please contact:
Dr Sarah Al Yousif
KAMC
Mobile [redacted] - [redacted]

In case you have any enquiries related to your rights as a research subject you can contact the Institutional Review Board on Tel 8011111 Ext. 14572.

أنت مدعو للانضمام طواعية لدراسة بحثية سوف يشرف عليها (اسم الباحث الرئيس) في (مكان اجراء البحث)

هذه الدراسة تهدف إلى (العرض الرئيسي ومقدمة مختصرة لموضوع الدراسة)

إن مشاركتك في هذه الدراسة طوعية ولك الحق التام في عدم قبول تعبئة الاستمارة أو الانسحاب في أي وقت تشاء بدون ابداء الأسباب ولن يؤثر ذلك على العناية الطبية المقدمة لك حالياً أو في المستقبل في الشؤون الصحية بوزارة الحرس الوطني.

لا يجب عليك التوقيع على ورقة المعلومات هذه ، فقط عليك الاختيار موافق / غير موافق فمجرد قبولك تعبئة هذا الاستبيان يعتبر بمثابة إقرارك بالموافقة على المشاركة في هذا البحث .

سنبقي الردود على الأسئلة سرية ومع ذلك ، فإن العمل عن طريق البريد الالكتروني والأنترنت يبقى هناك احتمال الاختراق خصوصية البيانات وسرية المعلومات ولكن بالرغم من هذه الاحتمالية تبقى الاخطار البدنية والعاطفية والاجتماعية والمهنية والمالية المترتبة عليك ضمن الحد الادنى من الخطورة.

إذا كان لديك أي اسئلة حول هذا البحث ، يرجى الاتصال (اسم الباحث الرئيس) (عنوان الباحث الرئيس/رقم الهاتف/البريد الالكتروني)

في حال كان لديك الاستفسارات المتعلقة بحقوقك كموضوع بحث يمكنك الاتصال بمجلس المراجعة المؤسسية على هاتف 8011111 تحويله 14572

☐ Agree to participate
☐ Disagree to participate

☐ موافق على المشاركة
☐ غير موافق على المشاركة

This information shall not be used, disclosed, or published without written approval from King Abdullah International Medical Research Center

Version No. : 1.0 Version Date: 9/5/2016

APPROVED By IRB
19 JUL 2016
KAIMRC

Non-Clinical Form Rev. 11/2014 Ref# ARF-Appx 05 Page 1 of 1 Appendix J O&M # 2101-1054

Kingdom of Saudi Arabia
Ministry of National Guard - Health Affairs

المملكة العربية السعودية
وزارة الحرس الوطني - الشؤون الصحية

King Abdullah International Medical Research Center
(KAIMRC)
(84) 94458 1515 94466 irb@ngha.med.sa

IRB Office **Memo Ref.No. IRBC/612/16** **E-CTS Ref. No.** **RYD-16-419812-93657**

Study Number: **SP16/043**
Study Title: **An Interview and a Questionnaire Studies to Explore the Perceptions of Pharmacy and Nursing Undergraduate Students and Teaching Staff on Medication Safety Education in KSAU-HS**
Study Sponsor: **Non Grant**
IRB Approval Date: **19 July 2016**
IRB Review Type: ■ **Expedited Review** ☐ **Full Board**
Study site(s): **Central Region**

Dear **Dr. Sarah Al Yousif**,
Clinical Pharmacist, Pharmaceutical Care
Ministry of National Guard – Health Affairs

After reviewing your submitted research proposal/protocol and related documents, the IRB has APPROVED the submission.

The approval includes the following related documents:

Document/Title	Version	Date
Research Proposal	01	19 Jul 2016
Informed Consent Form – Cross-Sectional	01	19 Jul 2016
Questionnaire	01	19 Jul 2016

The approval of the research study is valid for **one year** from the above approval to expiration date.

Terms of Approval:

- **Annual Reports:** An Annual report must be submitted for approval to avoid termination/suspension of your research.
- **Financial report:** If your study is funded project, details financial report should be submitted with the scientific report.
- **Final Report:** After completion of the study, a final report must be forwarded to the IRB.
- **Retention of original data:** The PI is responsible for the storage and retention of original data pertaining to the project for a minimum of five years.
- **Reporting of adverse events or unanticipated problems:** The PI is responsible to report any serious or unexpected adverse events or unanticipated problems, which could involve a risk to participants or others.
- **Biological samples:** No biological samples to be shipped out of the Kingdom of Saudi Arabia without prior IRB approval.
- **Participant incentives:** No financial compensation or gifts to be given to participants without prior IRB approval.
- **Storage of biological samples:** All biological samples collected for the purpose of this research must be stored in the KAIMRC Biobank facility.

[redacted]

Dr. Abdallah Adlan
A/Chairman, Institutional Review Board (IRB)
Ministry of National Guard Health Affairs

AA/GA/cad

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تلفون: ٨٠١١١١١
تلكس ٤٠٣٤٥٠

Appendix 12: IRB for approving interview and questionnaire studies at University of Dammam

Kingdom of Saudi Arabia
Ministry of Higher Education
University of Dammam
Office of the Vice President for
Research & Higher Studies

جامعة الدمام
UNIVERSITY OF DAMMAM

المملكة العربية السعودية
وزارة التعليم العالي
جامعة الدمام
وكالة الجامعة للدراسات
العليا و البحث العلمي

اللجنة الدائمة لأخلاقيات البحث على المخلوقات الحية
Institutional Review Board

IRB Number	IRB-PGS-2016-04-106		أيرب-يجس-١٦-٠٤-١٠٦
Project Title	Mixed method study to explore the perceptions of pharmacy and nursing undergraduate students and teaching staff on medication safety education		
Principal Investigator	Postgraduate Student / Hind Al Badali		
Supervisor	Dr. Maha Mohammed Al-Madani		
College / Center	Nursing	**Department**	Nursing
Approval Date	9/06/2016		

The application was reviewed and approved at the University of Dammam IRB meeting on Thursday, June 9, 2016.

Approval is given for one year from the date of approval. Projects, which have not commenced within six months of the original approval, must be re-submitted to the University Institutional Review Board (IRB) Committee. If you are unable to complete your research within the validation period, you will be required to request an extension from the IRB Committee.

On completion of the research, the Principal Investigator is required to advise the Institutional Review Board if any changes are made to the protocol, a revised protocol must be submitted to the Institutional Review Board for reconsideration.

Approval is given on the understanding that the "Guidelines for Ethical Research Practice" are adhered to. Where required, a signed written consent form must be obtained from each participant in the study group.

Vice President for Higher Studies & Scientific Research
Chairman of the Institutional Review Board

[redacted]

Professor Abdulsalam Al-Sulaiman

Stamp

جامعة الدمام
UNIVERSITY OF DAMMAM
وكيل الجامعة للدراسات العليا والبحث العلمي
Vice President of Postgraduate & Scientific Research

cc. - Dean
Deanship of Scientific Research
- Director General
King Fahd Hospital of the University
- Director
Center for Research and Medical Consultations
- Supervisor General for Quality and Safety
King Fahd Hospital of the University
- Director
Monitoring Office for Research and Research Ethics
- Director
Pharmacy @ KFHU

Appendix 13: Interview study themes subthemes and quotes - NURSING TEACHING STAFF in the UK and SA
Themes, subthemes and quotes emerged from nursing teaching staff interviews in the UK and Saudi Arabia

High level theme	Sub-theme / Definition	Quotes (examples)
1. MS Curriculum	**MS content** The constituent, chapters and sections included in MS. In addition, how MS was defined, conceptualized and understood as perceived by teaching staff.	*"I guess … I don't know actually; I've never really thought about it in terms of how I'd actually define it. ...I couldn't answer that". (TS - N 01 – UK)* *"I think ... the 5Rights of medication safety". (TS - N 02 – UK)* *"In what way it is very broad? I think I would define medication safety as ... safe administration of medications...". (TS - N 03 – UK)* *"So all the rights of medication prescribing: right patient, right time, right type and dose and right patient, so all of these are about medication safety". (TS - N 07 – SA – talking about the 5 Rights of medication administration)* *"Medication safety is a broad topic actually. It has lots of issues… " (TS - N 01 - SA) Actually I do not have a specific definition". (TS - N 02 – SA)…….* *"Yes, we do that in the third year; near misses when students cover that...we cover it in medication safety inter professional education ..." (TS – N 06 - UK).* *"... the medication administration argument in terms of the Five Rights... in the skills lab in the first year definitely. (TS - N 03 – UK)* *"But we definitely do pharmacology as a concept in the second year…, the mechanical part of it, for first year onwards but I think the actual pharmacology per se if one addresses it is probably not to be done in the first year." (TS - N 03 – UK)* *…….* *"The students here … when they join the programme in the second year they take the fundamentals of nursing. And then in the third year they take two courses in pharmacology. When it comes to theoretical knowledge regarding medications... basically the medical surgical courses ...two courses that allow the students to know how to prepare medications, to be in the skills and how to watch the Five Rights.". (TS – N 01 – SA)* *"Now we are having medication calculation discussion a side of course the basic Ten Rights of Medication we always include these and when we do the clinical rounds" (TS - N 10 - SA)*

High level theme	Sub-theme / Definition	Quotes (examples)
		"We mainly talk about high alert medication and they cover a lot of look-alike sound alike, medications".(TS - N 07 –SA) *"In my point of view, pharmacology and medication safety are linked with each other...". (TS – N08 – SA)* *"Pharmacology must be considered in patient safety education...its excellent course to teach medication safety topic within pharmacology". (TS - N 03– SA)*
	MS theories (e.g. human error) Theories underlying medication errors (i.e. specific for MS)	*"So part of that is ... learning about human factors about distractions and noise and work stress and work plan issues" (TS – N 02 - UK).* *"We do in terms of human factors' theory go through types of error ... and get the students to think about those different types of error in their life in general and also in practice.". (TS - N 04 – UK)* *"No I don't use human factors theory". (TS – N 03 –SA)*
	MS curriculum guide & guidelines (e.g. WHO, NMC and GPhC) Curriculum guide & guidelines used/consulted when designing and preparing MS materials	*"Well as an organization we refer to the WHO 2011 Patient Safety Guide which has got 11 topics of patient safety... So we refer to that guide" (TS - N 04 – UK)* *"We don't use WHO. No". (TS - N 01 – UK)* *"The Royal College of Nursing guidance for what the nursing safety issues are about what I should be teaching. NICE guidelines." (TS - N 06 – UK)* *"We use all NMC stuff, in terms of drug safety ..." (TS - N 01 – UK)* *"Guidelines includes for medication safety education, I think it will follow WHO guidelines …". (TS - N 03–SA)* *"Yes in the hospital intranet we have a resource where you can find information about the patient and medication safety programme…They call it one-stop resource yes…In the unit we discuss the Joint Commission International (JCI's) tips and the International Patient Safety Goals (IPSG)". (TS - N 08 –SA)*
	MS protocol & guidelines	*"I think the approach here was deliberately struck across different methods so there's the*

High level theme	Sub-theme / Definition	Quotes (examples)
	Set of rules, particular approach recommended by the college, aim and objectives regarding MS mentioned in the course description handbook	*more traditional lecture teaching sessions approach but there's also the skills approach ... so quite a good principle here is that we try and do these things in several different ways in the curriculum". (TS - N 04 – UK)* *"No I would say we teach it in several different ways. It's not expressed in the curriculum". (TS - N 06 – UK)* *"This is no specific approach or guide when teaching about medication safety..." (TS - N 02 –SA)*
	Learning outcomes Expected outcomes that need to be achieved	*"That they would know how you would administer a medication to a patient, that they know the checks that are required to make it done safely and basically the nursing role within the administration of medication" (TS - N 06 – UK)* *"In terms of medication safety, I think there are three elements. I would probably look at an outcome which would be a clear understanding of the nursing process and how that fed into medication safety, then the underpinning argument of basic sciences of how those contribute in terms of keeping safe in terms of pharmacodynamics or pharmacokinetics and how they impacted on medication safety, and then looking at clinical environment, not just in terms of the environment but in terms of safe clinical guidelines and how these impacts on medication safety".(TS - N 03 – UK)* *"The outcome is no less prepared for them to become safe practitioner like I said. Because you are preparing nurses at a general level and so medication safety actually becomes one of the most important components when it comes to patient safety. So the ultimate goal actually is patient safety and safe practitioner at the end". (TS - N 01 –SA)* *"A general one. We want to graduate a nurse, a professional nurse, which means that they have good information, proper nursing practice in order to deliver it to the population so they can improve the health of the population and to improve the image of nursing in Saudi Arabia". (TS - N 02 –SA)*
	Target knowledge, skills & attitudes (KSA) KSA that students need to develop when studying in order to practice medication safely after graduation	*"And they need to have knowledge of basic clinical pharmacology". (TS - N 01 – UK)* ***"**Well, the knowledge would be all the knowledge in terms of the basic science and ... the policies and guidelines that go with that... the process of administration..... administration techniques...". (TS - N 03 – UK)*

High level theme	Sub-theme / Definition	Quotes (examples)
		"Ok well they need to understand the fundamentals of patient safety...They also need knowledge of the policies and procedures ... They need knowledge around drug calculation. They need to know about the drug therapy itself and pharmacokinetics.". (TS - N 04 – UK) *"Pharmacology and education related to pharmacology".(TS - N 03 –SA)* *"The calculations and drug classifications". (TS - N 07–SA)* *"Basic rights of medication administration should always be remembered by the students because knowing basic rights and they will be good to go" (TS - N 10–SA)* *"Basically from having hands-on with establishing the route of the administration, whether it is IV, intramuscular, intrathecal and intraperitoneal...". (TS - N 01 –SA)* *"Know about medication safety then they will be knowing why it is safer" (TS - N11–SA)……* *"They should be able to calculate and do basic calculations... They should have the skill to convert. They should be empowered to question and not- the last thing I'd want is a nurse out there blindly following a doctor's orders." (TS – N 08 – UK)* *"Good communication skills... they need to be able to be reflective and have an awareness of their own limitations around medication". (TS - N 01 – UK)* *"So the skill is to be able to administer medication safely... and that includes not just being able to go through a drug chart but also being able to be to resistant to distraction and a lot of those kinds of arguments". (TS - N 03 – UK)* *"They need the psycho-motor skills. They need the checking skills...and then the skills around calculation". (TS – N04 – UK)* *"Nurses have to calculate doses accurately...they need to master medication administration skills". (TS – N 08– SA)*

High level theme	Sub-theme / Definition	Quotes (examples)
		"Know how to communicate properly with the patient with their colleagues and with other healthcare professionals. They have to have proper interpersonal relationships. They have to acquire clinical assessment skills … they have to acquire some proper numerical skills and besides some psycho-motor skills ...". (TS – N02 –SA) *"Clinical assessment skills…critical thinking" (TS - N 03 - SA) ……* *"They should be confident in their skills ..." (TS - NURS 08 – UK)* *"I think they need assertiveness ...they need to have an attitude and an awareness of their accountability...and they have to have an enquiring mind". (TS - N 06 – UK)* *"In terms of attitude I think one has to have a positive proactive attitude ...". (TS - N 03 – UK)* *"We want them to worry that things can go wrong so attitude wise we want them to be error wary.". (TS - N 04 – UK)* *"Well, I think they always need to have a professional attitude and they need to be able to communicate well with the inter-professional team ...". (TS - N 05 – UK)* *"They need a good level of self-awareness in order to be able to project the right attitude and so on...be aware of their own limitations". (TS - N 01 – UK)* *"They should be ...honest and patient" (TS - N 02 –SA)* *"The attitude... the students must be qualified, must have the concern for medication safety ...must be confident and must be honest in work this is a critical issue. The nurse must have a positive professional conduct" (TS - N 03 - SA)* *"Yes. Open to learning. I want them to do their own research. I want them to question what we do. I want them to have an open mind". (TS - N 05 –SA)* *"Professionalism in all aspects… Being humble and being honest". (TS - N 09–SA)*

High level theme	Sub-theme / Definition	Quotes (examples)
		"They need to learn to report errors if there is something wrong happens … So we want them also to learn how to express if there is something affecting them … they should engage with the teamwork and all of their attitudes should be really positive towards the work". (TS - N 07 - SA)
2.The teaching process	**Underlying learning theories** Teaching and learning theories used when teaching students about MS (e.g. Kolb's cycle, Bloom's taxonomy, Miller's pyramid, etc.)	*"… I'm personally a big fan of constructivist ...sort of Kolb, reflective type approaches, experiential learning" (TS - N 01 – UK)* *"Capstone it's an educational theory about making leaps for students across the content in the curriculum. Also we do a lot of reflective practice is big – Gibbs and John's Kits Michael's about learning, experience or practice". (TS - N 02 – UK)* *"Maslow's theory we tend to use quite a lot, is in a spiral kind of format we use, and we use Maslow's in terms of hierarchy ..." (TS - N 03 – UK)* *"I blend the theories I guess. I guess we look at learning styles. We look at Schon reflecting on action, Bloom, Maslow, Conscious Competence Model. Those are the ones that come to mind". (TS - N 02 – UK)* *"No I don't use specific theory when teaching" (TS - N 10 - SA)* *"When we attended this education to prepare us to be educators that time they mentioned about a constructive way of delivering the information to the students". (TS - N 07 —SA)*
	Teaching style Description of the teaching style (e.g. didactic, interactive, etc.)	*"Well it's very much taught in a didactic setting and through simulation so that experientially ... I think that you could argue skills and simulation work is experiential in part". (TS - N 04 – UK)* *"More didactic type stuff to try...It's quite an interactive teaching style". (TS - N 01 – UK)* *"More experiential!" (TS - N 02 – UK)* *"I like students to be asking questions throughout". (TS - N 07 – UK)* *"I do lectures, group discussion, role play and using e-learning … so it is mix of the two...we do didactic and experiential learning". (TS - N 04–SA)*

High level theme	Sub-theme / Definition	Quotes (examples)
		"Well I think it is blended now. We use the traditional one. And we use the E-learning so it is blended". (TS - N 02–SA) *"I do not like to be the only one who talk I like to interact with them and getting them to interact with me. I like to assist them through interaction.". (TS – N 07 –SA)*
	Time allocated for MS Is the time allocated for MS teaching enough to cover all aspects of MS	*"We probably need more time"*. (TS - N 05 – UK) *"I don't know. It is endless. I don't know really. I am not sure".* (*TS - N 07 – UK)* *"I don't think so. The lecture time will never be enough for medication safety" (TS - N 10 - SA)* "*Yes, for us it's enough. It is divided accordingly from the theory down to the simulation laboratory and down to the clinical experience".* (*TS - N 09 –SA)*
	Mode of integration Is MS integrated as standalone course or part of existing courses or both, which year is best for integration of medication safety component or course, and is medication safety being taught explicitly or implicitly	*"Well yes. I suppose we haven't labelled it particularly as patient safety. We've put it in the curriculum as medication administration and we haven't specifically labelled it as medication safety…….No. We don't have a specific module for medication safety. It's integral within the modules that we do have so I start off running it. I have a skills' module so it's involved in that". (TS - N 05 – UK)* *"Medication safety Well, medication safety is part of the module they do in nursing skills. So it's not really a standalone course. It is one aspect of understanding fundamental nursing skills" (TS – N 06 – UK)* *"We call it pharmacology and it goes throughout the entire three years. So medicines' safety is in there, yes when we are talking about pharmacology".* (*TS - N 07 – UK)* *"Looking at medication safety in the context of patient care. I don't know. Perhaps you need a combination of both." (TS - N 05 – UK)* *"No but I think just as a pure perspective idea for the students, if they have a whole module called it medication safety... they'll put more importance in it than they would if it was part of something larger".(TS - N 08 – UK)*

High level theme	Sub-theme / Definition	Quotes (examples)
		"I think possibly a medication safety module that incorporates pharmacology would be useful then you could put everything related to medication so practical elements as well as theoretical components together. (TS - N 05 – UK) "*Yes. We have actually developed a really nice e-learning process within that, and that's literally called 'medication safety".* (*TS - N 03 – UK)* *"So I think we don't do the medication side of things and safety as service by not making it really explicit in the curriculum". (TS - N 02 – UK)* *"I think it is compulsory not optional" (TS – N 04 - UK)…….* *"It's better to include it in each course; integrated…I think medication safety education is better to be integrated in every course related to patient care' (TS - N 03 – SA)* *"I think that patient safety is very much highlighted in the organisation together with the quality programmes… I think that they are and that this programme is very clear about highlighting safety issues… It is already integrated in the course." (TS - N 05 – SA)* *"So that is the medication safety course. Also during the course at university students also have medication safety lectures which is most likely embedded into the curriculum." (TS - N 05 – SA)* *"Yes, of course both types of integration will be beneficial." (TS - N 11 - SA)* *"Yes, very explicitly …very clearly labelled because it is incorporated in most professional nursing subjects" (TS - N 10 – SA)* *"Not that much. We do not have clear label for medication safety". (TS - N 02 – SA)* *"It is not labelled but the students know that it is very important and they apply already the maybe the constituents but it is not labelled that much". (TS – N 01– SA)* *"For nursing, I don't think there is an optional component for medication safety. It is compulsory". (TS - N 10 – SA)*

High level theme	Sub-theme / Definition	Quotes (examples)
	Mode of supervision Type of supervision during clinical placement and training related issued	*"From a practical point of view it's just a number of facilitators. It would be nice to have more facilitators so we could do more individual support, although we assess them individually on their skills" (TS – N 05 - UK).* *"Some mentors won't have sufficient time to train students... So it's all always a kind of pay off between the needs of the patient which must come first and the needs of the students. And that's why mentorship is so skilful and so students have good mentors who recognize that their students are there to learn, will encourage that whole thing about talking to pharmacists, will encourage them to do all the things that you would do as a registered nurse you would practice under supervision". (TS - N 02 – UK)……* *"because preceptors (tutors) is very busy doing such thing with the number of patient she is having that is why when it comes to discussing and explaining further to our students there are some limitations… some preceptors have the guts to explain further to our students such thing that they encountered in the clinical area. Probably because of the reason that they are probably tired or don't have enough time or they rather prioritize dealing with the patient, giving care rather than explaining or talking to our students especially if they are in front of the patient".(TS - N 09 – SA)* *"Another could be the increased workload of the mentor or the preceptor (tutors) of the students. Sometimes they want to finish their task, so instead of giving the chance to the student, they will just let the student to observe and they don't give them the upper hand in giving or administering medication. So that will contribute to the lost of chance to students practice".(TS - N 10 – SA)*
	Methods to deliver MS (learning resources) Methods used to teach MS currently or should be used (e.g. IPL, simulation, e-learning, etc.)	*"Well, we do things like lectures… medication safety in a skills lab (simulation lab). So if they are doing a case based study where the patient well they may have to talk about the drug therapy that the patient is on". (TS - N 04 – UK)* *"And then we also have a medication errors workshop really...". (TS – N 05 – UK)* *"…We then have a seminar which goes through safe medications.". TS - N 07 – UK* *"But we also have these online ones, e-learning ones that we use". (TS – N03 – UK).* *"There is black board learning, they have to do this as part of their learning … pharmacy is really more about the opportunity for them to work alongside pharmacists, to shadow the*

High level theme	Sub-theme / Definition	Quotes (examples)
		pharmacists and to understand their role, to observe what they do on the wards in practice" (TS – N 02 – UK). *"... When we get them into the third year we have these videos that have been made with actors and they actually act out real medication errors that have taken place in a large London hospital... then we get the students to discuss these medication errors and do a root cause analysis ...". (TS - N 06 – UK)* *"We do some role-plays and things where we perhaps have some scenarios" (TS – N 01 – UK)* *"It's uni-professional with small examples of inter-professional learning. But generally, I would say the bulk of it is uni-professional". (TS – N 04 – UK)* *"I think that it's important for the inter-professional aspect that they can see and that's the beauty of the third year work that they can see altogether how it all fits together from the doctors prescribing and how the doctors can then see what the nurses need to have for them to be able to deliver it safely and then the nurses need to understand where the doctors are coming from and what the role of the pharmacist is in making sure that we have the right preparations etc. I think it's useful for them, it's very useful to do that inter-professionally in some shape or form". (TS – N 03 – UK)……..* *"One of them is traditional lecturing, another is we run scenarios and high-fidelity mannequins (participant meant simulation method) …role playing" (TS - N 01 –SA)* *"In the college we give lectures, and the application in clinical practice and we encourage the students to make a topic presentation, tutorial, applications through video listening, we discuss case study and recommend session from case study to motivate them to contribute their own opinion, position…E- learning, yes, also blackboard, discussion board and we discuss with students" (TS - N 03 – SA)* *"In this they go around, and I start to give them the scenario and we start to observe the staff without…I mean like…I usually ask them ok let's watch this nurse who is giving the drugs, from there, and see what in your point of view went wrong. This is what I am assessing them and see what they know. Then after that I start to give them the*

High level theme	Sub-theme / Definition	Quotes (examples)
		information and then we start to try it on the mannequin, how to give the insulin, IV fluids and so on..." (TS - N 08 – SA) *"Just the nursing students… only uni-professional learning". (TS - N 04 – SA)* *"So maybe sharing knowledge in between students from different specialties like nursing, with pharmacy, with dieticians and medical students together sharing their knowledge. Maybe it can be useful why not?" (TS - N 06 – SA- talking about inter-professional learning)*
	Applied MS practices Teaching staff applying and practising MS in their professional practice	*"So I have to think about what I'm doing. So, when I'm administrating medication, I'm obviously doing the, sort of, usual checks of date of birth, age, doctor's signature, correctly filling out medication forms" (TS – N 01 - UK).* *"Yes. The Five Rights and making sure that students are supervised at all times when they are giving medications, making sure that they are not involved in any medication rounds where they don't know what the medication is and what it's used for, contradictions, side effects and all the rest of it" (TS – N 07 - UK).* *"Well that's across two areas. Well I am actually at university in a skills lab.... So, I teach students how to safely administer medication … we actually have packets made up of pretend medication. We have a pretend drug chart and one person will take the role of the patient and the other will take the role of the nurse and they sort of act out how they would administer medication safely…And the other things that I would do would be administering medication in the hospital which would involve patients". (TS - N 06 – UK)* *"We are teaching only undergraduate students regarding medication safety not only as clinical skills but also in terms of pharmacology knowledge so looking at drug action and adverse effects and how it happened". (TS - N 03 – UK)* *"Part of our seminars and post clinical conferences will be discussion about medication especially computation and the different rights of medication administration. We always stress to them that we are giving them this information because they have to be sure when they give medication to the patient. And also when we do our clinical rounds we make sure or we ask the students about the different medications that may give, name, what is the classification, to which route they have given. So that it will also stimulate their knowledge and critical thinking regarding medication administration". (TS - N 10 – SA)*

High level theme	Sub-theme / Definition	Quotes (examples)
	MS feedback Form of feedback from the students (about MS education is it positive or negative, methods used in teaching, difficulties faced during training, etc) Form of feedback from teaching staff (about many issues related to MS education) Mode of assessment (How MS course is evaluated, what form of evaluation (i.e. oral evaluation, online evaluation).	*Form of feedback from the students:* *"The feedback so far from students is that they found the simulation much more of a rich learning experience than, sort of too much didactic stuff". (TS - N 01 – UK)* *"Yes. They like it. In fact, we've spoken to someone today. She said how she appreciated being able to practise the different nursing skills in the skills lab in simulation before she actually got to the ward. And it increases her confidence". (TS – N 06 – UK)* *"Students very much enjoy inter-professional elements particularly where they have a focus which is rooted in their practice". (TS - N 05 – UK)* *"Well, we don't have a medication safety course but we do get feedback every semester regarding skills' courses and things like that. So, we do have regular feedback. Yes". (TS - N 07 – UK)* *"But I do know that they really like the medication safety module." (TS - N 03 – UK)* *"Well, I mean they do enjoy the pharmacological module that we run and they link it to medication safety". (TS - N 05 – UK)* *"They all understand that pharmacokinetics is important even though they find it difficult they will realize it is important". (TS - N 03 – UK)* "*I think the one place where we are not so good is when they are actually working studying on their placements in the hospital. And they see all sorts of practice and one remark they frequently make is this is not the way it's really done. So, when we are talking about safety the remark that we see practice which is very different and you know certainly some of the more especially junior students will say this is not the way it's done. And they thought I was telling them wrong. And then later in the third year and when they have a greater awareness and accountability then I do think they have a different take on it. But they certainly see all kinds of bad practice". (TS - N 06 – UK)* ……. *"Yes. Medication safety specifically no but we receive usually at the end of each semester something called 'Course Evaluation Survey' the students they have to fill it online. Usually*

High level theme	Sub-theme / Definition	Quotes (examples)
		they have said they have to study it (meant pharmacology) is hard as there are a lot of medication names that they have to memorise, and many actions that they need to know I think it is the nature of pharmacology, and you cannot give medication without studying it ... Actually they are always complaining". (TS - N 02-– SA) *"The students are not interested to take a lot of knowledge in Pharmacology". (TS - N 03 – SA)* *"I think the biggest issue that often comes with discussions is the lack of opportunities that they have hands-on in the hospitals. Because in some hospitals they allow some hands-on experience for the students, some they allow only learning by observation (talking about observation method). You know the students agree that they want to know the things by hand. Actually that's the way you learn because you put yourself in the situation and you learn through doing it". (TS – N 01 – SA)* *"I think the students do enjoy simulation lab and interact in medication error scenarios…it is a safe environment to practice before going to clinical placement". (TS – N 09 – SA)* *Form of feedback from teaching staff:* *"I think they are enabling them to learn but I think it could be enhanced and it could be more specific and it could be more clearly set out for the students what it is they need to learn and why". (TS - N 04 – UK)* *"I think they are good at getting them to learn about medication but I don't think they are necessarily good at teaching about medication safety". (TS - N 02 – UK)* *"I think some of the drug safety… the mandatory training that's done within the NHS, is, sort of, lacking in terms of simulation and things like that. I think it can get a little bit boring for the participants and; therefore, they don't sort of necessarily learn that much*". (*TS - N 01 – UK)* *"Well I think we could always explore more. We could always do… I think the simulation is very useful. I think the e-learning is useful. And I think we could do ...if we could increase that content, increase those simulations I think that that would be beneficial". (TS - N 05 – UK)……*

High level theme	Sub-theme / Definition	Quotes (examples)
		"The current methods are okay and enabling students to learn in general not specific for medication safety topic, but there is always room for improvement." (TS – N 04 – SA) *"I think it is a good approach to have inter-professional learning for nursing students" (TS – N 06 – SA)* *"Actually they are eager to learn more about scenarios especially the error. Because once you tell them the errors they will be having an awareness on what are the errors so that they could not have this, or commit such and such that was mentioned in the scenario. So they are very eager to see or to hear about medication safety". (TS - N 09 -– SA)* *"So the students they don't like to give feedback because they think that it is going to be held against him". (TS - N 08 – SA)* *Mode of assessment:* *"Yes well if I am doing it I wouldn't say it's informal but we like to get feedback on the session and whether they have enjoyed it. They are able to fill out an evaluation form and at the end of the year all of their feedback is collated and we receive a communication about the feedback". (TS - N 06 – UK)* *"I think it is a number of ways. I think it is oral feedback. I think it's evaluation forms". (TS - N 05 – UK)* *"I do also assess students that are doing observed skills assessments so these are sometimes called OSCEs. ". (TS - N 04 – UK)* *"Feedback is limited as students do not fancy filling out an evaluation form" (TS – N 08 – UK)* *…….* *"We have different kinds of feedback. We have the course evaluation survey and multiple choice questions that they respond to, but also narrative when they have issues that wasn't mentioned in the multiple choice. We also have the student feedback, they write…in their course portfolio, they write their own ideas like how to improve the course the next time it is delivered... plus the verbal feedback. So the last hour usually is for a discussion and a*

High level theme	Sub-theme / Definition	Quotes (examples)
		clinical seminar so they can give feedback and we take care of their comments". (TS – N 01 – SA) *"At the end of the day before I leave I sit with them and their preceptors (tutors) and we discuss what is the feedback for that day.". (TS - N 07 – SA)* *"You know screening: you know a clinical exam or an OSCE exam, a midterm exam or hospital or clinical experience. Each experience they pass through it I ask them to write feedback so I can identify what problems they face ..." (TS – N 02 – SA)* *"We have a very low rate of feedback; last year it was 20 per cent feedback obtained by quality assurance department ..." (TS – N 03– SA)*
3. Evaluation of MS education	**Perceptions of teaching staff on adequacy of current education** Views and perceptions of teaching staff on the quality and adequacy of the current medication safety education (i.e. is the portion of medication safety education is sufficient to satisfy the requirement and meet the need for safe medication practice)	*"Could be enhanced and it could be more specific and it could be more clearly set out for the students what it is they need to learn and why". (TS - N 04 – UK)* *"They do not have enough practice in the college really especially relating to the insertion of the IV line… Maybe related to nursing skills that's one thing we notice that in the beginning that they do not have enough skills; that this is one of the difficulties. But they are students and we always consider that they are students. So they still do not have enough experience so we have to be patient with them". (TS - N 06 – SA)*
	Lessons learnt from course evaluation and student feedback The knowledge or understanding of medication safety gained by reviewing course evaluation and student feedback	*"I think in with the rise of patient safety we are need to be clearer and more specific about what we are delivering to pre-registration students about patient safety and more co-ordinated in the way that we do it and the same with medication safety". (TS - N 04 – UK)* *"What we need to get them to understand before we give medication to patient ...they need more understanding of pharmacology so they can understand about side effects, contraindications and they can also be wise about giving out information to patients".(TS – N 02 – UK)* *"But that needs to be from the very, very beginning so that you are teaching them that actually if they are involved in medication rounds like I mentioned earlier about the Five Rights...". (TS - N 07 – UK)*

High level theme	Sub-theme / Definition	Quotes (examples)
		"I think we need to talk about the reality of clinical work because for example we will stress to them you do not sign the drug chart to say it's being administered until the patient has actually taken it. But to be honest if a nurse went round and stood in front of every patient until they took their drugs we would be giving out drugs for hours on end... But I think we need to have a discourse about the realities of clinical practice and …give the students some tools to deal with it in a safe way rather than saying you are going to work and you are going to do this. Sometimes it doesn't actually marry with what takes place on the ward". (TS - N 06 – UK) *"Well, I think it needs to be about students' responsibility... I think throughout students need to be aware of being responsible for their actions, that means medication and giving medication safely". (TS - N 07 – UK)*
	Barriers to positive MS educational outcomes Difficulties and obstacles which prevent or block improvement in medication safety education	*"I think that most of the aspects of the medication safety are there in the programme but they are not necessarily followed up in as much detail as they should be..." (TS - N 04 – UK)* *"I think the whole platter that hasn't been addressed clearly or has been addressed but hasn't necessarily been embedded yet in theory so the whole kinetic argument hasn't been really embedded very well, the understanding of how the different the kidneys influence drugs hasn't really been clearly embedded". (TS - N 03 – UK – talking about not embedding pharmacokinetics in pharmacology)* *"…when you go for a job as a nurse, especially if you were to go to King's College Hospital, they have the most rigorous medication calculation and safety assessment and I think it's slightly worrying how many fail it. I know that when I took the test, 40% of the people that took it failed that assessment. Which is very telling". (TS - N 08 – UK)* *"It's always a dilemma getting enough facilitators. There comes a point where we can't run the simulation session if we don't feel we are going to be safe. Yes". (TS - N 05 – UK)…….* *"… poor calculation skills is a barrier, which I'm experiencing with nursing students coming for hospital training"(TS – N 03 – SA)* *"Like I said it was only the thing with the hospitals not allowing the students to have hands-on... They do not want to bother the patients with student training. So they learn from observation". (TS - N 01 – SA)*

High level theme	Sub-theme / Definition	Quotes (examples)
		"There are some medications and some routes such as IVs and IMs that they are not allowed to do or to give because they are bonded by the student nurses' scope of practice…wherein some routes like intravenous they will not be allowed to give. So can be a limitation also regarding their practice in safely administering medication". (TS - N 10– SA) *"Maybe the time, the time is not enough, they have something they could come to the clinical areas as nursing students. They only come from 7.00 o clock to 12 o clock". (TS - N 06 – SA - talking about insufficient time during hospital training)* *"Maybe during lecture would be one limitation would be the time…Sometimes we are allotting one- hour or two-hour discussion for medication safety I think that will not be enough". (TS - N 10 – SA – talking about insufficient time in the classroom)* *"Yes, because as I said when they come to us, they don't know much. So, when it's time to actually link it…I mean if they have a bit of information from the college it would help when they come to reality... When they come to us, they know the basic nursing but they don't know what the medication safety is about. So, it will be like a struggle like to tell them what I am talking about" (TS - N 08 – SA)* *"In the university when they come to us, they are not aware of new drugs and the names of them. They are not aware of these issues... I wish they would just emphasise the names of the medications and the classification of the drug especially the high alert ones. So, I think that a lot of the drugs when we mention them, they do not know about it". (TS - N 07 – SA)* *"Obstacle would be depending on probably the clinical area that we are having as far as our affiliation. Because there are some hospitals wherein there are limitations of learning that our student could get. In such a way that…because preceptors are very busy doing such things with the number of patients, she is having that is why when it comes to discussing and explaining further to our students there are some limitations". (TS - N 09 – SA)*
	Strategies to improve MS education Ideas, methods and plans suggested by teaching staff or students to improve medication safety	*"But I think it's important to get on to it quite quickly because as students go into practice they sometimes see, unfortunately…. Most of the time things are good, but they sometimes see poor practice or old-fashioned practice and can easily start to pick up bad habits, you know, which can be harder to undo than if we pick them up in the first place" (TS - N 01 –*

High level theme	Sub-theme / Definition	Quotes (examples)
	education	*UK)* *"Well better co-ordination across the programme would be a way of doing it, that there would be a more structured model for how patient safety and medication safety were going to be delivered across the programme and then making it explicit to all lecturing staff where it came in and how it came in". (TS - N 04 – UK)* *"I think having more time, more facilitators, and obviously at the moment we mock up the drugs as much as possible". (TS - N 05 – UK)* *"If you could do some more elements around simulation or inter-professional work" (TS - N 05 – UK)* *"A lot of our students are unaware of what ward pharmacists and community pharmacists actually do. I think getting them to shadow pharmacists and realise the scope of their practice is integral as well". (TS - N 08 – UK)* *"Well I think now with some of the applications that are available like phones, IPads and things like that I think there's an opportunity to broaden it out more in terms of supporting students with medication safety. And I think we could do more around specific scenarios for patients and managing that patients' medication…" (TS - N 04 – UK)* *…….* *"Because they start the nursing and relations with the patient in the second year so they have to know about medication safety and who can communicate and work with the patient safety."(TS - N 04 - SA)* *"I would say throughout the programme. May introduce the basic concepts early on then you can build on it". (TS - N 01 – SA)* *"Sometimes after the examination, let's say midterm exam, final exam, the students tend to forget all these concepts and principles. So I think it is a responsibility of the instructor to keep repeating the concept so that the students will have the retention of information…I think it comes up to the same point that I have earlier, we have to keep on emphasizing and stressing on the points and importance of medication safety". (TS - N 10 – SA)*

High level theme	Sub-theme / Definition	Quotes (examples)
		"Lectures, its ok to prepare your students uni-professionally but also expose them to a multidisciplinary kind of experience when it comes to medication safety. So this is one thing. The other thing, each curriculum should be planned so that the concept is administered at different levels with different levels of complexity. So it is introduced, like the basic is introduced earlier in the programme but then the progress is with the group of students. Also we should make use of the technology, like I said the high fidelity simulation and the online resources. And it could be something like I said not the general information that is available online, but something more like protocols. ".(TS - N 01 – SA) *"But for the students they have, we have to teach them something like this which is very important I think. We also have to ask for other teachers. We have to know how to report different errors and we need to know that we have to report". (TS - N 02 – SA)* *"They must emphasise in clinical practice to prevent any mistakes including medication error during clinical practice" (TS - N 03 – SA)* *"We improve the teaching through the technology, the technology which can be available for nursing students. You must encourage the students to create a work provided fields like preparing a video related to medication safety education". (TS - N 03 – SA)* *"So it is about cooperation between college objectives and clinical objectives and training". (TS - N 06 – SA)* *"When the student comes to the clinical area this is the first exposure for the infusion pump for them so we want them, it would be much better if they were exposed in their labs. And there are a lot of mannequins and they can demonstrate and do that so when they come to the real clinical area it will be easier for them to focus on a lot of opportunities to learn because they have already learned about this machine… They should practise on how to use this, and this and that, how to calculate the rate, how to take the rate, all of these ones are very important when they are giving medication. So all will apply to medication safety as you see, so if it will be done in their labs then when they come to the clinical area it will be excellent actually! That will give me more time to discuss a lot of things with them rather than spending time on using this syringe pump or infusion pump in administering this medication".(TS - N 07 – SA)*

High level theme	Sub-theme / Definition	Quotes (examples)
		"or given something about for example what they will face in the clinical area when they come, they can practise giving some maybe lab to class about insertion of IV line, IV line or programming the machine, the IV pump machine they will use in the hospital, they need this sometime there and also the nurses and the preceptor when they are with the students in the clinical area". (TS - N 06 – SA) *"Of course, for students as we said the involvement of the instructors should be higher in the clinical area with the CRNs, with the preceptors right …I need the instructor to be involved with us, to be sure that their goals are met. This is why I am saying this will reflect a lot on their practice and their knowledge if there is interaction, daily interaction from their clinical instructor and those students with the CRNs". (TS - N 07 – SA)* *"We need to have like a quiz what medications you are going to give on a daily basis like today and how you calculate this medication, what is the action of this medication. That will even encourage them to read more to deal with my patient, and it will be a habit". (TS - N 07 – SA)* *"It is always better that medication safety component will be integrated in all subjects, aside from Pharmacology, it should be integrated in all professional nursing subjects". (TS - N 10 – SA)*

MS = medication safety

Appendix 14: Interview study themes subthemes and quotes - PHARMACY TEACHING STAFF in the UK and SA

Themes, subthemes and quotes emerged from pharmacy teaching staff interviews in the UK and Saudi Arabia

High level theme	Sub-theme / Definition	Quotes (examples)
1. MS Curriculum	**MS content** The constituent, chapters and sections included in MS. In addition, how MS was defined, conceptualized and understood as perceived by teaching staff.	*"I couldn't put a definition to it, because it is such a broad topic… so really hard to define". (TS - P 07 – UK)* *"Well it depends how broad you want to make medication safety… In terms of medication safety, I would say yes. Perhaps if you have medication errors or adverse drug reactions it gets a little bit narrower". (TS - P 10 – UK)* *"I would say medication safety and medication's management and possibly audit as in making sure that the processes that one is using when handling medicine are safe. So not just about what is happening here now; it's about the whole process because your practice may be safe but if you put your practice within the context of other practices it may become less so".(TS - P 03 – UK)* *"Medication safety is making sure that patients get the right medications. It is all at the right time and at the right dose without contra indications etc. and it is preventing harm to the patient by use of medicines really for so many different reasons... I think it might mean different things to different people". (TS - P 09 – UK)* *"when you are talking about somebody in community pharmacy, they will give you a very different explanation of what medication safety is, because you might be looking at the MURs for the patient, mightn't you? You might be looking at the poly-pharmacy and the dosing of … is the dosing appropriate to the patient? So, then you might talk to someone in the hospital, who might be saying well it is all about administering the drug, so really hard to define". (TS - P 07 – UK)* *"It is true and we end up giving the students more than one definition. So we usually use the WHO, the ISMP definition, but I think they all have in common the main issue of not having the patient risk of any harm while under their care and related to medication. ".(TS - P 01 – UK)* ……. *"I think medication safety, there is no assured definition it's a kind of vague it has multiple*

High level theme	Sub-theme / Definition	Quotes (examples)
		definition, because it can fall under a medication error, can fall under side effect and adverse effect but an assured definition no... Medication safety is a broad topic we can't specify" (TS – P 12 – SA) *"My understanding is that it is a very, very, very broad term..." (TS - P 04 – KSA)* *"It's hard to define medication safety, okay, you can define about I think the five rights for the patients and you have to provide the right drug, right route of administration, the right dose and the right time for the right patients". (TS – P 08 – SA)* *"Medication safety is anything related to using medication. What happens when we take medication? So this is how I define medication safety in terms of what would happen if I had the medication, what would happen if I miss the medication.". (TS – P 02 – SA)* *"Medication safety, well my personal understanding of medication safety is that it deals with the consequences of taking medications in terms of what this medication could cause and how we take this medication, about the general precautions of taking medications in terms of like of what is specific about this medication, what are the side effects of it this medication, so also what are the consequences of taking these medications in terms of like having negative consequences and positive consequences and what precautions for the medication. So this is my understanding about medication safety" (TS - P 02 – SA)* *"My understanding of medication safety is the safe medication use from the beginning from the first part, from the beginning of the medication process from procurement till the monitoring part you need to make sure you have a safe medication use".(TS - P 05 – SA)* *"My understanding is that, pharmacists, patients and our students should have the knowledge and understanding of what are the risks and what will happen if you give wrong medication or wrong dose of medications. It's basically how you educate the faculties, pharmacists and students". (TS - P 09 – SA)* *"Medication safety, my understanding is we are trying to avoid errors, not necessarily things that might kill patients but even near misses, I think identifying near misses is really important because I think most people when you think of medication safety they just hear that they just want to avoid errors but for me I feel like 'Yes, we need to avoid errors but*

High level theme	Sub-theme / Definition	Quotes (examples)
		also we need to identify near misses in order to avoid these errors as well'". (TS - P 10 – SA) *…….* *"the way the curriculum is applied here effectively is in a spiral so that most of these concepts are started in year one but they are of increasing complexity throughout the course so that in year two they will re-visit aspects of the same points but are more complex and then again in years three and four so rather than being taught in a single place they are being taught repeatedly at escalating complexity" (TS – P 08 - UK).* *"So we teach them in their very first … we teach our students from the very first year about why people make errors, what makes people make errors, what the factors are that contribute to people making errors. That includes human factors, so the human factors really" (ST – P 07- UK).* *"Teach them how to do root cause analysis and failure mode effect analysis (FMEA").(TS - P 01 – UK)* *"So in the first year we have sessions where we talk about medication errors, we talk about the vincristine case to get the students to watch a video and try and get them to think about the issues involved in that video …". (TS - P 10 – UK)* *"So they do that in the second year in the dispensing classes, when they report, self-report in Royal Pharmaceutical Society templates, they also record errors in their CPD for the year" (TS - P 05 – UK)* *"Teach them pharmacology" (TS - P 03 – UK)* *"We talk about the patient's role in patient safety". (TS - P 01 – UK)* *"Yes in terms of communication for example we teach that a number of different points across all four years in communication skills which feature quite prominently". (TS - P 05 – UK)* *"I think the content of medication safety taught to pharmacy students is different in each level of studying, and each pharmacy programme has their own curriculum I guess" (TS – P*

High level theme	Sub-theme / Definition	Quotes (examples)
		12 – SA). *"I am teaching drug therapy problems identification and solving, and pharmaceutical care issues".(TS - P 01 – SA)* *"Yes, yes, exactly. There is no specific course by name like medication safety but we have three different courses that you know deal like somehow with medication safety. We have non-prescription drugs courses that has some material about medication safety. We have another course called Drug Information and Evidence Based Medicine. Also we have a clinical toxicology course.". (TS - P 02 – SA)* *"My main focus currently is therapeutics to prevent side effects, ... prevent drug interactions...these are medication safety issues" (TS - P 07 - SA)* *"I'm not teaching medication safety I'm teaching pharmacology but as a part of our lecture if there is information related to medication safety we have to highlight it in red. (TS – P 08 – SA)* *"As I said chemotherapy is all about medication safety, so controlling the side effect or preventing the side effect is one of the objectives of that lecture".(TS - P 06 – SA)* *"I think we have the course called the Pharmacy Management. I think they talk about the sentinel event, medication error, reporting system. So I think they talk about that because this course" (TS - P 06 – SA)* *"We have to report errors so we teach them how to disclose errors to the patient" (TS - P 03 - SA)* *"The aspects of how adverse drug events underlie the different forms of medication errors and we would give the students forms where they would identify them". (TS - P 04 –– SA)* *"We are teaching them dispensing errors, prescribing errors, administration errors, we have also technology errors or technical errors, errors also when the system management for the drug errors" (TS - P 03 - SA)* *"When they are counselling, educating the patient they will prevent too many*

High level theme	Sub-theme / Definition	Quotes (examples)
		administrating errors related to medication error…double check for any prescription or any dispensing process…if they are in clinical field in the hospital...if they have some strange prescriptions how to communicate with the physician or pharmacist in order to know the correct one, if there are some mistakes in dose or prescriptions". (TS - P 15 – SA) *"We have something like a sound-alike, look-alike preparation session" (TS - P 14 – SA)* *"Also we teach them root cause analysis (RCA) and failure mode & effect analysis (FMEA)". (TS – P 03 - SA)* *"For us, the module is called "Principle of Safe Medication Practice". (TS – P 03 – SA)*
	MS theories (e.g. human error = Reason Model of Accident Causation)Theories underlying medication errors (i.e. specific for MS)	*"So we teach them the theory, human error theory and we talk about safety culture and we talk about risk assessment" (TS - P 01 – UK)* "*The theories relating to medication errors…probably the human factors theory. We make reference to reason model of accident causation…". (TS - P 02 – UK)* *"So we teach them in their very first … we teach our students from the very first year about why people make errors, what makes people make errors, what are the factors are that contribute to people making errors. That includes human factors, so the human factors really".(TS - P 07 – UK)* *"We teach students about human error theory and how it relates to medication errors… yes, reason model of accident causation" (TS – P 05 - – SA)* *"One of them is Swiss cheese theories ah… how it can be related to many medication errors" (TS - P 12 – SA)*
	MS curriculum guide & guidelines (e.g. WHO, NMC and GPhC) Curriculum guide & guidelines used/consulted when designing and preparing MS materials	*"Yes, the WHO Patient Safety Curriculum we looked at and the GPhC obviously… In terms of medication safety there are the two key documents ...and national patient safety agency (NPSA) material that has been used to implement medication safety on the course. We have found the WHO stuff quite useful as well in terms of medication errors.....I found it very useful when we were drawing up the course and some of the material within it is used in the course as well...". (TS - P 10 – UK)* *"I don't know. It sounds interesting but I have never used it or known about it".(TS - P 03 –*

High level theme	Sub-theme / Definition	Quotes (examples)
		UK) *"I haven't used any international curriculum guides" (TS - P 09 – UK)* *"The GPhC standard there is not a lot there in terms of what they are expecting so we had to go through our own personal experiences of what we think is important in medication safety in hospitals and in the literature as well…GPhC obviously we have to bear in mind has a limited amount of specifics about medication safety because it tends to be not too detailed…". (TS - P 10 – UK)* *"a fairly vague description that comes from the GPhC" (TS – P 08 - UK)* *"Yes. We are always looking at the various institutes for safe medication practices and the ISMP work...". (TS - P 09 – UK)* *"The main … the main source of information I use is for medication safety aspects is usually the NPSA guidance...".(TS – P 07 – UK)* *…….* *"Well our curriculum has to be approved by the university but the specific content, what we go through to develop the course, the content, ... and the WHO ... and also Michael Cohen and 'To Err is Human' reports and the ASHP, the clinical pharmacy and the American Pharmacists Association, American Council of Clinical Pharmacists (ACCP)".(TS - P 04 – SA)* *"No, I have not used WHO Patient Safety Curriculum Guide". (TS - P 02 – SA)* *"I went through the ASHP guidelines book ... I think this is a very interesting chapter for medication safety … in addition to the ISMP alerts …and medication errors book by Michael Cohen which is really very nice" (TS - P 05 – SA)* *"Yes, because here we focus mainly in Tennessee curriculum. Also we use the American College of Clinical Pharmacy... We mainly focus on those references". (TS - P 06 – SA)* *"I give those cases, they applied it on Saudi FDA reporting system...I can see the recalls from the Saudi FDA and I just show it to the students ...". (TS – P 03 -- SA)* *"In addition to some selective articles for medication safety like I have one article called*

High level theme	Sub-theme / Definition	Quotes (examples)
		Medication Errors. It provides with a basic classification about Five Rights and their prevention strategies for medication errors". (TS - P 05 – SA)
	MS protocol & guidelines Set of rules, particular approach recommended by the college, aim and objectives regarding MS mentioned in the course description handbook	*"There is no set curriculum from the pharmacy school council. They give an indicative curriculum but it's not really particularly detailed and although it talks about methods of delivery it doesn't go to the level of detail that you are suggesting. Within the school we agree within ourselves how we will deliver various aspects" (TS – P 08 - UK).* *"the way the curriculum is applied here effectively is in a spiral so that most of these concepts are started in year one but they are of increasing complexity throughout the course so that in year two they will re-visit aspects of the same points but are more complex and then again in years three and four so rather than being taught in a single place they are being taught repeatedly at escalating complexity". (TS - P 08 – UK)* *"We do a mixture … we try and introduce the theory to them potentially didactically, so in the sort of lecture. So for example the human factors are done as a lecture. We expect them to go and do some self-directed learning too, so we will send them away to do some reading. And then we bring them back to do small group teaching sessions, usually around case studies…we do workshops, and then if you like, you could describe what we do in terms of role play and prescription dispensing as simulation". (TS - P 07 – UK)* *"I think all of the above approaches... Blended approach." (TS - P 02 – UK).* ……. *"No, not anything that I know. I do not know if there is anything specific written of how to teach medication safety or if there is any specific approach to teach medication safety. Again I did not hear that… Nothing specific written that I could remember". (TS - P 02 – SA)* *"It is explicitly mentioned in the curriculum that we use these methods in teaching – the case study, the role play and case discussion, we do all the things that mentioned because in the curriculum in each learning domain we have to write the learning outcomes of the course and beside the learning outcome we write the applied teaching methodology, the methods we use to assess learning outcomes.(TS - P 01 – SA)* *"The Administration is encouraging us to put a slide in each lecture that is related to medication safety ... " (TS - P 07 –*

High level theme	Sub-theme / Definition	Quotes (examples)
	Learning outcomes Expected outcomes that need to be achieved	*"Well we want them to be aware of key patient safety concepts, so when they come across key issues related to patient safety and the literature related to patient safety they understand what it involves and what it entails. We want them to be able to participate in risk assessment as well whether the prospect of a retrospective and we want them to think about the learning environment that they're in terms of safety culture and reporting and that sort of thing...So that's our other main outcome is for them to understand the consequences on a bigger scale rather than just be focused on one individual patient, but more in the community family setting and in a national setting". (TS – P 01 – UK)* *"An awareness of the medication safety, an awareness of the factors that cause errors, understanding their own role in preventing the errors an understanding the importance of teamwork. It is quite basic at this stage" (TS – P 02 - UK).* "*the outcomes are understanding the definitions of medication errors and prescribing errors, some of the main features of those types of errors, and the difference between ADRs, preventable ADRs and prescribing errors, different methods of detecting medication errors and their advantages and disadvantages, and the prevalence of prescribing errors in hospitals in the UK, explaining what are the causes are and reasons framework and being able to recommend suggestions for the prevention of errors". (TS - P 09 – UK)* ……. *"I like to use this statement for therapeutic, it is all related to select the right medication, with the right dose, at the right time, for the right patient. To ensure that the outcomes will be in the benefit of the patient. This is mainly the therapeutic. The medication safety, I think mainly from my viewpoint related to the prevention of side effect and provide safety medication to the patients".(TS - P 07 – SA)* *Definitely increase their knowledge level regarding therapeutics specifically. Increase their skills to identify the patient problems because this is the core of clinical pharmacy. The core of clinical pharmacy is the ability to detect all the patient information, detecting the patient problems and then to manage it. We try to increase their knowledge and to increase their clinical skills, as I said the cognitive skills and the management of this data. And they have to come with management plan, to implement it and to monitor this plan and to take the next step by interact with the responses.(TS - P 06 - SA)* *"I want them to remember, the most important information and the major side effects for each medication I want them to have the outcomes at the end of this course". (TS - P 08 –*

High level theme	Sub-theme / Definition	Quotes (examples)
		SA) *"definitely understanding the importance of medication safety and again understanding the importance of reporting medication safety so we can prevent this errors form happening…I feel like we are under reporting and for under reporting this medication safety issues will continue to happen because we cannot solve it, so reporting and knowing what to do even after reporting, how to prevent these errors from happening, things like that and just what do you do".(TS - P 10 - – SA)* *"Ok if you ask me honestly my primary goal is to tell them that medication safety is part of their daily activities. They have to think of safety whenever they do anything in the pharmacy. And I would love them to be an advocate for medication safety, knowing the tools, knowing the consequences of medication errors, knowing how to prevent and how to deal with medication errors is really very important I would like to reach with my students. And mainly I want them to love medication safety… And they also need to know that medication safety is not the topic or job for medication safety officer or pharmacist only. Medication safety a mission for all and this is one of the topics that I always teach them".(TS - P 05 – SA)* *"For my course, my outcome is that the students will learn about medication errors but not only learn, they apply it, they believe that something called medication errors and they believe that we can benefit, I don't want them to go to start practising and think that it's only something they learn it in a textbook and then they start to work in a careless way or always make medication errors and don't bother about it so they just give it to the patient like everyone will know that there is no consequences". (TS - P 03 – SA)* *"For example if I am teaching them let us say communication skills my learning outcomes that I would like them to have is to like change them, to change their cognitive behaviour and change their perceptions of patients to have learning outcomes that impact their interactions over medications with patients and even with other healthcare professions. So these are my learning outcomes to teach them to make them to become excellent communicators and so these are my real outcomes".(TS - P 02 – SA)* *"Our students should be the future clinical pharmacist and I would like them to be precise, clinically oriented, taking care of patients or using patient-oriented or patient-centred type of care. And to be good thinkers, this is really important in our profession because even if*

High level theme	Sub-theme / Definition	Quotes (examples)
		you have guideline that will help you to solve the patient problems. Sometimes you should customise this guideline or use them just as a guide so you should learn how to think and how to find information and how to help in solving problems".(TS - P 01 – SA)
	Target knowledge, skills & attitudes (KSA) KSA that students need to develop when studying in order to practice medication safely after graduation	*"a pharmacist definitely they should be able to do calculations and they should be able to think about interaction between different medications, and they should know about a contraindication, ...and they should be aware of the patient in terms of compliance as well...". (TS – P 01 – UK)* *'I think having an understanding of human factors and how communication can impact on medication errors". (TS - P 10 – UK)* *"Ok. Students need to define what medication safety is and what this comprises of. Students will need to understand what adverse drug reactions are and what defines a medication error. Students will need to have an understanding of safe distribution systems for medication systems and any record keeping that needs to be kept. Students will need to have an idea of how to dispose of medications and what makes up a good work flow within the pharmacy to minimise risk. I guess students will need to have an understanding of governance as well and what sort of governance can be put in place as in audit, standard operating procedures and understanding what are high risk medicines that they come across in their daily practice". (TS - P 04 – UK)* *"I would expect them to know about the high risk medications that commonly end up with patients in hospital and I would hope that they could clearly defend their professional decisions if questioned". (TS - P 06 – UK)* *"They should be able to understand why things go wrong and then hopefully work out ways to prevent that in future".(TS - P 09 – UK)* ……. *"I think there are some courses that are very crucial as knowledge needed for pharmacist to practice medication safety - like pharmacology, pharmaceutics, Pharmaco-epidemiology and drug safety, pharmaceutical care, last but not least therapeutics". (TS - P 01 – SA)* *"Their knowledge regarding pharmacological actions of medication, pharmacogenetics, dynamics of each medication, they should master these skills. I think also the monitoring*

High level theme	Sub-theme / Definition	Quotes (examples)
		of medication and how to follow up, to do patient counselling is very important also, to prevent certain adverse outcomes that are related to little understating or poor understanding of the patients regarding the medication". (TS - P 07 – SA) *"The epidemiology about the different population they should know, in what sectors of population usually medication errors happen a lot with the elderly or with children for instance you should think about it also...They have to have some pharmaco-therapy knowledge and skills ...". (TS - P 03 – SA)* *"They have to have excellent clinical knowledge ... I just said probably learning how to report an error and then what to do after reporting… how to deal with an error after it happens" (TS - P 10 -— SA)* *"I wish that they would learn more about the kinds of medication safety and medication safety research so that they would have a clear picture of it and be able to practise…". (TS - P 04 – SA)* *"So they have to have the knowledge from different aspects. Also economics knowledge because in the end maybe you can end up in the committee or something you can use drugs so you have to think about the economy". (TS - P 03 – SA)* *"How to manage their time". (TS - P 15 – SA)* *"How to use good resources and reliable resources and how to search for the data in appropriate way". (TS - P 15 – SA)* *"Work ethics because ethic is a big thing with medication safety. I mean that's the whole problem, is you know, is you could know something but you don't report because you are involved on it because you are scared that your name could be there and you might end up in trouble...". (TS - P 10 – SA)* ……. *"Skills. ... Lot about communication skills as well, so being able to communicate with patients and communicate with your team because a lot of errors are due to communication. So I think that is one very large skill that you can help and certainly provide them with the building blocks for that but it is something that you need to*

High level theme	Sub-theme / Definition	Quotes (examples)
		practise" (TS – P 09 UK - talking about skills). *"I said we require that they have some critical thinking analysis to be able to participate in any root cause analysis or analysis that is relevant to risk assessment for incidents that happen as well". (TS - P 01 – UK - talking about skills needed)* *"I think decision making is important, understanding when and what are good resources to help with patient safety so having that critical thinking that they can identify the resources that will help them". (TS - P 04 – UK)* *"Negotiating grey areas and difficult decision making areas, balancing risks and benefits. Sometimes the decisions that may cause harm and upset people, so you cannot always avoid harm. Also clinical decision making skills." (TS - P 10 – UK)* *…….* *"I think communication skills are very important. Professionalism is very important, problem solving skills are very important, research skills are very important, all these drug information finding skills are very important. All these skills are very important". (TS - P 01 – SA)* *They should have good literature research skills, they should know how to look up for the needed information from accurate sites, and from the right information source..." (TS - P 07 – SA)* *"They need to have good body language because sometimes a simple sign in the body language of medication safety officers would affect the investigation for any incident and stop staff from talking to them..."(TS - P 05 – SA)* *"What I would wish that they would also learn is about most of the checks that I told you about earlier.(TS - P 04 – SA – talking about medication double checking skills)* *"They can analyse and they can solve a problem in any case, they have to have critical thinking skills". (TS - P 08 – SA)* *"Analytical skills are very important as they will be looking through a huge amount of data. They need to learn how to look at it in an efficient way in order to get the best way to get the information from the data they have". (TS - P 05 – SA)*

High level theme	Sub-theme / Definition	Quotes (examples)
		"Decision making skills, because they have to decide on something. So they must know how can they decide, it's not only the book knowledge...They have to decide from themselves" (TS - P 13 –SA) *"The calculation and which drug should be taken for example as orally and one given as IV and so on". (TS - P 09 – SA)* *"Increase their clinical skills ... cognitive skills and the management of this data". (TS - P 06 – SA)* *"they need to be good negotiators because they need to convince the pharmacy admin sometimes, the patient ..."(TS - P 05 – SA)* *"Observation skills ... Listening skills are very important because they need to be good listeners". (TS - P 05 – SA)* *"Identifying, knowing the kinds of errors and being able to identify them". (TS - P 04 – SA)* *"I think the skills like how to identify medication errors, how to conduct a failure mode & effect analysis (FMEA) this is skills, root cause analysis (RCA) this stuff, I don't think that you only need to read about it you have to practise it you have to use it as an exercise...". (TS - P 03 – SA)* ……. *"The acknowledgment that they made mistakes and the ability to be open and receptive to the notion that somebody may be pointing out that they made mistakes" (TS – P 02- UK - talking about attitudes).* *"Should always have confidence on day one. If they see something which they don't understand or they think could potentially be an error or a mistake to be able to say hang on a minute could someone explain why this isn't here, and I am not entirely happy... That is professionalism..." (TS - P 03 – UK - taking about attitudes).* *"It is about that questioning, about being conscientious, it is those sort of professional behaviours".(TS - P 07 – UK)* …….

High level theme	Sub-theme / Definition	Quotes (examples)
		"You have to be persistent. I want to do this. This is best for the patient. You do not have to be very lean and soft because otherwise you will not achieve a lot...you have to be assertive certain and have a very clear mind. And this is the best way to focus …They need to be good listeners. They need to be respecting others, and they need to be open minded … open for new ideas...they need to be open to everything, accepting, flexible and respecting others in this matter". (TS - P 05 – SA) *"Confident, accurate, concise, professional of course. Maybe it's all related to accuracy and to be concise, confident in yourself". (TS - P 07 –SA)* *"I think they should be confident also about their knowledge about medication safety...".(TS - P03 – SA)* *"Definitely they have to increase their awareness about the importance of medication safety". (TS - P 06 – SA)* *"I always teach my students to not be ashamed if s/he did a mistake. Everyone can do a mistake. So I can make a mistake and go quickly and report this mistake, report this error to the chief pharmacist or to my supervisor that I did an error and try to get hold of the patient as soon as possible, if I did it with a patient.". (TS - P 02 -SA)* *"To report this problem since another person will learn from his/her fault. This will help them. Solve the problem and report this problem…S/he have to solve the problem at the same time if s/he can".(TS - P 15 – SA)* *"So they have to focus on books and textbooks and like for example, like if they are searching for something they have to go all background and stuff like that. This is the drug, what is the background, how it can cause problems, which type of patient should be provided with this, all this information". (TS - P 13 – SA)* *"attitude is the desire to learn…That is the attitude that I would like my students to have and that is what I always teach them" (TS - P 02 – SA)* *They should acquire an open-minded mind-set. They should know that still the drug error will be evolving and they should have the mind-set of knowing no finger pointing and they should realise or be aware that they could not point fingers to the prescribers and make a big fuss, identify errors without finger pointing (TS - P 04 – SA)*

High level theme	Sub-theme / Definition	Quotes (examples)
		"They have to trust themselves" (TS - P 09 – SA)
2. The teaching process	**Underlying learning theories** Teaching and learning theories used when teaching students about MS (e.g. Kolb's cycle, Bloom's taxonomy, Miller's pyramid, etc.)	*"Not that I'm aware of, not particular theories of learning, I'm aware of Bloom's taxonomy. I don't use that when I'm teaching". (TS – P 02 - UK).* *"integration between science and practice and we used the Harden Ladder which the GPhC recommends (so knows, knows how, shows how and dose), we used outcomes for learning based on the Harden Ladder".(TS - P 05 – UK)* ……. *"Teaching theories, no I am not using theory, no, any theories of what? How to teach? Actually I use my personal skills…Maybe it is my practice and personal skills which I obtained from work experience. I did not go through theories of teaching. I did not go there". (TS - P 05 –SA)* *"In fact I like the constructive theory in which we can start by discussion and help our students generate knowledge themselves in order to conclude we would like to say".(TS - P01 - SA)* *"I am familiar with Bloom's taxonomy…I probably take that into account when I prepare my exam so that I focus on that when I prepare the lecture but actual teaching theories no". (TS - P04 — SA)*
	Teaching style Description of the teaching style (e.g. didactic, interactive, etc.)	*"Blended. It is a mix of lectures and interactive work" (TS – P 02 – UK).* *"It's currently taught in mainly lecture based (didactic approach)".(TS - P 04 – UK)* *"My teaching style is interactive. So I prefer to question the students to make sure they understand any concepts... This is my style on patient safety teaching". (TS - P 04 – UK)* *"Yes, I think it is both didactic and experiential styles". (TS - P 05 – SA)* *"Yes we can say that is in both of them, didactic courses in therapeutics and experiential while they are practising in the hospital". (TS - P 07 – SA)* *"We have didactic teaching for pharmacology, therapeutic and pharmaceutical care, it is better to do this in simulation lab in the college. It is better than just teaching it in the classroom".(TS - P 01 – SA)*

High level theme	Sub-theme / Definition	Quotes (examples)
		"It is a didactic approach and interactive style at the same time". (TS - P 05 – SA) *"Yes, I am trying to use interactive style". (TS - P 01 – SA)* *"Yes, I interact with them...Yes, I like both of them I like the interactive lectures that you know that student will understand you well it is not one way teaching it's a two-way kind of teaching". (TS - P 08 – SA)* *"My teaching style of my courses, I usually focus on active learning and I give lectures but I like making discussions and I like teamwork.". (TS - P 02 – SA)*
	Time allocated for MS Is the time allocated for MS teaching enough to cover all aspects of MS	*"We are never going to be able to cover all aspects of medication safety. What we have got to be able to do is introduce the concept and the common issues with … wherever we are teaching it... I think the way we do it; we probably do allocate enough time to cover the common problems that they might … that the students might encounter" (TS – P 07 - UK).* *"I think we spend enough time talking about medication safety explicitly". (TS - P 08 –UK)* *"It is hard to say you need to consider time of teaching the concepts". (TS – P 05 – UK)* *"Because it is integrated all the way through, you touch on it with everything you teach… I can't … very difficult to put a figure on that". (TS - P 07 – UK)* *"I don't know about that, I'm not sure about adequacy of time allocated" (TS - P 04 – UK)* "*I think the time and the curriculum is enough" (TS - P 01 – SA)* "*In our medicinal chemistry course yes, but I don't have any information about other courses" (TS - P 09 – SA)* *"I think it's a bit too little, for example one slide could be two minutes maybe. So I think it should have at least five minutes per lecture or to mention something about it". (TS - P 14 – SA)* *"No it is not… Actually I just wish we had more time as I mentioned before".(TS - P 04 – SA)*

High level theme	Sub-theme / Definition	Quotes (examples)
		"I think we should add more time to teach medication safety". (TS - P 12 – SA) *"If it is integrated I mean we can't really track it because it is just throughout the course". (TS - P 10 – SA)* *"I can't give you a clear answer because we don't have dedicated time for medication safety, so I don't know if it is enough or not". (TS - P 07 – SA)*
	Mode of integration Is MS integrated as standalone course or part of existing courses or both, which year is best for integration of medication safety component or course, and is medication safety being taught explicitly or implicitly	*"So I think there is a need to combine both types probably" (TS – P 01 - UK).* *"I think both, the approach of having both…There is this place to be explicit about it but there is also a place where it should be entwined in everything else as well". (TS - P 09 – UK)* *"I don't really think we will need to have that separate. It shouldn't need to be separate because in my view you cannot separate safety from any practice that the pharmacies or healthcare do". (TS - P 03 – UK)* *"I would say if possible, we can integrate that in everything we do because it is part of everyday practice in medication safety. We are developing skills in particular areas, and covering certain issues in a particular time. We should not really separate medication safety in my opinion but actually it is a core part for the health care professional and what the pharmacist does. It should really feature throughout the course, the only thing building complexity, introduce core concepts".* (*TS - P 05 – UK)* *"I think it should be probably integrated in all of the courses from the very, very beginning". (TS - P 01 – UK)* *"I would say earlier in a pharmacy course, either in year one or year two" (TS - P 08 – UK)* *"Yes. But actually personally I would prefer that it's not taught in a single unit and that it should be emphasised throughout the course". (TS - P 08 – UK)* *"So it is taught in that sense but probably not as explicit as you're saying as in a patient safety lecture it's just taught underlying to everything else that they're being taught". (TS - P 01- UK)*

High level theme	Sub-theme / Definition	Quotes (examples)
		"Medication safety is taught implicitly. Lectures and workshops are not designed specifically to identify medication safety issues". (TS - P 04 – UK) *"No, because all the way through the course, we picked up on many aspects of medication safety... So it is not labelled 'medication safety'.(TS - P 07 – UK)* *"So it is not just seen as a separate subject because it would be everywhere really. So it is explicitly highlighted as well you are going to learn about error theory for example and how that applies to prescribing when dispensing etc.". (TS – P – 10 – UK)* *"So all the course components are compulsory" (TS - P 02 – UK)* *"At the university we don't have optional units" (TS - P 04 – UK)* ……. *"No, I think, mixed is better, special module and integrated in different courses". (TS - P 03 – SA)* *"So I think we have to include both methods to make a course about medication safety, which should be comprehensive course, include all the basics, highlight the importance of medication safety, and how medication safety can affect the patient goals. At the same time, we should include this aspect in each course because as I said, each course has different details. And medication safety incorporates in all its details, so we should focus on both methods". (TS - P 06 – SA)* *"But if you make it a dedicated course I think the student will take the course, pass the exam and then they will forget all of it. So in my opinion I think if you…let's say take the pharmaceutical issues or something related to medication safety in preparation, storage and in pharmaceutics. Take it to drug therapy problems, patient problems and patient safety, put it in therapeutics, it will be more effective than just make it in one course and then they will forget it". (TS - P 07 - SA)* *"If we had the possibility to have medication safety as a standalone course it would be great we could give them more topics. You can go deep because you have more time".(TS - P 05 –SA)*

High level theme	Sub-theme / Definition	Quotes (examples)
		"Stand alone course. Because if you will combine with other courses like pharmacology you will add a little information there and only related to the drugs. If it's a stand-alone course, you will focus to the whole aspect of medication safety, in that way, it will be more beneficial".(TS - P 13 – SA) *"Medication safety component is very explicit in pharmaceutical care courses, therapeutics courses, and mainly hospital pharmacy courses". (TS - P 01 –SA)* *"Yes, it's clearly labelled to the students in our school". (TS - P 03 – SA)* *"When I have it, I have it here it was a clear topic and named 'medication safety'. (TS - P 04– SA)* *"We did not have a specific class for medication safety but it was clear throughout the programme". (TS - P 10 – SA)* *"but I think till now it's not clear not labelled as medication safety". (TS - P 12– SA)* *"But as a medication safety as a terminology…I'm going to tell you an issue about medication safety it is not clearly labelled in pharmaceutical care course". (TS - P 14 –SA)* "*Well in fact I think that is very, very, very important to be taught to students and to be highlighted while teaching because the major job of the pharmacist is to ensure medication safety, to ensure operational medication use, to ensure ideal and getting best benefits of medication and avoiding the risk. So we are highlighting the medication safety and we are emphasising the importance of ensuring medication safety while teaching this for students…". (TS - P 01 – SA)* *"I believed it is definitely very important to the students to be clearly labelled and to know this medication safety". (TS - P 10 – SA)* *"...it is extremely important to teach medication safety earlier in the pre-graduate level in bachelor or PharmD programmes". (TS - P 05 – SA)* *"It will help them that they will get the experience early... and also it will be unique for the*

High level theme	Sub-theme / Definition	Quotes (examples)
		students and that they will be graduated and have in their curriculum medication safety course". (TS - P 08 – SA) *"All elements of medication safety are compulsory not optional" (TS - P 01 – SA)* *"Everything is compulsory, there is no optional... Yes, our medication safety course is compulsory you won't graduate until you take it". (TS - P 03 – SA)*
	Mode of supervision and training Type of supervision during clinical placement and training related issued	*"Well, we supervise students so students are set tasks and we supervise their practice and we identify whether their practice is consistent with patient safety or not. So we watch for example in the dispensing process we watch them to see if they have a logical and safe work flow..." (TS – P 04 - UK).* ……. *"I have to supervise my students during their internship and during their training during the clinical training in the hospital, that's part of my job...".(TS - P 01 – SA)* *"We tried to ask the preceptors (tutors) to teach the students how do you report, what did you do about rather than just discussing the case and that's it". (TS - P 10 – SA)* :*"Most of them (training sites) are short of clinical pharmacists who are really qualified to teach our students". (TS - P 01 - SA)* *"But I think most of the hospitals have a shortage of staff and the number of students is a little bit more than their capacity especially we have other universities competing with us on the training sites. Training is a big challenge" (TS - P 02– SA)* *"The hospital preceptors (tutors) because you know some hospitals are so busy, so sometimes they do not have time to teach students. They do not have time to train students actually so I have to be with them to train them. I think that the schedule and the overload that they have in some really big hospitals make us not able to train our students very well …". (TS - P 02 –SA)*
	Methods to deliver MS (learning resources) Methods used to teach MS currently or should be used (e.g. IPL, simulation, e-learning, etc.)	*"We have workshops and inter-professional education so we're working with groups of medics, we have didactic lectures, and they have ... I think they may have role plays as well… so quite a variety of different methods. They have to do a root cause analysis of a medication and they start to think about what is that process actually.... " (TS – P09 - UK).*

High level theme	Sub-theme / Definition	Quotes (examples)
		"I believe that case studies work the best when we are teaching patient safety because this gives an opportunity for the students to contextualise legislation rather than any teaching". (TS - P 04 – UK) *"…they do clinical placements currently in the third year… The clinical placement is observational".* (*TS - P 08 – UK)* *"They have simulated role play and practice and there's aspects in which if this affects the issue they will play the equipment". (TS - P 03 – UK)* *"We simulated that in a simulation room with a full-size mannequin …Simulation and workshops methods are both used in teaching medication safety". (TS - P 06 – UK)* *"But there is a bit of self-directed study"* (*TS - P05 – UK)* *"I would say at this point it is uni-professional…, we don't have a nursing and medics students…". (TS - P 03 – UK)* *"Yes. Currently in terms of the inter-professional learning around patient safety the second year students, they work alongside social work students and radiography students to study a patient case where medication safety or safety for the patient had been neglected".(TS - P 04 – UK)* *"But I think as a concept it's a very good idea to get students working together at that stage in training rather than waiting until they are Pre-Registration junior pharmacists in the workplace setting…And they get teaching with others, with medics as well. I think that that's a very insightful way of teaching this, working with other professions about medication safety".* (*TS - P 09 – UK)* *"As well I think that is really important to get those different perspectives…Getting the inter-professional perspective on that sort of behaviour is really interesting…So that kind of inter-professional perspective is really interesting. And also the other professionals will learn when pharmacists will ask questions…".* (*TS - P 10 – UK)* ……. *"Right now yes, we have lectures and problem-based learning, we have case studies and*

High level theme	Sub-theme / Definition	Quotes (examples)
		sometimes we make like role play and simulation session for students, using sim man until we get well-designed pharmaceutical care lab and the satellite pharmacy… And sometimes we use something like flip classroom strategy in order to help our students to be self-learners".(TS - P 01 – SA) *"We do send them journals or papers, we do send them regarding and we tell them beforehand so this chapter is in the Blackboard, research paper is on the Blackboard you should read it". (TS - P 11 – SA)* *"… We only use the e-learning and blackboard just to communicate if there are any announcements or the lectures by themselves, they will be there on the blackboard". (TS - P 07 – SA)* *"Also we show them some videos, from the Saudi FDA and ISMP reports on some medication errors" (TS - P 03– SA)* *"If you show them videos they can visualise and it will be good for them to retain in their brain". (TS - P 13 – SA)* *"For the Introduction to Pharmacy Practice Experience (IPPE) it's mainly an observation for students, they have to observe and shadow what the pharmacists and clinical pharmacists do". (TS - P 06 – SA)* *"It is a uni-professional learning right now". (TS - P 02 - SA)* *"Inter-professional education that is the ideal but actually we didn't apply it yet. We are thinking about inter-professional education to have pharmacy students, nursing students and medical students learning together...". (TS - P 01 – SA)* *"I don't think so. No, no…simulation lab to teach medication safety it is only a compounding lab for pharmaceutics course". (TS - P 11 – SA)* *"No simulation used for medication safety in our school of pharmacy". (TS - P 04 – SA)* *"No, we're working on this, because we have a simulation sitting, we're working on it to make it inter-professional…but for the medication safety course we don't use simulation*

High level theme	Sub-theme / Definition	Quotes (examples)
		before, we can integrate it with other courses like the labs" (TS - P 03 - SA) *"also we got some projects like root cause analysis, failure mode & effect analysis (FMEA) you give them cases and they conduct the RCA in failure mode & effect analysis (FMEA)". (TS - P 03 – SA)*
	Applied MS practices Teaching staff applying and practising MS in their professional practice	*"Within the universities we have also undergraduate student projects I supervised with medication safety and I also teach medication safety in the undergraduate and post graduate curriculum within the pharmacy school" (TS – P 02 - UK).* *"Well as I said I'm not really practising in clinical setting, so it's usually related to more research aspects of things, and doing studies and doing pilot work with undergraduate student projects is that sort of thing?" (TS – P 01- UK)* *"As I said, I'm just supervising my students...I'm not practising pharmacy in the clinical setting".(TS - P 03 – SA)* *"Now, because we have specialised in therapeutics and also in medication management, and we are all the time discussing the incidents of side effect and how to prevent. So I think in every case discussion this is the most important point that we stress on. So we focus mainly in the side effect and indications, how to prevent, how to monitor…I think this is one of the most area on which we are focusing on in medication safety". (TS – P 06 – SA)* *"When we supervise students we make sure to present medication errors and how to avoid medication error, and identify drug therapy problems in patient files in their prescriptions and during the therapeutic planning or what is called pharmaceutical care planning …". (TS - P 01 – SA)*
	MS feedback Form of feedback from the students (about MS education is it positive or negative, methods used in teaching, difficulties faced during training, etc) Form of feedback from teaching staff (about many issues related to MS education) Mode of assessment (How MS	*A. Form of feedback from the students:* *"I think generally there is more positive feedback for the simulation based training and e-learning, and less for didactic format" (TS - P 02 – UK)* *"They were very positive, they identify that they would like more and that they find it useful. The comments often relate to the practice that we are trying to achieved inter-professional group works that is not sufficient for the time allocated and they would like to do more of it more often" (TS – P 02 - UK).*

High level theme	Sub-theme / Definition	Quotes (examples)
	course is evaluated, what form of evaluation (i.e. oral evaluation, online evaluation).	*"It depends, so we get some students that come and speak to us immediately afterwards and say, this was a really interesting session and they should have given us this earlier and we should have known about this and if I had known about this in year 2 I would have done differently in my dispensing class for example"(TS - P 01 – UK)* ……. *"They want something close to real life… for us we've been students before and it was so rigid it was only lecture, we like to see something in real life or something that simulates real life". (TS - P 03 –SA)* *"Yes, I think they like it (meant simulation method). Because they spend good times in the simulation lab downstairs" (TS - P 07 – SA)* *"Some of them say you should teach a workshop or you can give a workshop. The only recommendations by students that it should be taught as a workshop (talking about medication safety)" (TS - P 03 –SA)* *"This is exactly the feedback that I get they would love to go to the hospital or to the pharmacy to see what I was teaching them about how to prevent medication errors and double checking, tall man letter in the real world. They see it and check it themselves". (TS - P 05 – SA – talking about clinical placement method)* *"They are interested in medication safety and they know that it's very important for their career …". (TS - P 01 - SA)* *"The feedback I receive is good, and they believe that medication safety is an important topic" (TS - P 05 - SA)* ……. *B. Form of feedback from teaching staff:* *"I think so...their course work is related to medication error, medication safety seems quite good as well… They seem to understand medication errors and the importance of it". (TS - P 10 – UK)* *"And I think simulation is really useful when you want to try something which by its own nature would be unsafe. It's really good ...to show people how something goes wrong*

High level theme	Sub-theme / Definition	Quotes (examples)
		without putting anyone at risk. ...".(TS - P 03 – UK) *"Simulation is never going to be like in the real world. You cannot simulate a picnic in a boardroom because it doesn't rain, and there are not insects everywhere." (TS - P03 – UK)* *"Compared to in the past when … you may not have been exposed to the concepts of medication errors. So I think students leaving university I would say now are probably better prepared than other generations have been in the past".(TS - P 10 – UK)* ……. *"Inter-professional learning is a very good method and it is one of the methods to deliver medication safety education, I hope we can implement it like simulating the situation for healthcare providers. I think it will be ideal to be both that way because it will be like practical experience". (TS - P 01 –SA)* *"I think simulation sessions are really good to have before going to the hospital but it is not really something that available right now". (TS – P 02 – SA)* *"I enjoy having a group discussion and I like it when students try to think outside the box and give answers to what I have discussed". (TS - P 04 – SA)* *"So a group based scenario or example exercise will not only teach them medication safety but other important tools for medication safety officer like listening, giving feedback, presenting data, facial expressions and body language understanding". (TS - P 05 – SA)* *"So it is a problem-solving technique that we are using now. It increase the student cognitive skills and the clinical skills vs. just a recall skills" (TS - P 06 – SA)* *"The good thing for clinical pharmacist is to go and see at a site visit and take more cases…it could be good to take students and make them pick some cases about medication safety or drug errors at our hospitals…". (TS - P 02 – SA)* *"For me I don't like lectures, if I can give medication safety without lectures I will do. …lectures, I don't think lectures is the right way" (TS - P 03 – SA)* *"I think they are good methods but not enough. We need to put the students... in real*

High level theme	Sub-theme / Definition	Quotes (examples)
		situation like taking them in hospitals or simulation labs and put them in certain situations …". (TS - P 01 –SA) ……. *Mode of assessment:* *"Not specifically about that no. I get general feedback about my course and the courses I teach on, but not specifically about medication safety". (TS - P 03 – UK)* *"Feedback is general on the whole programme; it is not specific about medication safety." (TS – P 05 – UK)* *"Definitely exams as an indicator to how well the students have performed or what are the key concepts that the students have grasped...We also have at the end of the module they have a module evaluation survey..."(TS - P 01 – UK)* *"For example we have in lecture questionnaires, MCQ questionnaires...and we just quickly quiz them about what we have covered …We have an annual feedback form … We have students who fill out our optional online surveys...".(TS - P 06 – UK)* *"Each student has a reflective portfolio and the most informative stuff that comes back to us about how they are linking what we have taught them in the university to what they see on clinical placement. The reflections that come back from placements, which feedback and actually bring out the issues of medication errors and safety for patients". (TS - P07 – UK)* *"Very low. If you assume there are 100 students per year group, there is a minimum of 400 students who have received the questionnaire and 25 responded".(TS - P 06 – UK)* *"It is a low response rate I think". (TS – P 08 – UK – talking about feedback received from pharmacy students)* ……. *"Yes, a general evaluation for each subject. . Honestly, most of the opinion I get are about the course itself not about the medication safety". (TS - P09 – SA)* *"But it didn't have any aspect about medication safety (talking about feedback form)". (TS - P 11 – SA)*

High level theme	Sub-theme / Definition	Quotes (examples)
		"The only actual feedback, I think they have a form that need to be filled…it's like an evaluation form". (TS - P09 – SA) *"They are requesting us to collect our students 'feedback at the end of the year through course evaluation surveys and lecture-skills surveys...".(TS - P 01 – SA)* *"Students preferred to provide us with verbal informal feedback, but not a written one…some provide online feedback". (TS – P04 – SA)* *"Feedback is limited; I think few students fill out the evaluation form according to quality assurance department". (TS – P 01 –SA)*
3. Evaluation of MS education	**Perceptions of teaching staff on adequacy of current education** Views and perceptions of teaching staff on the quality and adequacy of the current medication safety education (i.e. is the portion of medication safety education is sufficient to satisfy the requirement and meet the need for safe medication practice)	*"An awareness of the medication safety, an awareness of the factors that cause errors, understanding their own role in preventing the errors …It is quite basic at this stage". (TS – P 02 - UK)* *"Whether we teach it sufficiently in terms of amount is an arguable point really". (TS - P 08 – UK)* *"Generally yes, for methods that involve the student's participation to be able to apply the learning from didactic sessions and theory based teaching".(TS - P 02 – UK)* *"We need medication safety component to be more clear, specific and more presented from starting of the pharmacy programme and throughout ... also the quantity of medication safety component is not enough I think" (TS – P 11 – SA)* *"I think the current medication safety education is okay, but it is a good strategy and always recommended to improve the teaching especially for important topic like medication safety, as well as updating current educational methods" (TS – P 02 – SA)* *"So the students have to know the importance of the medication safety by seeing real cases in the hospital, but teaching them only in college is not enough" (TS – P 12 – SA)* *"There is always a room for improvement...of course we need more integration and focus on medication safety teaching". (TS – P 05 – SA)*

High level theme	Sub-theme / Definition	Quotes (examples)
	Lessons learnt from course evaluation and student feedback The knowledge or understanding of medication safety gained by reviewing course evaluation and student feedback	*"I believe that it should be taught in the first year the importance of medication safety and the basic concepts of what medication safety is and I think there should be recognition of that in the first year.". (TS - P04 – UK)* *"They were very positive, they identify that they would like more and that they find it useful. The comments often relate to the practice that we are trying to achieved inter-professional group works that is not sufficient for the time allocated and they would like to do more of it more often" (TS – P 02 - UK).* *"I think you have to use a multitude of different methods to try and get across different points". (TS - P 10 – UK)* *"We need medication safety component to be more clear, specific and more presented from starting of the pharmacy programme and throughout ... also the quantity of medication safety component is not enough I think" (TS – P 11 – SA)* *"I think there is a need to update the current methods and include more simulation and inter-professional learning" (TS – P 08 – SA)*
	Barriers to positive MS educational outcomes Difficulties and obstacles which prevent or block improvement in medication safety education	*"Clinical placements are relatively short and because they are compressed in terms of time the amount of actual practice that a teacher can show them is not huge. I think this is one of the problems that we have found in training in comparison to medical nursing training the exposure to clinical practice is very slight". (TS – P 08 - UK)* *"The students also get real practice by using reporting forms and documentation, they get exposure in filling in error reports ... The students get some exposure but it is quite limited because it is not that routine made practice not doing it on a day to day basis. That is one of the limitations" (TS – P 02 - UK).* *"I think covering all the issues can be quite problematic. There is a lot to cover, it is not just about errors but also covering about the basic. Time is an issue. You have to find a dedicated time to cover that. In addition finding external speakers is not always easy, so you might want medics, nurses, people with knowledge of medication safety can be quite problematic".(TS – P05 – UK)* *"Yes. Many obstacles, but those are routine obstacles that you have to overcome because*

High level theme	Sub-theme / Definition	Quotes (examples)
		for example time resources, appropriate methods, location because sometimes we are in a massive lecture room which can hold 200 people…". . (TS – P 06 – UK) *"In our lectures we deliver to somewhere between 100 and 120 students and it's difficult to have a conversation with them in those circumstances…". (TS - P 08 – UK)* ……. *"So I do not think there will be enough time to teach this especially with other different courses you know". (TS - P 02 –SA)* *"in the real setting we cannot do this because yes, we have a lack of these simulation labs* *"Most of them are short of clinical pharmacists who are really qualified to teach our students". (TS - P 01 - SA)* *"But I think most of the hospitals have shortage in staff and the number of students is a little bit more than their capacity especially we have other universities competing with us on the training sites. Training is a big challenge… The hospital preceptors (tutors) in some hospitals are so busy, so sometimes they do not have time to teach or train students…so I have to be with them to train them. I think that the schedule and the overload that they have in some really big hospitals make us not able to train our students very well...". (TS - P 02 –SA)*
	Strategies to improve MS education Ideas, methods and plans suggested by teaching staff or students to improve medication safety education	*"the only thing I would consider probably change is potentially move the explicit patient safety materials around errors, medication errors and pharmacovigilance we can move that if we have the space to move it to, to earlier in the curriculum … I think the students may want to learn about it in more detail in the second or third year".(TS - P 05 – UK)* *"…and then when they got to fourth year what they are really focusing on is application of that kind of patient safety knowledge which they do in the fourth year...". (TS - P 05 – UK)* *"Using multidisciplinary approach…, you have different professional groups providing that perspective, try to have recognised experts in the field, having specialists in the school-medication safety for example. Making it clear as much as possible in whole curriculum that the major part of pharmacist and other healthcare professional role is patient and medication safety… teaching medication errors concepts earlier and revisit that on multiple occasion throughout the curriculum, building on that knowledge and integrate it*

High level theme	Sub-theme / Definition	Quotes (examples)
		with pharmaceutical care skills to the students when they finished that degree so they got an integrated view of both as a whole rather than looking on a specific issue".(TS - P 05 – UK) *"It should be built up through the course as you go through and so this idea of a spiral curriculum where you re-visit things at a higher level as you go through so in like our third year of medication error course work is far more complicated than what they see in the first year". (TS - P 10 – UK)* *"I think again doing more work based practice assignments. While they eventually have access to the work place would be a good way and I think there are some elements currently which lack research and evidence based. So the only thing I feel pharmacy as a whole maybe now is a little more time and a little more focus on developing research for practitioners" (TS – P 03 - UK).* *"I think teaching people clinical reasoning and critical thinking; anything to do with thinking it requires a long-term empathy and I think the early stages of the M Pharm the students are just figuring out what they have got themselves into".(TS - P 03 – UK)* *"ADRs and reporting. They can be covered explicitly but you can talk about reporting when you are doing a dispensing class and you've spotted an error in a prescription. You could bring it in then, you could bring it in all the time but then you could also revisit it as a topic on its own".* (*TS - P 09 – UK)* *"We tried introducing videos and real life patient stories for example, because I think that's also a very powerful message... So I think that has a powerful effect as well as seeing real cases and real patients perhaps being harmed or somebody dying from an actual medication safety incident. ".*(*TS - P 01 – UK)* *"I suppose we could run virtual simulation in the form of videos or could follow a patient's journey where they have been exposed to poor medication safety and the students can identify what the potential consequences of that would be". (TS - P 04 – UK)* *"The inter-professional education and it would be good to do more of that because a lot of these are in there and a lot of problems arise in patient safety from miscommunication*

High level theme	Sub-theme / Definition	Quotes (examples)
		to lack of understanding about teams and how the teams work… It is way of improving things …". (TS - P 09 – UK) *"… more clinical placements where students are coming to the clinical area reviewing real patients so you can do that as well on a more regular basis …". (TS - P 02 – UK)* *"I think more time allocated will help".(TS - P 06 – UK)* ……. *"Yes, it can be from first year until they finish their study. It is something that should be built in their mind'. (TS - P 01 – SA)* *"I think we have to include it in the lecture objectives or course objectives or clinical discussion objectives. One of the objectives should clearly talk about medication safety issues." (TS - P 02 –SA)* *"What is medication safety. I think we went through the programme but we did not come across with the definition of medication safety so what do you mean with medication safety, what are the elements of medication safety…Anything that will clarify and simplify this concept it will be our benefit and it will help us to deliver more information to the students". (TS - P 07 – SA)* *"Maybe we can just let's say one lecture at the beginning of therapeutic courses, to make more clear about medication safety, what is medication safety, what is medication safety dealing with, what are the medication safety tips or very important issues that you should pay attention while you are dealing with the medication. So then we can apply it in each lecture or in each case discussion so it will be more…" (TS - P 07 SA)* *"The third part about the medication safety how they can report medication error". (TS - P 08 – SA)* *"I think it may be beneficial to include in the fourth year when they are in their clinical rotations to possibly be able to identify medication safety issues, near misses, errors, something that happened and learn to report because I feel like we are not doing good job in reporting here, so maybe learning because at that time they will be at the last year before graduation, so some of them will have jobs right away so I feel like it is very important for them to be able to identify error and report it at that point" (TS – P 10 – SA)*

High level theme	Sub-theme / Definition	Quotes (examples)
		"But I don't think we do a good job of what we do when it happens. You know I feel like we teach to prevent but what we do when it happens because it will happen you know, so I think maybe this will be in the fourth year when they have realized that okay we did what we can and it happened, what are we doing in that case, how do we improve, so we really need to help them think about things like that, thing that would be helpful". (TS – P 10 – SA – Talking about teaching management of medication error) *"I would focus on medication safety research because I think it is very important to be taught…I would add some medication safety research because research is the future for medication safety and it will helps students to understand medication safety" (TS - P 05 – SA)* *"To engage the students in medication safety projects". (TS - P 12 – SA)* *"I think they should be thought about hmm… the case scenario of … medication errors the cases how these errors happened and the theories how to prevent this these errors... to teach them in a no blame environment, so that they can be brave if they even made a mistake, they can stand out and say they made a mistake at for the patient safety. Also in addition … …How to prevent these errors before it's even happens, … what gaps can lead to these errors" (TS – P 12 –SA)* *"I would add some quality tools. I would want to teach some quality tools that we use in medication safety for example root cause analysis (RCA) and failure mode and effect analysis (FMEA), somehow that sort of presentation and how to use Pareto charts and how to identify, how to do it and how to understand it. I think this would help them to know more about medication safety". (TS - P 05 – SA)* *"The role of technology in medication error and what are the cons and pros in the use of technology because I can see there is a lot of misconceptions of that technology which is always safe in the healthcare sector and medication use process. In reality it is safe but not always…I would focus more on the use of technology and informatics because this is also the future like RCA, automation dispensing cabinets, medication administrations and the use of bar codes. This is our current environment and the future is for technology. I want to make sure pharmacists are technology friendly and focus more on that". (TS - P 05 – SA)*

High level theme	Sub-theme / Definition	Quotes (examples)
		"They have to go to the hospital to see real patient and have to interact with them and solve the problem" (TS - P 08 – SA – talking about clinical placement) *"We need to put the students in real situations and examine their performance in real situations not only in the schools. We should put them in real situation like taking them in hospitals or simulation labs and put them in certain situations in which they can identify and solve the medication error or prevent them or highlight the importance of medication safety". (TS - P 01 – SA)* *"It could be through simulation…through an introduction what it is in the real world for medication safety research and history how it has evolved" (TS - P 04 – SA)* *"Yes we are as pharmacists we are involved with other healthcare providers like nurses who are responsible for medications; anything about medications. But I think it would be a good thing to have this as an inter-professional thing, even to have as a major option to have an inter-professional course... So I would say it is inter-professional… More beneficial, yes, yes, it will be more beneficial to have IPL".(TS - P 02 – SA)* *"I do believe in examples and videos, and real cases. So maybe if we have something that is related, like medication safety videos or real cases that have a bad or good consequence when you apply or ignore the medication safety tips. I think these issues will stick in the mind more". (TS – P 07 – SA)*

MS = medication safety

Appendix 15: Interview study themes subthemes and quotes emerged - NURSING STUDENTS in the UK and SA

Themes, subthemes and quotes emerged from the nursing student interviews in the UK and Saudi Arabia

High level theme	Sub-theme / Definition	Quotes
MS Curriculum	**MS content** The constituent, chapters and sections included in MS	*"Or in the process of learning about various other things … specific medications in specific circumstances …what sort of things do you give them and why we give out is bio-science and they cover that". (ST - N 01 - UK)* *"Well I think I would like the method we started off with and that was last year before we got into placement. So just teaching us how to give medication and follow all the Rights you know. … Its medication administration that is what it is called – medication management". (ST - N 02 - UK)* *"Patient safety component taught in clinical skills". (ST - N 04 - UK)* *"For the pharmacology I think we are not getting enough pharmacology. I think in the beginning they should start telling us how the medicines function in our bodies and what the uses of the medicines are and just direct us to eager to learn more about it, better than to wait to the very last, the very end when we are about to finish...So we should do more pharmacology like on and off all the time". (ST – N 02 – UK –talking about pharmacology course as related to medications)* ……. *"Maybe it's all of practical courses like Fundamental of Nursing, Medical Surgical…Psychiatric and Maternity in third year, Pediatrics and Critical Care in fourth year …also Pharmacology …Any practical course we have to take about medication safety and medication errors".(ST - N 03 – SA)* *"Yes there is some medication safety in Adult 1 and 2 courses" (ST – N 07 – FG (2) –SA)* *"We start nursing in the first year and we have some subject like ethical course, we have some topics for medication safety". (ST - N 03 – SA)* *"In the hospital they taught us the 5 and 6 rights, while in the classroom we learn its almost 10 rights… also medication calculation... Yes we have medication error reporting I think in the Medical Surgical course …in the third year ". (ST - N 03 – SA)*

High level theme	Sub-theme / Definition	Quotes
		"How to check the expiry date and the route of the medication how to know which route to put the medication in…we take how to store the medication…the right storage of the medication…like the right temperature for each medicine". (ST - N 04–SA) *"Maybe the side effect of the medication and how we can assess the patient before and after the medication like physical examination and the vital signs". (ST - N 01 –SA)* ……. *"When you know the classification of medication, each action for each medication also the Pharmacokinetics…Pharmacology is an important course and it help to understand medication safety". (ST - N 06 – SA)* *"Pharmacology is for theoretical so we take the medications and effects ...we learn the theory in pharmacology. We take two pharmacology courses only which is not enough...". (ST - N 02 – SA)* *"As I said there is a concern about the pharmacology course which was not interesting and I was a little concerned about it". (ST - N 02 – SA)* *"I did not like the pharmacology course and it was so hard… The course was so hard to understand, it is just a lot of memorizing and I do not know. It was hard".(ST - N 04 – SA)* *"Pharmacology is complicated course…A lot of side effects for each medication, it makes me confused when I study". (ST - N 06 – SA)* *"Drugs name that need to be known because sometimes we get confused from look-alike and sound-alike".(ST - N 07 - FG (3) – SA)* *"Sometimes we have we have obstacles of memorize the action of the medication". (ST - N 01 – SA)* *"… but it is not stuck in our mind. But when we go to the hospital and we learned the most medication that they used, so we can learn more pharmacology". (ST - N 01 – SA)*
	Medication errors (e.g. definition, causes, how to reduce it) and medication safety definition.	*"Not following the Five Rights of medication administration. That is what I think medication error is". (ST – N 02 – UK)*

High level theme	Sub-theme / Definition	Quotes
	Perception of student on medication errors, how they define it, what are the causes and what strategies to reduce	*"Medication error, first of all it can involve different professionals. It can be committed by another nurse, or the doctor themselves or even the pharmacist, so it is more of a team responsibility. And it can entail giving the wrong medication to the wrong patient OK, or giving the wrong dose. If the patient is allergic to the medication people were not aware of that so it has many different aspects". (ST – N 04 – UK)* *"Time pressures tend to be a cause for error. We have got a lot of patients to see and so if they have got a lot of medication or a lot of medications that are similar". (ST – NURS 03 – UK)* *"The workload is more so it is going to be so that people are not receiving as close attention and I am not quite sure". (ST – NURS 04 – UK)* *"They also did not pick it up because the names are very similar, the boxes are very similar". (ST – NURS 01 – UK – talking about look-alike sound-alike error)* *"Improving communication is a key point. And I think is all it can do is make things safer because if people do not and people are not willing to and professionals are not willing to interact with each other and communicate with each other then you are going to make mistakes …you are going to have more mistakes made if people are not prepared to speak up". (ST – N 01 – UK)* *"One of those things is that we all have a tendency to go a bit too fast especially when we think we know what we are doing and I do not know if we could do some sort of training to get people to slow down" (ST – N 01 – UK)* *"Ensuring that you have got a good skill mix of staff, making sure that your staff are able to do the job and ensuring that you are following procedures and double checking". (ST – N 03 – UK)* *"I guess of course the Five Rights and also …I guess more patient involvement instead of 'Here are your tablets' more like when people that prescribe the medications, of course they are able to and in a position to participate are given a list and say 'Oh I can see that you are due for some Paracetamol? Is this correct?" (ST - N 04 – UK)*

High level theme	Sub-theme / Definition	Quotes
		"I think medication safety is ensuring that the correct medication is given to the correct person. As a nurse we have the Five Rights: the right dose, the right time, right person, right date and right route to ensure that the correct thing that has been prescribed is going to the correct person. That sort of checks and balances the checks on it for medication safety". (ST - N 01 – UK) *"Medication safety? I think that is what according to the errors is just doing everything in the right way well, and following the directions that have been set regarding safety". (ST – N 02 – UK)* *"Medication safety is making sure that you give the correct medication to the correct patient in the correct form at the correct frequency. Making sure that everything that they take is what should be taken and again that goes from prescribing all the way through to dispensing administration. It is like following the steps, having the protocol or policies and making sure that you are doing your checks, the Five Rights always there, making sure that things are not allergic and having a system to ensure patient safety. Also making sure that each member of the team is checking what the others are doing". (ST – N 03 – UK)* *……* *"Any medication given for example in the wrong dose, missed medication that can put the patient at risk or harm...We have to check the Five Rights…For the patient and we have to ensure that it is the right medication for the right patient at the right time at the right dose. All Five Rights there". (ST - N 05 – SA)* *"Maybe misuse of the medication …Wrong prescription of medication by the doctor". (ST - N 07 – FG (1) – SA)* *"OK it means that I received an order ...it is wrong dose and there is an error made in the calculation, wrong administration because of the wrong calculation. Also medication error it can be from the bad handwriting of the physician … Or from the wrong dose or ... the wrong medical card". (ST - N02 – SA)* *"So not following the Five Rights or Ten Rights … that is very wrong and dangerous thing to do". (ST - N 04 –SA)* *"Extra dose of medication caused side effects to patient; wrong route of medication may lead*

High level theme	Sub-theme / Definition	Quotes
		to medication error". (ST - N 06 –SA) *"It was an emergency nurse. He gave the ventolin via IV route instead of an inhaler". (ST – N 02 – SA – talking about wrong route error)* *"The most error that maybe happened in the medication is the dosage of the medication…Yes. The doctor may order the nurse to give patient for example a dose of 0.06mg, but she administer to patient a dose of 0.6mg. So this will be error in the dosage of the medication". (ST – N 01 – SA)* *"Very soon the nurse to the next shift she just looked at the paper and recognized that another nurse who signed had administer medication for another patient by mistake". (ST - N 05 – SA)* *"Not writing prescriptions electronically the main cause". (ST – N 02 – SA)* *"Medication error caused by poor handwriting of doctor". (ST - N 07 – SA)* *"One of the causes is communication is a problem... either with the patient communication either with patient, physician, nurses and healthcare providers". (ST - N 05 – SA)* *"Maybe the poor verbal communication, verbal description gets confused". (ST - N 07 - FG (6) –SA)* *"Yes. One of our patients, we received an endorsement in the morning. The nurse endorsed to us that the patient received an anti-hypertensive medication. OK. The patient told me that it was not given to her. But it was signed on the paper…No appropriate communication with the patient" (ST - N 05 – SA)* *"OK. I told the preceptor that and she said, 'No. Just ignore her. It is already signed' OK. I just came back to the patient to tell her that. She said that 'No', it was not given to her and that she took it on her own. OK". (ST – N 05 – SA)* *"For example for the patient himself, he doesn't have enough information for the medication given and how to use medication at home. Doctor told them just use it three times a day,*

High level theme	Sub-theme / Definition	Quotes
		they will take it three time a day but not on the same duration". (*ST - N 03 – SA)* *"So when we ask about the health history maybe the patient will not tell us that he went to the other hospital and he took medication there. Maybe the doctor is not taking all the medication history from the patient. So maybe the mistake will be from the doctor or the patient so the medication history is the cause". (ST – N 02 - SA)* *"I think lack of information, lack of expert people there".* (*ST - N 03 – SA)* *"The language barrier between patients and healthcare professionals". (ST – N 05 – SA)* *"Well you know it is very wrong because you might infect the patient with whatever you have. You might not know that you have something and you might infect the patient because you have not sterilized or cleaned your hands". (ST - N 04 – SA)* *"Yes maybe as an emergency nurse maybe because of a lot of orders presented at the same time for many of patients. Also the noise is a problem sometimes you have the patient's mother or father coming and making a lot of noise and distraction. You can see a nurse or physician not focused on their work… Yes, pressure of the work. The nurse takes care of many patients…so the workload is a cause". (ST - N 01 –SA)* *"One of the reasons also the nurse might not know the calculation how to calculate the medication so I think that is one of the reasons". (ST - N 04 – SA)* *"Maybe they use prohibited abbreviation".(ST - N 07 – FG (2) – SA)* *"First double check the patient name and the medication. Double check the expiry date...check the 10 rights of the medication that we mentioned". (ST – N 01 –SA)* *"Maybe we need to check the Five Rights, and check the order of physician". (ST - N 07- FG (3) – SA)* *"So I think using electronics system and putting the dose on the electronic health record is safer for the patient because you have alerts and they know that this dose is high and stuff like that". (ST - N 04 – SA)*

High level theme	Sub-theme / Definition	Quotes
		"Yes the nurse has to be involved in the treatment plan, … Yes. So if she is involved in the plan it would be better and it can save the patient". (ST – N 02 – SA) *"We have to check the medication expiry and the right storage for that medication because most medications like they have a certain degree of saving in the refrigerator...The room temperature and the temperature of the medication". (ST – N 04 – SA)* *"She really care about the cleanliness or aseptic techniques of the medication. Some nurses do not care really. She washes her hands two or three times at the beginning of the shift and then at the end". (ST – N 02 – SA)* *"And also we have to check the allergy for medication of the patient". (ST - N 07 – FG (6) – SA)* *"Maybe we have to taught the patient about his medication to be aware about what he is taking…the indication of this medication, the side effect and the contra indications. So when the patient go to any hospital you will know his medication and you will be aware about it". (ST - N 07 – FG (5) –SA)* *"The nurse should listen carefully to the patients as patient opinion is very important and patient knows about his medication" (ST – N 02 – SA)* *"We should involve the patient with the care plan…sometimes the patient is the one discovering the mistake". (ST - N06 – SA)* *"Maybe we have to report error for other nurses to be aware, maybe medication need to be changed". (ST - N 07 – FG (3) – SA)* *"Yes. If the patient reports this one and report error, and they wrote that errors specifically other nurses who have the access to see the errors and what is happening will focus on this error and they will try to prevent it". (ST - N 07 – FG (1) –SA)* *"We have many simulation sessions to practice and to avoid medication error. (ST - N 01 – SA)* *"If the nurse taking care of the patient can't ask the patient or can't understand what the*

High level theme	Sub-theme / Definition	Quotes
		patient is saying she can seeks for an assistant. Like requesting the unit assistant to translate from English to Arabic so the patient will understand what the nurse is trying to say…The nurse can try to find a way that the patient can tell her what she wants". (ST – N 05 – SA) *"Maybe I think the patient profile has to be in all hospitals like if there is a unified patient system…yes all hospitals have to see the history of the patient and know which are his current medications". (ST - N 07 – FG (2) – SA)* *"Differentiate between the high alert medications". (ST – N 06 – SA)* *"Medication safety is following the Five Rights when giving medication" (ST – N 06 – SA)* *"Anything you can do it for giving medication in safe way, not harm the patient, also not harm you as a giver of the medication, healthcare giver". (ST- N 03 – SA)*
	MS guidelines & references Guidelines used when teaching of medication safety and references used as source of information	*"BNF's for half an hour and learn about drugs".(ST - N 03 - UK)* *"...you read through the NICE guidelines and then you are right when you start. So when you go into placement you are reading through this technical stuff step by step". (ST - N 02 – UK)* *"No, we don't use guidelines on medication safety topic when studying or during hospital training" (ST - N 07 - FG (2) – SA)* *"Any medication that we give we have to know, we have to open the nursing drug guide and know the side effects for the patient and the warnings..."(ST - N 04 – SA)*
	Target knowledge, skills & attitudes (KSA) KSA that students need to develop when studying in order to practice medication safely after graduation	*"I think we need to know and to have a basic understanding of pharmacology, basic understanding of what happens when things go wrong and I think that it is really. I do think pharmacology is very important in order to stop medication errors …" (ST – N 01 – UK)* *"Yes definitely it is an applied skill to do and to calculate so definitely that is a very important thing...also the Five Rights". (ST – N 04 – UK)* *"Pharmacological knowledge. Maybe the drug classification". (ST - N 07- FG (4) – SA)* *"Yes, I mean it will be important to know the action of the medication before it is administered to the patient…Yes, the most essential knowledge is pharmacology". (ST – N 01 –SA)*

High level theme	Sub-theme / Definition	Quotes
		"And also the advantage of Pharmacology they teach us the side effects of medication. (ST - N 07 – FG (3) –SA) *"Of course how the medication it works for the patient, its side effects and the interaction between the medications itself...What herbal medication the patient is taking which might interact with the medication". (ST – N 05 –SA)* *"Should also learn about first aid knowledge, you don't go to the hospital and you didn't learn about it in the College". (ST – N 06–SA)* *"The knowledge of medication safety and medication errors...If we do a mistake or accident we have to report it. And for who we can ask any question and what we report, what will we write and who can help us in this situation". (ST - N 03 – SA)* *"Knowledge on education that should be given to the patient". (ST – N 05 – SA)* ……. *"Learning skills to do with draw up medications as well and I think as well we need more practice with things like injection techniques and stuff and making sure that we give medication properly". (ST – N 03 – UK)* *"You need calculation skills …some people make a lot of errors from doing the wrong calculations when giving medication. So you need to know your calculations very well… communication skills…and double checking I think even in the placement people should be double checking …". (ST – N 02 – UK)* *"I think skills around how to organise a drug round really and learning the time management of doing medications" (ST – N 03– UK)* *"The nurse should be more skilful in calculation to prevent the medication error and know the calculation for every type of medication if it's IV or oral". (ST – N 06 – SA)* *"Of course, communication skills which is one of our priorities". (ST – N 05 – SA)* *"Explain to the patient all the procedure and their case and appointment, everything". (ST - N 07 –FG (5) – SA – talking about good communication with the patient)*

High level theme	Sub-theme / Definition	Quotes
		"Good communication with the sitter, always we are talking with the sitter". (ST - N 07 –FG (4) – SA) *"The nurses should learn about the different routes of medication and how to administer medications to the patients".(ST - N 01 – SA)* *"Like as I said the psycho motor skills have to be enhanced or stressed on". (ST – N 04 – SA)* ……. *"Assertiveness yes and powerfulness and transparency if they committed a mistake". (ST – N 04 – UK)* *"I think you should be able, because obviously you have gone into nursing you just have to be positive. It's not a rushed up thing that you should just do. You should do it very vigilantly and very carefully". (ST – N 02 – UK)* *"And I think it is making sure that you are competent and making sure of the medication you are giving and also keeping up-to-date". (ST – N 03 – UK)* *"Cooperation with the staff and be patient with them… I think cooperation is very important thing". (ST - N 06 –SA)* *"Yes competing with myself…If I do it one-time wrong, I will try and try again till I do it good". (ST – N 03 – SA)* *"I think nurses should be more open minded to improve the patient safety and to improve the quality of care given to the patients. I think we should be open minded about new experiences and new knowledge and new information". (ST - N 04 – SA)* *"Explain the information about medication to the patient". (ST - N 07 – FG (1) –SA)* *"Respecting the patients and the team that they work with. Develop his learning and self-learning…any mistakes that can be done in the hospital or obstacles that be in front of the nurse. The nurse has to go to the home and learn about it". (ST - N 01– SA)* *"They have to be more knowledgeable about the medication and the side effects and why it is*

High level theme	Sub-theme / Definition	Quotes
		given to that patient…and ask why it is given to the patient and so on". (ST – N 05– SA)
2. The teaching process	**Time allocated for MS** Is the time allocated for MS teaching enough to cover all aspects of MS	*"I think it is not enough, we need to cover more topics of medication safety". (ST – N 02 – UK)* *"We need more time allocated for medication safety teaching" (ST – N03 – SA)*
	Mode of integration Is MS integrated as standalone course or part of existing courses or both	*"Ideally both I think. Maybe there should be a whole course, a pharmacology course for nurses; maybe also including the legal side of medications, of schedules of drugs, home medication nurses, pre medications and CDS and the ethics of giving medications". (ST – N 03 – UK)* *"Kind of both…Like to happen as patient safety and also throughout the modules". (ST – N 04 – UK)* *"Yes. I think a larger pharmacological component would be a very good thing and medication safety could easily be part of that and so I think more pharmacology would definitely help". (ST – N 01 – UK)* *"Definitely there was a medication safety that was separate and was given its attention". (ST – N 04 – UK)* *"Yes. It has been labeled and it has been labeled as medication safety". (ST – N 02 – UK)* *"Yes. It should be made more explicit. Medication safety is a serious thing".(ST – N 02 – UK)* ……. *"Yes both of them, it should be separate course and also to put it in other course".(ST – N 01 – SA)* *"But I do not think I have ever seen any topic or like a main topic on medication safety".(ST – N 04 – SA)* *"Every course or every year we learned about the medication safety like in Fundamental in medical and surgical, in critical care course. Every course has topic about the medication safety". (ST – N 01– SA)* *"…but not like a huge topic. You know what I mean. It is not like a whole lecture about*

High level theme	Sub-theme / Definition	Quotes
		medication safety. No, I think it is one of the topics that they talk about in the lecture. Yes. Actually, we learn about medication safety not in one course. We take it first in the fundamental, and then again in pharmacology…, and then in medical surgical…".(ST – N 02 – SA) *"Yes, it is better to have medication safety as part of exiting courses". (ST – N 03 – SA)* *"I think that, I do not think it would be good to have as separate course. I think when you repeat it in so many courses like as I said fundamental, pharmacology or medical surgical, it is like reminding you 'Patient safety, patient safety' and 'medication safety is important but having it as one course and not having it repeated as part of other courses I think students will forget about it and forget how important it is". (ST – N04 – SA)* *"It should be start earlier in the programme like in the second or third year".(ST – N 05 – SA)* "I *think medication safety topic is clearer in the hospital training". (ST – N 01 –SA)* *"Yes. They tend to say it clearly in general and one of the topics is medication safety". (ST – N 04 –SA)* *"Yes. It is clearly mentioned. As I said a special course or one of the labs and one of the classes that it is about medication safety. (ST – N 02 – SA)* *"Medication error, I always hear about it. But medication safety as a term is not clearly labeled". (ST – N 06 –SA)*
	Mode of supervision Type of supervision during clinical placement and training related issued	*"Like I do work in an assessment unit and the mentor has really pushed me and I am really pushed on learning more about my medicines. So if you don't have a mentor push you and say 'Excuse me you don't know this' then you will just pass on without knowing stuff you know. Sometimes you know you can do these things yourself but sometimes you need someone to tell 'Bang on people's heads. Do this. You need to know this more". (ST – N01 – UK)* *"The mentors do really well with teaching… So far its fine you know and it's working well in the hospital because we are attending to everything that they tell us to do. The mentors are really approved as well" (ST – N 02 – UK)*

High level theme	Sub-theme / Definition	Quotes
		"...in placement like during placement practice that I had to be supervised by another member of nursing staff to give medication. I feel that it was effective". (ST – N 04 – UK) *"Yes each instructor has four students in each department so there is enough time to teach each student". (ST – N 01 – SA)* "*Yes. The training nurses have time to teach the student about the medication safety or error. ". (ST – N 02 – SA)*
	Experience in different settings (classroom, simulation lab and clinical practice) Settings in which student learn most about medication safety	*"I do not know I think my main learning in terms of medication errors has happened in the hospital when I have been in placement not one of those done in university... In terms of medication safety, I think I have learned more in the hospitals than I have in the university". (ST - N 01 - UK)* *"Yes. When we started that course we had like practical sessions of medications...I have seen that in clinical practices. It is very well done usually. We do get some training". (ST – N 03 – UK)* *"I think hospitals are better place to learn about medication errors…Because like if you see an error or if you learn about this from the working environment where you will be working for your entire life I think you will memorise it more than just in a classroom" .(ST – N 04 – SA)* *"Before I went to hospital for training, when I took the pharmacology course I thought that all the heparin injection concentration will be 90%, ... So I went to a thin patient and I was looking to my preceptor, and she just say No this is a wrong dose for this patient weight. So I learned from my preceptor that there are several strengths of heparin, while I didn't learn this information during the lecture in the classroom". (ST - N 07 – FG (1) – SA)* *"It's the same but if we practice it in a real situation it remains in my mind and I will not forget because I see how we do it really… I think I learn more in the clinical training". (ST - N 03– SA)* *"When we go to the hospital … we learn what is the most popular medication that is used. So by that we can learn the action of medication (pharmacology)". (ST - N 01–SA)* *"Yes, I learn about medication safety in the lecture and in the hospital". (ST - N 01– SA)*

High level theme	Sub-theme / Definition	Quotes
		"Actually in the university we learn more because in the hospital I will practise what I learned". (ST - N 02– SA)
	Methods to deliver MS (learning resources) Methods used to teach MS currently or should be used (e.g. IPL, simulation, e-learning, etc.)	*"So I would like to practise everything I have learned in the lecture and skills sessions (meant simulation sessions)". (ST – N 02 – UK)* *"Is observing in hospital practice". (ST – N 03 – UK)* *"We had to do an E-learning module on pain management and …workshop … that was discussion in groups and looking things up on the Internet and things like that or looking things up about medications and medication errors. We had a simulation skills lab and role play…". (ST – N 01 – UK)* *"Yes. It is mostly role play with somebody doing the play...Yes, it is role play as you administer the medication, you have to make sure that you ask all the right questions, have to fill out the forms. So, role play is very much a good way of putting it". (ST – N01 – UK)* *"But mostly I remember last year we did self-directed learning and a skills session".(ST – N 02 – UK)* *"We use like interactive videos like an interview from the patient's relatives" (ST – N 04 – UK)* *"It is mostly uni-professional with some inter-professional workshops with medical students" (ST – N 03 – UK)* *"Yes, the piece in the inter-professional education that was actually called medication errors".(ST – N01 – UK)* ……. *"We have lectures and we have case-based study in the simulation lab also. Yes, there is a role play. Maybe 2 students play a role, one give the patient the medication. She has to check about the six rights of medication to present, and also we practice it when we go to the hospital with the instructor. Yes, we have the blackboard … we have the e-library". (ST - N 01 – SA)* *"I remember that we have on the blackboard the nurse instructor makes some group discussion for medication calculation …some role plays for safety and stuff like that. You know*

High level theme	Sub-theme / Definition	Quotes
		I think role-play method is a good way, a very good way to teach about medication safety, also blackboard it was e-learning" (ST - N 02 – SA) *"Yes we have a lot of discussions for medication. Also we have topics and researches that we have to attend for this medication safety. It's also included in any case study we have to do it about medication… Yes we use e-learning and blackboard". (ST - N 03 – SA)* *"Lecture and workshop. Yes workshop regarding medication safety which take place in the lobby of the College of Nursing. Also we have simulation on medication errors". (ST - N 07 – FG (1) – SA)* *"We use to observe the preceptor or the doctor how they administer, how to follow the five rights". (ST – N 06 – SA)* "*No inter-professional learning, only uni-professional learning". (ST - N 03 – SA)* *"Yes it is only nursing students no other healthcare students, it is uni-professional learning". (ST - N07- FG (4) – SA)* *"First we have to finish the simulation before we go to the hospital. So we do like some like role play inside the labs. We have a doll or mannequins".(ST - N 02 – SA)* "*In the simulation lab we can demonstrate all types of injection on mannequins… I think in simulation lab we can discuss with the preceptor (tutors) about what will happen like this". (ST – N 06 – SA)*
	MS feedback **Form of feedback provided (**about MS education: is it positive or negative, methods used in teaching, difficulties faced during training, etc) **Good and bad practices (**seen during clinical practices (e.g. double checking – bad	*A. Form of feedback provided:* *"I tend to think it is variety that makes a difference. Some lectures are always good and also workshops and simulations … I learn something differently by learning it from a different method".(ST - N 01 – UK)* *"I think it is very beneficial. I think it helps to break down some of the barriers we have here in this country between the different professions and I think that is really, really important for the safety of the patient.". (ST – N 01 – UK – talking about IPL method)* *"Well, I think they are effective (meant current educational methods) and I don't think there is*

High level theme	Sub-theme / Definition	Quotes
	communication))	*enough of it. I think we just need more inter-professional stuff as well". (ST – N 04 – UK)* ……. *"Yes of course simulation will help us to understand about medication safety and medication errors". (ST – N 07- FG (2) – SA)* *"The workshop and case-based scenario are good method and it help us to understand medication errors" (ST – N 07- FG (5) – SA)* *"I think yes, especially the simulation it's the most effective one... Yes its helpful better than the lecture because we practice it by hand, and any error that I will make it, I will learn from it, rather than the lecture". (ST – N 01 – SA)* "*I think the simulation is very important because it is based on how it is like in the hospital. It prepares us for the real life and we would have simulation rotations before we go to the hospital so preparing us to the hospital life or environments". (ST – N 04– SA)* "*It helps to decrease incidence of medication error". (ST – N 06 – SA)* *"To prevent the error… because we are using the medication in managing the disease and to treat it and we don't want to have any complication or side effect or contraindication for this medication".(ST – N07 – FG (1) – SA – talking about importance of medication safety education in decreasing errors)* *"It is a big topic and every person in the hospital should deal with it and practice it". (ST - N 01 – SA)* ……. *B. Good and bad practices seen:* *"I have seen a nurse go to get the medication chart and go through it and look at something and go "That does not seem right. The dosage not seem right" And sort of hold back on it before and actually query it before she actually gave it and in fact it did turn out right, it was the wrong dosage. So that was good she queried it. So again that gave me the training just from watching it". (ST – N 01 – UK)* *"Definitely the Five Rights...an electronic prescription system that is available on portable computers...that people are trying to enforce people to carry these portable laptops with the*

High level theme	Sub-theme / Definition	Quotes
		prescription charts with them...". (ST – N 02 – UK) *"Actually quite on the practical side in the hospitals we are not allowed to dispense or do anything with medications without having a nurse right there when we are a student which is a good thing". (ST – N 01 – UK)* *"Although I will say what happens in reality people read through it all and do not actually read most of it which is a problem". (ST - N 01 - UK- talking about bad practice seen - reading of electronic medication charts in the hospital)* ……. *"We have the medication five rights- right name, right dose, right time, so and so. And also explanation of medication for the patient like you take this medication for this disease, it will be like this, you might have this…explain about the medication when given".(ST - N 03 –SA)* *"I have seen in the hospital where I have had some training that there is a pharmacist in the same ward. At the ward there is a pharmacist so whenever there is an error or the nurse sees and they think that this is not the right medication so she can ask the pharmacist about this. I think this is one of the medication safety practices and it is very important". (ST - N 04 – SA)* *"In King Fahad University Hospital, they bought a big cabinet with a secret number in the fever's ward and it is batched by the head nurse. So no one can take something unless they enter the medical record of the patient and the drawers". (ST - N 02 – SA)* *"I have seen there is new technology that when you take the medication you have to put the patient code and sometimes in paediatrics there has to be two nurses for you to take out that medication from the machine and now there are machines that make it safer for the patient because you do not take the wrong medication there… And also I have seen like in the paediatric ward there are two nurses that give the medications so we can have like independent double checking for medications, I think this is also a medication safety area".(ST - N 04 – SA)* *"Double check what the doctor write about the medication, about the route, the time, when I am sure about the medication then, I could administer to the patient. Also the right patient". (ST – N 06– SA)*

High level theme	Sub-theme / Definition	Quotes
		"The nurse was doing skin tests for some patients, skin tests for antibiotics and if there is no skin rash the nurse carried on and would administer the antibiotic. So when the nurse started doing the skin tests she did not make the skin swab. So when we were observing I was hiding some alcohol swabs in my pocket. So I take it out and said. "Maybe you forget this mum." So she took it out and used it" (ST - N 02 – SA – talking about bad practice seen - not following proper aseptic technique) *"I have seen like sterilization techniques which were like they were given the medication with like no gloves and withdrawing the medication from the bottle with no gloves or that kind of stuff or not checking the Five Rights before preparing the medication I have seen that, but not so many times just a few times". (ST - N 04 – SA)* "*Because recently or what I have seen a lot of nurses are not being open minded to new technology or new information. Like they are not accepting changes in technology like say electronic health records they are saying "No I do not want that" .I think nurses should be more open minded to improve the patient safety and to improve the quality of care given to the patients. I think open mindedness is very important". (ST - N 04 – SA)* *"Maybe while giving the medication some nurses just allow the patient to take his medication alone, this is a wrong way to giving medication. So nurse have to be with the patient while giving the medication". (ST - N 03 – SA)* *"I observe one nurse who used the crashing device to crash a tablet, and then she didn't wipe or clean it when she used it again for another drug". (ST – N 07 – FG (2) – SA)*
3. Evaluation of MS education	**Perceptions of students on adequacy of current education** Views and perceptions of students on the quality and adequacy of the current medication safety education (i.e. is the portion of medication safety education is sufficient to satisfy the requirement and meet the need for safe medication practice)	*"I think for like dosing and for pharmacokinetics and pharmacodynamics it is so important that understanding that why you need to space doses, why medications are dosed in the way that they are and what different forms of medications means …". (ST – N 03 – UK)* *"For the pharmacology I think we are not getting enough pharmacology. I think in the beginning they should start telling us how the medicines function in our bodies and what the uses of the medicines are and just direct us to eager to learn more about it, better than to wait to the very last, the very end when we are about to finish". (ST – N 02 – UK)* *"I think also more inter-professional stuff will get us involved with medics and pharmacists… also practising in simulation lab". (ST – N 03 – UK)*

High level theme	Sub-theme / Definition	Quotes
		"Yes. When we started that course we had like practical sessions of medications. So it just went through topic like how medications are charted, things that you need to know on the prescription chart. And also in nursing you have the Five Rights of medication administration which are Right Drug, Right Patient, Right Form, Right Time, Right Route we have, and also checking the identification of our patient, identification and allergy. I have seen that in clinical practices. It is very well done usually. We do get some training". (ST – N 03 – UK – talking about medication safety component) *"I honestly do not know. Because honestly I do not think it can be. Maybe the way they teach it should be changed, I honestly think the way of teaching is very important to understand the course. I do not know. I do not know how to overcome that problem". (ST – N 04 –SA – talking about teaching of pharmacology)* *"For example, in our examination they have a lot of works they have to divide us about it, so they ask who wants to be for medication calculation, medication giving, another for example taking care for the patient, another for calling the doctor in Pharmacy, like this. So when the one choose the medication they have proper chance for using medication, know about it. But others doesn't choose it so the chance of practice about medication is decreased". (ST – N 03 –SA)* *"In hospital, the nurses cannot clarify them sometimes for us. They are busy always don't have any time but I think in simulation lab we can discuss with the preceptor about what will happen like this".(ST – N 06 – SA)* *"In reducing medication error, it should be supported by supervision. Sometimes they just depend on us and we don't have enough experience".(ST - N 07 – FG (1) – SA)* *"Yes, we have limited time for hospital training as we visit the hospital once per week". .(ST - N 07 – FG (4) – SA)*
	Barriers to positive MS educational outcomes Difficulties and obstacles which prevent or block improvement in medication safety education	*"I think it is a problem. That is my opinion. I think we need more… I really think a more basic understanding of pharmacology would be a good thing. So, I think we need more pharmacology". (ST – N 01 – UK)* *"I think if you don't understand that (meant pharmacology) it makes medication safety harder". (ST – N 03 – UK)*

High level theme	Sub-theme / Definition	Quotes
		"We have just done a bit on pharmacology and then the medication safety, we just did medication safety nothing to do with pharmacology. So you get so many students who don't know how the medicines function you know in the body and they cannot explain it well So that is carried on to clinical placement…". (ST – N 02 – UK) ……. *"For us we have the lowest mark in Pharmacology for all of us…I think we don't understand pharmacology". (ST – N 03 –SA)* *"Yes... we go to the hospital and we work with a nurse with a long working experience, it will be difficult to ask her or point out anything… as a student about a mistake or she missed something and she will be angry. So I have to be careful in asking or saying something to her". (ST – N 02 –SA)* *"... I said medication calculation some of the students have like a problem with that and they were not concerned about that...one student say I did not understand this equation or did not understand how to calculate this medication ...".(ST – N 04 –SA)* *"There are some difficulties when we go to administer like IM injection, I think its difficult for me because the nurse don't allow me always to administer like this type of injection, IM. For that I feel fear and not comfortable to inject IM medications when I graduate and become a nurse". (ST – N 06 –SA)* *"For example, some medications when we use it in the medication calculation, for example they give us about ringer lactate and there is no ringer lactate because of the shortage in samples and materials for practical using for training. So we use a normal saline because there is no ringer lactate…Some medication we are not allowed to use it and deal with it in the hospital...". (ST – N 03–SA)*
	Strategies to improve MS education Ideas, methods and plans suggested by teaching staff or students to improve medication safety education	*"I think it needs to be integrated throughout the course. We have done, anytime that medications or pharmacology or anything like that is talked about I think it needs to be, the safety part needs to be brought back into it if only by talking about what could go wrong". (ST – N 01 – UK)* *"Yes. I think a larger pharmacological component would be a very good thing and medication safety could easily be part of that and so I think more pharmacology would definitely help". (ST – N 01 – UK)* *"I think if you were going to make it as a course I think that that should be an inter-professional course in the first year of pharmacy, nursing and medicine. They should all have*

High level theme	Sub-theme / Definition	Quotes
		to do this together really…And I think working inter-professionally is the only way forward". (ST – N 03 – UK) *"More simulated practices are needed". (ST – N 04 – UK)* *"They should put e-learning into what they do because the only e-learning we have is about this medication administration and the other one is medication safety but they should put more pharmacology into the e-learning and people can just go ahead and read the way they did with the other one". (ST – N 02 – UK)* *"More exposure to some of the clinical skills that we do the IVs medications". (ST – N 03 – UK)* …… *"Really I think inter-professional teaching will be a good method to include … It will be interesting because one student will come from pharmacy and one from the nursing profession really yes and real not just acting". (ST – N 02 – SA)* *"Maybe visit the pharmacy and learn about it and shadow pharmacists would be good". (ST – N 03 – SA)* *"I think if we had like a research on medication safety or something I think it is going to be more beneficial". (ST – N 04 – SA)* *"Maybe we have to discuss more about the medication errors. We have to see a scenario and the way it is done in regard to medication error and we can learn from it". (ST – N 05 – SA)* *"Yes, more videos about medication safety and medication administration". (ST – N 07 – FG (2)– SA)* *"Because our instructor they learn how to teach us but they practice less than us. So if we have practiced nursing like instructor for us, it will be better". (ST – N 03 – SA)* *"We should be trained on how to report medication errors". (ST – N 05 –SA)* *"The closest way to refresh or to get the information back is from the smart phone…So there are a lot of applications about this.". (ST – N 02 – SA – talking about using technology to improve medication safety teaching)*

MS = medication safety

Appendix 16: Interview study themes subthemes and quotes emerged - PHARMACY STUDENTS in the UK and SA

Themes, subthemes and quotes emerged from the pharmacy student interviews in the UK and Saudi Arabia

High level theme	Sub-theme / Definition	Quotes
1. MS Curriculum	**MS content** The constituent, chapters and sections included in MS	*"So medication safety was part of other modules. We never had a module which was dedicated purely to medication safety or errors as it were always part of other modules". (ST – P 02 – UK)* *"No definitely not ...There was not really any module on it. We were just taught generally about very briefly about the checking process I guess". (ST – P 01 – UK)* *"So what they did was to merge them together so there was like an outbreak for example public health outbreak disease how does patient safety impact etc. But when they did teach us about patient safety it was very much medication safety focused". (ST – P 02 – UK – talking about Public Health and Patient Safety module)* *"In dispensing classes, we were told to spot medication errors". (ST – P 01 – UK)* *'the second, third and fourth year we were reminded of medication safety and medication errors topics, particularly in the fourth year". (ST – P02 – UK)* *…….* *"Communication skills, pharmaceutical care courses, institutional hospital pharmacy practice course, and in therapeutics". (ST – P02 –SA)* *"Part of the clinical pharmacy course, it is not like separate course by itself, it is included in multiple courses like for example pharmaceutical care, drug pharmaceutical care they have medication safety and for example medication skills you have now to communicate and give the patient safety experience for medication and in therapeutic taught, so not that separate course, it is included in the multiple courses". (ST – P 03 – SA)* *"from first year in my college we take pharmacy practice or pharmaceutical care…there is also ah communication skills, and in therapeutic class, in medicinal chemistry class, in*

High level theme	Sub-theme / Definition	Quotes
		pharmacology class we just take the same information, medication error, drug therapy problems, how to prevent the drug therapy problems, how to make a proper communication with patients, how to deal with like blind patient or women patient or cultural differences or with the different language. We have an ethical class...". (ST – P 04 – SA) *"Communications and medication errors in management course". (ST – P 07 – FGM1 (5)– SA)* *"When I took rotation on inpatient pharmacy, I took a presentation on what topics to report. What is a report and what type of reports, internal reporting, external reporting, how to report to international institute of medicine (IOM)". (ST – P 07 – FGM1 (2) – SA)* *"Introduction to pharmacy practice experience was the main cause of teaching a lot of concepts about Medication Safety". (ST – P 07 – FGM1 (3) – SA)* *…….* *"They just gave us a title but the word high alert medication we just knew it in the hospital, in the summer training". (ST – P04 – SA)* *"They teach us a lot about counseling and educating the patient". (ST – P 02 – SA)* *"Part of the IPPE course is the root cause analysis". (ST – P 08 – FGM2 (4) – SA)* *"They were focusing on the medication errors one by one, and how to prevent it. For example the adherence, explaining the adherence, and different types of adherence, and how to prevent this problem". (ST – P01 – SA)* *"Incompatibility of two drugs, contra-indications, drug-drug interactions, allergy, crushing the tablets, pharmaceutical control, drug-food interactions, formulary, and different formulation for the same drug will give us different dosage". (ST – P06 – FGF1 (3) – SA)* *"In the management course we study about how to deal with error". (ST – P 08 – FGM2 (1)– SA)*

High level theme	Sub-theme / Definition	Quotes
	Medication errors (e.g. definition, causes, how to reduce it) and medication safety definition. Perception of student on medication errors, how they define it, what are the causes and what strategies to reduce	*"OK, it could be a prescribing error, it could be an administration error, it could be a dispensing error, and there are several types. But at the end of the day it could be something like a near miss so it hasn't goes out to the patient or an actual error so it has harmed the patient". (ST - P 01 – UK – defining medication error)* *"My definition of medication error would be giving an inappropriate dose or drug given other than prescribed…the wrong medication other then prescribed". (ST - P 02 – UK)* *"but I think in general what happens in pharmacy is in community in particular it is very rush-rush, come on quickly and we need to dispense all these medications. So when it comes to look-alike and sound-alike medication we see them and generally speaking, look at the box and does it look familiar. You kind of act within your, I do not know how to say it, but you see it and say 'That is it!". But you just quickly pick it and you might see the first three letters and you miss and it is so easy to miss. So you quickly grab Tramadol10". (ST - P 02 – UK – talking about error due to poor double checking)* *"So it was like a hundredfold increase in strength or something which caused horrible side effects to him". (ST – P 02 – UK - talking about wrong dose error)* *"Chloramphenicol ear drops administered to a child's eye instead of to the ear so it was the wrong route". (ST – P 02 – UK – talking about wrong route error)* *"the gentleman pharmacist who gave us a medication safety incident was when the wrong dose was calculated of I cannot remember which drug it was and one of the patients suffered a massive reaction to it, seizures and passed away and that was because nearly fourfold of the medication was given, 360 milligrams was given instead of 60 milligrams. So that was quite bad. So that was one of the stories we had illustrating the importance of dose calculations and stuff like that, and to double check etc". (ST – P 02 – UK – talking about wrong calculation error)* *"Yes. I think there was a case a long time ago when a woman gave out Propranolol instead of Prednisolone … and she passed away I think". (ST – P 02 – UK – talking about wrong drug error)* *"Yes, usually the pharmacist would get 30 minutes but sometimes that gets delayed and*

High level theme	Sub-theme / Definition	Quotes
		delayed and delayed if he is on his own because the rush is constant so then you can see the difference in the pharmacists checking procedures. Yes I need a break now so that I should be respected I think because if you are compromising patient safety on that I don't think it worth it". (ST – P 01 – UK – talking about workload and fatigue) *"…so drugs that look alike, sometimes the boxes like TEVA, the brand TEVA makes all the boxes look the same so it could be confusing. We had one with nasal sprays before like Fluticasone and Beclomethasone. I have one for Bromocriptine and Bendroflumethiazide before as well. Also medication errors due to medication packaging".(ST – P 01 – UK – talking about error due to similar packaging)* *"And sometimes the ones that are happening quite often these days is we have not had time to check the expiry date so the stock rotation is not being done and expired stock is going out, because more often than not I think people don't check expiry dates. It is always part of my checking process but I guess". (ST – P 01 – UK)* *"Staff shortage we don't have enough staff. Again because of staff shortage sometimes a pharmacist is self-checking which is not adequate from my point of view but it happens in practice". (ST – P 01 – UK)* *"I think it is time restraints you are under a lot of pressure to complete a prescription within a certain amount of time to please the patient and to keep your business running". (ST – P 01 – UK)* *"Maybe perhaps in pharmacy, in the community for example if we had a little card 'If there are any concerns with regards to your medication or you feel an error has been made please do contact us and please do not take any more tablets.' I think that could be put in a bag or something. It would be a good idea so it suggests some form of reporting system. And providing education to other pharmacists like in a community pharmacy it is different because it is only one pharmacist generally speaking. But in hospital there is just so many pharmacists and we are just communicating with other pharmacists as well to say "By the way in the past we have had this incident so when you are dispensing this make sure you look out for this for example, so providing education to other pharmacists". (ST – P 02 – UK)* *"I do think errors should be reported to drug manufacturing companies because their*

High level theme	Sub-theme / Definition	Quotes
		packaging in some cases does not help. For example they would make, in that case it happened, ear drops and eye drops both begin with 'e', both are Chloramphenicol, and they are both very small containers. Maybe make them completely different colours and it is mandatory". (ST – P 02 – UK) *"And in some cases that is helpful like Amlodipine and Amitripyline on a shelf together and we were frequently causing errors with Amlodipine 10 and Amitripyline 10 milligrams so we have put them in place and put them in completely different positions something like that, which has helped… Or in the case of Terbinafine or Trimethoprim we have put them in two different positions where we check everything". (ST – P 02 – UK)* *"You could try keeping it separately for a day and if the strength, if the cause of medication error is between strengths, then try separating that out on the shelf or highlighting it in some sort of way". (ST - P 01 – UK)* *"Double checking, accuracy and clinically so not just checking once, but double checking and accuracy, clinically checking". (ST – P 02 – UK)* *"You have got the right amount of staff to know that you can operate safely. That doesn't always happen but also ideally you get someone to check your work before it goes out". (ST – P 01 – UK - talking about strategy of having enough staff to operate safely)* *"Well I think it does, well the way we have in now in the pharmacy, let us say I dispense, the pharmacist will check and then we will have a third person who will bag. So we have three checks. So I will look at it and dispense it, OK that is the right thing, the pharmacist will look at it and check it, OK fine, and then the third person as a final check will check while bag it, and as s/he is bagging they will say 'OK. That is right' and will look at the prescription and say 'That is right!' So yes having three checks or having more than one person checking does certainly help". (ST – P 02 – UK)* *"Yes, I think that's why you have two people involved in the dispensing process at all times". (ST - P 01 – UK)* *"Making sure that your staff is trained appropriately" (ST - P01 – UK)*

High level theme	Sub-theme / Definition	Quotes
		"Making sure that your mind is always fresh and you are looking at it with a fresh pair of eyes all the time". (ST - P 01 – UK) *"But in hospital there is just so many pharmacists and we are just communicating with other pharmacists as well to say By the way in the past we have had this incident so when you are dispensing this make sure you look out for this for example, so providing education to other pharmacists". (ST - P 02 – UK)* *"I think that it is important in practice, and that when errors do occur the first thing we look at is our own procedures and how we are dispensing it ...We should look at our own processes and we should not be doing that …". (ST - P 02 – UK)* *"But I would say it is all about preventing the errors and to make sure that the right medication is going out to the right patient at the right time and all the steps involved in order to prevent errors from outside as well". (ST - P01 – UK – defining medication safety)* *"Medication safety in my opinion would be the measures put in place to ensure the safe provision, supply of medication and use of medication I would think". (ST - P 02 – UK)* *…….* *"Or not harm, could not be harm to patient but still it is an error. It might reach the patient and medication error could be as a sub therapeutic we could examine the patient if the pharmacist doesn't know the prescriber, don't call, it might not cause harm to the patient". (ST – P07 – FGM1 (1) – SA)* *"Medication Error or I call it the Drug Therapy Problems. Any problems or any issue that relate to medication that may harm the patient or may lead to admit him to the hospital and stay for more period". (ST – P 04 –SA)* *"It is any mistake happen to the patient like adverse drug event or mistaken calculations". (ST – P 05 – SA)* *"Medication error can come in different causes, Its maybe from the pharmacist, from the doctor or relative to the patient administration. Error in the process of prescribing, dispensing or even the administration". (ST – P 02 – SA)* *"Medication Error maybe prescribing the wrong medication for the patient while patient is*

High level theme	Sub-theme / Definition	Quotes
		allergic for that medication". (ST – P03 – SA) *……* *"We don't know, the patient history of the medication". (ST –P 03 – SA)* *"Missing important details in the patient file, lab profile or gender or even the age, where the patient come from, Middle East, Russian, American, African you know". (ST - P 04 – SA)* *"Documentation…lack of documentation for medications" (ST – P 08– FGM2 (3) – SA)* *"Something happened in the pharmacy, there were 2 patients with similar names, the first and second names are similar, so… I did not check the medical record of the patients, so I put all the medications together for one patient. So, if there is no checking by supervisor or pharmacist there, they will administer this medication to a wrong patient. That is why checking is very important". (ST - P 02 – SA – talking about error due to similar patient names)* *"Then from the dispensing from pharmacist, sometimes they dispense one medication instead of other or like if there is no double-checking, sometimes".(ST – P 02 – SA)* *"The same packaging …Some companies have the same box for so many medications. They are so misleading. The same box, it is identical in all different kinds of medication". (ST – P07 – FGM1 (3) – SA)* *"Work load and time constrain which affect the quality of the care provided to the patient and may lead to medication errors". (ST – P 05 – SA)* *"I think the crowded hospital is extremely important problem that even if the pharmacist or the doctor know how to do things perfectly he can't because it is really crowded, he needs to do you know thing real fast and this is, it has big chance of doing medication errors". (ST - P 09 – FGM3 (1) – SA)* *"I think it's the lack of knowledge". (ST - P 09 – FGM3 (7) – SA)* *"Well, it was because the residents, they cannot distinguish between the two pharmaceutical preparations or the formulas, so he thought they are the same, so his transcript the prescription wrongly reach the pharmacists". (ST - P06 – FGF1 (7) – SA)*

High level theme	Sub-theme / Definition	Quotes
		"First of all, it's coming from the doctors, while prescribing medications, if they did not ask the patients what medications are you using or these thing, so it starts from the process of prescribing from the doctor". (ST - P 02 – SA) *"I think maybe its related to the lack of patient education, like the doctor or the pharmacist did not educate the patient well that he has to take 6 tablets only once a week, so the patient thought that it's like any other medication and he had to take it once daily. This will lead to errors if the patient did not know how to administer these medications". (ST - P 02 – SA)* *"Lack of patient awareness". (ST - P 09 – FGM3 (1) – SA)* *"The patient has no enough knowledge about his disease, he have no enough knowledge about his treatment". (ST – P 03 – SA)* *"I think the patient is not engaged in the treatment plan. It's like solid eye. Physicians and pharmacist do all the job, take this your medication so and I've seen this with my mother she's covered in NGHA and she's asthmatic for more than 30 years and she doesn't know how to use inhaler". ST - P 09 – FGM3 (1) – SA)* *"Lack of adherence by the patient can lead to medication errors". (ST - P 01 – SA)* *"The patient, non-compliance for example for an antibiotic. If he feels he's ok he will discontinue the medication and the result was the resistance, you know". (ST - P 04 –SA)* *"There was a case last week presented about the patient...who have, he is an asthmatic patient and the visitor give him non-steroidal anti-inflammatory drug (NSAID)". (ST – P 06 - FGF1 (7) – SA)* *"She was telling her physician she was feeling dizziness like that but he didn't decrease the dose. So no response between the physician and the patient…He didn't listen to her or ignore her complain". (ST - P 01 –SA)* *"Miscommunication a bigger risk of medication errors maybe". (ST - P 09 – FGM3 (2) – SA)*

High level theme	Sub-theme / Definition	Quotes
		"For the doctors, some doctors or physician you know they are so many they are busy. They cannot even talk to the patient; they cannot listen to the patient". (ST - P 04 – SA) *"Yeah communication barriers like different languages" (ST – P06 – FGF1 (2) – SA)* *"Also medication names written in non-English language, I mean in different languages like German or French, because I used to train here in the hospital and some bring different brands of certain medication, you can't read the name, the generic name of the drug not in English".(ST – P 03 – SA)* *"Different accent spoken on the phone between medical staff can lead to error due to misunderstanding". (ST – P 06 – FGF1 (3) – SA)* *"Bad handwriting can lead to medication errors". (ST – P 08 – FGM2 (4) – SA)* *"Medication errors due to system failure" (ST - P06 – FGF1 (3) – SA)* *"Implementing new system in the hospital likes for example the best care, increase the chance of error especially in the beginning. They are not familiar with the system so a lot of mistakes". (ST - P07 – FGM1 (1) –SA)* *"I think we have a major problem specially in our country like we don't have a general system that has the main medications that the patient takes so when the patient goes to any pharmacy he will take the medication each or over the counter medication without asking if he is taking another medication". (ST - P09 – FGM3 (1) – SA)* *"In community pharmacy? They dispense anything for the profit". (ST - P 01 – SA)* *"I think we have a major problem specially in our country like we don't have a general system that has the main medications that the patient takes so when the patient goes to any pharmacy he will take the medication each or over the counter medication without asking if he is taking another medication". (ST - P09 – FGM3 (2) – SA)* *"Last week we had one patient who came for just a medical procedure, he was given lidocaine local anesthetic, the patient had the history of PCI 5 years ago, and just after given*

High level theme	Sub-theme / Definition	Quotes
		the lidocaine local anesthetic, in like two minutes, the patient collapsed and he had a code blue, cardiac arrested. ...so it is a problem of adverse drug reaction. It is a problem. So this is, the patient was at increased risk of having cardiac problem, the patient had PCI. And maybe the lidocaine was given in a wrong way that maybe deliver high concentrations in the blood that reach to the heart and damage the area, the cardiovascular system". (ST - P 07 – FGM1 (1) – SA) *"Well, it was because the resident doctors, they cannot distinguished between the two pharmaceutical preparations or the formulas, so the doctor thought they are the same, so he transcript the prescription wrongly reach the pharmacists, and the pharmacists didn't check the dosage since its very high for the Amphotericin-B, it was 5mg for Amphotericin-B, it should be for the Liposomal". (ST - P 06 – FGF1 (2) – SA)* *"Maybe the physician is busy and has no time to prescribe the proper dose for the patient". (ST - P 05 – SA)"* *"From the patient himself if he administers it, if it's like subcutaneous medication, or if it is subcutaneous and he administer it wrongly by IV or by IM this things may occur and it may cause a very huge error". (ST - P 02 –SA)* *"… Yeah, yeah, sometimes the patient use, the patient use aerosol or salbutamol inhaler for asthma. They used it like a perfume like Dr. Huz". (ST - P 04 – SA)* *"Yes, my grandma was on overdose of metformin". (ST - P 01 – SA)* *"Some doctors say mefenamic acid, meloxicam together or ibuprofen and diclofenac together plus acetaminophen". (ST - P 04 – SA – talking about error due to same group of drugs)* *"We just presented a presentation about medication error due to drug-drug interaction last week so the presentation was on methotrexate and diclofenac, the patient has rheumatoid arthritis, and she had fracture so they admitted her and they gave her the methotrexate dose and diclofenac dose so she developed the bed site apnea and kidney failure and then she died". (ST – P 06 – FGF1 (6) – SA)*

High level theme	Sub-theme / Definition	Quotes
		"I think most of the medication error happens in the hospital like double medication, double therapy". (ST – P 03 – SA) *"So I witness so many Medication Errors happened by using a manual input. Yah, prescribers add an extra zero or an extra numbers, instead of 10 became 100, so that's almost 10x of the normal".(ST - P 07 – FGM1 (3) – SA)* *"I have a case with the labels. In one of the wards a nurse prepared an injection but did not labeled it with patient name. The medication for two patients. She mixed it". (ST - P 08 – FGM2 (2) – SA)* *"Look-alike sound-alike medication". (ST – P 06 - FGF1 (1) – SA)* *"The medication error is not just in prescribing or administration. It might be in the quality, in the quality of the medication or manufacturing". (ST - P 08 – FGM2 (4) – SA)* *"Maybe sometimes there is a dangerous medication inside their herbal preparations". (ST - P 09 – FGM3 (4) – SA)* *"In our Saudi society people think that herbal medications are natural substance not medications and will not have an effect on patient body, which is wrong". (ST - P 09 – FGM3 (1) - SA)* *"Herbal medications are not considered as a medication while it could have a fatal effect on the patient". (ST - P 09 – FGM3 (2) - SA)* *"The case that I have, my brother has an allergic to the ibuprofen IV but it is not documented. So he went to the ER and gets an ibuprofen IV after that he develop an anaphylactic shock". (ST - P 08 – FGM2 (1) – SA)* *"As we said, unknown drug allergy can be a cause for an error…There is a case from the same hospital, about antibiotic allergy, its about allergy and I think it was a systematic error, when ah... so you don't know that the patient is allergic to this antibiotic or not". (ST - P 06 – FGF1 (4) – SA)*

High level theme	Sub-theme / Definition	Quotes
		"Male and female, sometimes here in Saudi, I think sometimes the male feels like OK he should not talk with the female or the opposite. Especially is she is like, from her appearance, she like appears to be more conservative than others". (ST – P06 – FGF1 (6) – SA) *"Assume what she is doing is right…convincing yourself that they are perfect when they decided that dose". (ST – P06 - FGF1 (3) – SA)* *"Negligence is one of the reasons". (ST – P 08 – FGM2 (3) – SA)* *…….* *"We print the prescription from the quadra-med application there is a drug-drug interaction window so we just enter the all the medications and give the category of the drug the category of interaction. A, B, C, D. C, or D, or above we just separate the dose you know". (ST - P 04 – SA)* *"The hospital should provide the pharmacy with the counseling area, we don't have a counseling area or... you know some patient with the hemorrhoids or sexual dysfunction so it is not proper to counsel the patient in public area not in private area, the patient will just rash to have his medications without counseling because he is embarrassed".(ST - P 04– SA)* *"Work load problem…if they can get enough employees or staff this problem will be solved". (ST - P 05 – SA)* *"Yeah I think, it is one of the responsibilities of the hospital. I am a young pharmacist giving medication to 50 patients. I can't educate everyone, so they have to hire many pharmacists to provide good patient care". (ST – P 09 – FGM3 (6) – SA)* *"Encourage the patient to ask questions, to give information". (ST – P 09 – FGM3 (1) – SA)* *"patient even should make sure this is the medication for this indication or not, patient should make sure that this medications are for him not for another patient".(ST - P 04 – SA)* *"For us as pharmacists we have to make sure to educate the patient very well, to tell him to ask questions if he did not understand these things related to medication. Because if we will not do these things, no one will do it for the patient as we are the medication experts in the hospital. So this is our role and we have to do it as much as we can, even if there were so*

High level theme	Sub-theme / Definition	Quotes
		many patients there". (ST - P02 – SA) *"Unified system ...I think by developing system such as best care system. I mean it mandates prescribers to type and to write information". (ST - P 08 – FGM2 (3) – SA)* *"Well they can improve the system, double checking for high alert medication, the high dose". (ST – P 06 – FGF1 (7) – SA)* *"Before the administration of the medication, we should ask if there are, the patient has undocumented allergy or problem related to medication". (ST - P 08 – FGM2 (2) – SA)* *"Record the allergy…Documentation of allergy". (ST – P 06 – FGF1 (1) – SA)* *"Patient counseling is important to reduce errors" (ST - P 06 – FGF1 (3) – SA)* *"Taking the patient history and consultation". (ST - P 05 – SA)* *"I think knowing Patient history is very important point to reduce medication errors". (ST – P 07 – FGM1 (6) – SA)* *"So we need to review patient profile carefully. At least review patient file check his medication if I say for example Aspirin. I should ask him do you have a cardiac problem. What is your age? Are you in the middle age (over 45) suffering from stroke or have a fever or headache or something or we should divide the dose like talking one ibuprofen, one tablet ibuprofen after breakfast one after evening".(ST - P 04 – SA)* *"There are some steps actually to do this, implement this here… I mean the unified patient information system". (ST - P 09 – FGM3 (3) – SA)* *"I think if they make unified patient record system in Saudi Arabia. A system which has all patient files so wherever patient goes to any hospital his or her file will show all current and previous medications, I think this system will help to reduce a lot of medication errors and adverse drug events, and will increase medication safety significantly". (ST - P 03 – SA)* *"For medication that are look-alike or sound-alike in their names, look-alike mainly, they are*

High level theme	Sub-theme / Definition	Quotes
		capitalizing the look-alike letters in the medication so that the pharmacist will not take other medication instead of the right one". (ST - P 02 – SA) *"One of the ways they used is the Tallman letters to distinguish between the sound-alike and look-alike medications, and separate the one which look similar". (ST – P 06 – FGF1 (4) – SA)* *"Patient Education, I think. If the patient knows everything about this medication sometimes, he might prevent medication error. If he knows his medication and the nurse bring another medication for example, he might prevent medication error. So we can implement this in the practice by patient education". (ST - P 08 – FGM2 (1) – SA)* *"Yes it can be prevented easily by educating the patient very well and by telling the patient that if you did not understand how to administer this medication, come to us and we will tell you again and again until you know clearly how to use it". (ST - P 02 – SA)* *"I believe that teaching patient how to report is the most important part of managing of Medication Error. Because the end result of the incident will appear on the patient. So if the patient did not report, it will not show up. So, teaching patients how to report is really important". (ST – P 07 – FGM1 (1) – SA)* *"Also educating the healthcare providers like physician, nurses and others". (ST – P07 – FGM1 (2) - SA* *"By communicating with the physicians, when the dose is wrong, talk to him kindly and nicely to change the dose like that". (ST - P 01 – SA)* *"Improving communication. I think it is a major part in reducing Medication Error among teams, among health care providers, among clinical pharmacists, and nurses, when to administer, how to administer. A lot of things. So communication is a key to reduce such things". (ST – P07 – FGM1 (1) – SA)* *"Put an IT center which you can communicate with the patient, the patient can call asking their questions, send emails like just". (ST - P 03 – SA)* *"Yeah and even for the doctors hand writing they can use the typing with the computer*

High level theme	Sub-theme / Definition	Quotes
		(meant electronic prescribing system) . So they cannot be confused to". (ST – P 06 – FGF1 (1) – SA) *…….* *"Using medications supposed to be without harming the patient and give the therapeutic effect". (ST - P 06 – FGF1 (1) – SA)* *"The best outcomes without harming the patient". (ST - P 06 – FGF1 (2) – SA)* *"I think it's big term like including everything". (ST - P 09 – FGM3 (1) – SA)* *"Medication safety is like the safe use of medication by patient when we prescribe the right medication, dispense it to the right patient and educate the right patient about the medication, safe use of medication will occur". (ST - P 02 - SA)* *"Medication safety in my opinion is preventing side effects of the drugs… how to make sure there is no adverse or side effects from the drug maybe, I think". (ST - P 03 - SA)* *"Make sure that the patient gets the right medication, right dose, in right time. In addition, by applying medication safety principle we can save some money from the hospital, from the government". (ST - P 05 - SA)* *"When you care to make what's right, you achieved something in medication safety". (ST - P 06 – FGF1 (7) – SA)* *"Apply high quality of care to the patients".(ST - P 08 – FGM2 (1) – SA)* *"Increasing the awareness of the medication use". (ST - P08 – FGM2 (3) – SA).*
	MS guidelines & references Guidelines used when teaching of medication safety and references used as source of information	*"We use the British National Formulary (BNF) to search for information about medication use, but nothing in particular for medication safety" (ST – P 02 – UK)* *"I don't remember any guidelines specifically to medication safety" (ST – P 01 – UK)* *"We follow the ISMP recommendations for the prohibited abbreviation. Every warning or alerts in the ISMP is mentioned in our college website". (ST – P 08 – FGM2 (2) – SA)*
	Target knowledge, skills & attitudes	*"In terms of knowledge there you have to know your stuff and you cannot forget about it any*

High level theme	Sub-theme / Definition	Quotes
	(KSA) KSA that students need to develop when studying in order to practice medication safely after graduation	*way... So yes I think up to date and knowing all your knowledge". (ST - P02– UK)* *"In terms of knowledge you cannot pretend, you cannot just have to be open". (ST - P 02– UK)* *"Pharmacology and Toxicology is very important when to use it and how to use it and when it's become a toxic or, when it's overdose, what are the symptoms". (ST - P 03 - SA)* *"Side effects of using medications". (ST – P 06 – FGF1 (2) – SA).* *"Like interaction between anticoagulant and anti-hypertension drug which is important which you have to discontinue if this one or this one". (ST - P09 FGM3 (5) – SA)* *"Yes. Therapeutics and how to choose the right medication, how to choose the right dose, what dose to start with, how to titrate for example… I think this is the most important thing to know to prevent medication errors in the future". (ST - P 02 - SA)* *"Pathophysiology about diseases, we want to know how diseases are happening so that we can treat them, how the medication will be, will affect this organ in that way so that we can understand, we don't want just to memorize the mechanism of action". (ST – P 06 – FGF1 (1) – SA).* *"Drug-drug interaction but there is a food-drug interaction but when you give the medication to the patient it is like a medication safety…". (ST - P 09 FGM3 (4) – SA)* *"For me I think doses calculations, the suitable doses for different ages like children. I know what is the suitable dose…the most suitable dose for him". (ST - P 01 –SA)* *"For Medication Safety, you have to have a good drug Information". (ST – P 05– SA)* *"We have to know the types of reporting of medication errors. How to report, how to communicate, how to deal with Medication Errors and also how to analyze if there is a Medication Error". (ST – P 07 – FGM1 (3) – SA)* *"Strong knowledge about Medication Error" (ST – P 07 – FGM1 (2) –SA)*

High level theme	Sub-theme / Definition	Quotes
		"The causes of medication error". (ST - P 08 - FGM2 (2)– SA) *"Types of errors that happened like wrong drug". (ST - P 09 - FGM3 (2) – SA)* *"How we can prevent medication errors". (ST - P 09 - FGM3 (6) – SA)* *"The concept itself, the concept of medication safety". (ST - P 08 - FGM2 (4) – SA)* *"I think, he had, he need to have a wide knowledge and he need to apply it wisely … when he dig for medication error it will be with him in his mind or see it in a real cases. It's not a kind of lecturing or something, it's a kind of experiences of the life like anything else like when he experiences something in his life about how to deal with this, he will next time he will know how to deal with it". (ST - P09 - FGM3 (1) – SA)* *"I think any emergency procedures we should know about them, anyone, is not for the pharmacist only". (ST – P06 – FGF1 (6) – SA).* *…….* *"Your checking process has to be a solid. It has to be consistent all the time again like the expiry date thing so it has to be always, always checking that no matter what".(ST - P01 – UK)* *"Good communication skills are absolutely necessary".(ST - P02 – UK)* *"…for Medication Safety yah you need to have communication skills, a good communication skills" (ST – P 05 – SA)* *"Skills of writing, while you are reporting something or also write a case such as … patient case, if one patient comes with allergies, so you write exactly this allergy for this patient…okay about medication". (ST – P 06 – FGF1 (6) – SA)* *"Critical thinking skills is very important one". (ST – P 08 – FGM2 (1) – SA)* *"Skills …how to educate patient and explain to him/her that patient counseling is for their own benefit, and it is better then dispensing medication without counseling. How to encourage the patient to ask questions and give information". (ST – P 09 – FGM3 (2) –SA)*

High level theme	Sub-theme / Definition	Quotes
		"Teamwork skills is the key one". (ST – P 07 – FGM1 (4) – SA) *…….* *"Being active and not being passive in everything you are doing … So taking an active role in everything you are doing instead of just being a passive robot. I think that is also a good skill to have". (ST - P 02– UK)* *"coming back to knowing that you are alert at all times and knowing yourself if you know that your brain is not focusing as much be honest with your employer or your staff so you know I need a break now…attitudes of always double checking medication ". (ST - P 01 – UK)* *"I suppose you must have the attitude to always be learning. You cannot think you already know everything. You have to be open to learning new information". (ST - P 02 – UK)* *"In the middle, yes balanced, not everything the doctor will tell you, do this is Ok and not too aggressive you just you feel everything the doctor say your in the middle between them… being patience and calm". (ST - P 03 - SA)* *"Tolerance we know the patient may come and shout but we don't need to shout back on patient". (ST - P 03 - SA)* *"I think if you want to work in a hospital you have to be tolerant and always smiling. I think these are the main attitudes". (ST – P09 – FGM3 (3) – SA)* *"So we have to double check it again and again in order to make sure that this is the right thing". (ST - P 02 - SA)* *"Not being aggressive or passive...I have to be open minded of course". (ST - P 03 - SA)* *"You have to be Professional". (ST - P 05 - SA)* *"You can say what you want to say in professional way so you don't be personal but you need to not give this because it's wrong". (ST - P 06 – FGF1 (1) – SA)* *"By communicating with the physicians, when the dose is wrong, talk to him kindly and*

High level theme	Sub-theme / Definition	Quotes
		nicely to change the dose like that". (ST - P 01 - SA) *"Without being harsh because you need to develop some communication skills and you are dealing with other health care professionals". (ST – P 08 – FGM2 (3) – SA)* *"Need to treat the patient in friendly manner, laugh and joke with him not only dispense medication and counsel him". (ST – P 09 – FGM3 (2) – SA)* *"I would say admit the error if you do it". (ST – P 08 – FGM2 (4) – SA)* *"Accept the fact that you can commit mistakes, not always you will be correct". (ST - P09 – FGM3 (2) – SA)* *"Keeping good environment". (ST – P 08 – FGM2 (2) – SA)* *"I will educate the one who made the error". (ST – P 08 – FGM2 (1) – SA)* *"I will report it also, that is what's happening. It's not personal thing it is a way to learn from errors and improve the practice". (ST – P 08 – FGM2 (2) – SA)* *"Whenever a pharmacist did any error he has to report it so it will not occur again and they can discuss why this error occur and how to prevent it. So it starts with preventing medication error". (ST - P 02 - SA* *"Transparency is an important attitude". (ST – P 08 – FGM2 (1) – SA)* *"The pharmacist should accept discussions and different opinions". (ST - P 04 - SA)* *"Be confident with the patient, alert, ahh what else...talk to the physician". (ST – P06 – FGF1 (4) – SA)* *"When you care about the patient...about the...know how serious the medication error so you linked your knowledge at pharmacy school with the patient part". (ST - P 06 – FGF1 (6) – SA)* *"Pharmacists especially Clinical Pharmacist should be responsible for patient care, he should*

High level theme	Sub-theme / Definition	Quotes
		be calm and his minds should be clear, clear mind, he will face big load on him, maybe patient life between his hands". (ST - P04 - SA) *"Responsibility, to learn how to be accountable for your actions. This is very important and this would help a lot to make an action against the Medication Error". (ST – P 07 – FGM1 (6) – SA)* *"Should be responsible… you should be vigilant". (ST - P 06 – FGF1 (3) – SA)* *"Like doesn't…he doesn't neglect any information from the patient like even if the patient said something that is not important, he neglect it, the patient think that he is not going to listen if I say something or stay silent so encouraging the patient and stay like enthusiastic about what they say or report". (ST – P 09 – FGM3 (1) – SA)* *"You should be a good listener to patients, and should listen to them carefully". (ST – P 09 – FGM3 (3) – SA)* *"And to keep in mind the famous saying in Medication Error is "to Err is human" so we don't blame people who do mistakes". (ST – P 07 – FGM1 (3) – SA)* *"Just learn how to prevent it". (ST – P 07 – FGM1 (5) – SA)* *"Cooperation between team members". (ST – P 09 – FGM3 (4) – SA)*
2. The teaching process	**Time allocated for MS** Is the time allocated for MS teaching enough to cover all aspects of MS	*"Maybe we need more time for medication safety". (ST – P01 – UK)* *"I'm not sure maybe we need more time". (ST – P 02 – SA)* *"I think we need more time for medication errors and medication safety topics" (ST – P 07 – FGM1 (1) –SA)*
	Mode of integration Is MS integrated as standalone course or part of existing courses or both	*"Yes. I think that would be better being a part of other courses which were there. I think integration works better". (ST - P 01 – UK)* *"I think personally I prefer both, I think both". (ST - P02 – UK)* *"Yes. It should be made extremely explicit. There is a lot reading on it as well and there are a*

High level theme	Sub-theme / Definition	Quotes
		lot of severe possible consequences that could happen. And at the end of the day our job is as medication experts, we are the drug experts …". (ST - P 02 – UK) *…….* *"I think the best way is to have them both. Separate and a part of other subjects ... So yah I prefer to take them both". (ST – P 05 – SA)* *"Actually I disagree with the course about medication safety. We don't need to add anything to the curriculum". (ST – P 09 – FGM3 (7) – SA)* *"I think there is no need for specific course for medication safety because things are repeated and we are taking the component of four courses and all of the lectures of medication safety are somewhat repeated. So if I will have specific course of it there will be more repetitions about the same things. So integrating it is better". (ST – P 02 – SA)* *"To be mainly integrated in practical courses like in the Introduction to Pharmacy Practice Experience".(ST – P07 – FGM1 (3) – SA)* *"Each course for example if we took it from practical we will going to deal with medication, we took it from the administration, how do we deal with it, it's how we let's say collect and internalize and we do it. We can integrate it with management, pharmacy management courses. So it should be like each profession. I am going to say its courses". (ST – P 07 – FGM1 (4) – SA)* *"So I prefer in the school to have medication safety issues under one subject that will benefit me" (ST – P 04– SA)* *"I think new courses for the medication errors and a specific course for the medication safety". (ST – P 06- FGF1 (6) – SA)* *"Yes it is clearly labeled. Yah. Like having like each disease or each therapeutic course you take, that you know for like one slide or one topic that talks about Medication Safety issues regarding this specific topic for instance. What things that could happen or what things could be wrong and how to deal with it". (ST – P 07 – FGM1 (1) – SA)* *"Yeah ...Yeah. . .sure medication safety is clearly mentioned and labeled"(ST – P 04 – SA)*

High level theme	Sub-theme / Definition	Quotes
		"Every course includes medication safety topic. Yes, the lecturer himself makes sure to include something about medication safety". (ST – P 08 – FGM2 (2) – SA) *"We need to have it (meant medication safety topic) more clearly labeled". (ST – P 05 – SA)*
	Mode of supervision Type of supervision during clinical placement and training related issued	*"Who teaches? It was always what would be known as the clinical or practice pharmacists. But then we would have certain pharmacists who were specialists in clinical or practice and they would generally be the ones teaching us about medication error and safety". (ST – P 02 – UK)* *"It would be interesting to see points of views from hospital and in the community. Like in the hospital. At university we get teacher practitioners so some come from hospital and some come from community so that what I meant like they would come. Yes explain what they come across in practice". (ST - P 01 – UK)* *"The clinical pharmacist who practice really he is the most knowledgeable person". (ST – P 08 – FGM2 (2) – SA)* *"I see that a clinical pharmacist who is really a practitioner in the hospital, he is more expert in medication safety more than also the lecturer who just teaches in the college. He is just a professor for example in the college. While the practicing clinical pharmacist he is really in real life and knows what's happening in the practice". (ST – P 08 – FGM2 (2) – SA)* *"I think the clinical pharmacist…. who practice in the hospital is suitable to teach medication safety topics…he sees cases every day". (ST – P08 – FGM2 (4) – SA)* *"Do lecturers with no hospital practice know about the cases that happen in the hospital? No". (ST – P 08 – FGM2 (2) – SA)* *"Both of them. Everyone, everyone who is interested will know how to teach medication safety". (ST – P 08 – FGM2 (3) – SA – talking about clinical pharmacist with clinical experience and pure academic lecturer)* *"You know, every one related to the pharmacy profession can educate regarding medication safety". (ST – P 08 – FGM2 (1) – SA)*

High level theme	Sub-theme / Definition	Quotes
		"You will not learn from someone who have never been practicing, someone in academics". (ST - P 07- FGM1 (6) – SA) *"Yes, to some extent. Maybe some trainers they have faced a lot of Medication Errors, they know, he knows or she knows how to deal with such situation.". (ST - P 07 – FGM1 (2) – SA)*
	Experience in different settings (classroom, simulation lab and clinical practice) Settings in which student learn most about medication safety	*"I think we learn most of medication safety in clinical placement" (ST – P 01 – UK)* *"I would say in the hospital, we have more time, we have the practice. We learn more medication safety in the hospital". (ST - P05 – SA)* *"The best way is to bring the students in the hospital and see the kinds, the real life. This is the best way to teach the students, to involve them in the situation". (ST - P 07 – FGM1 (1) – SA)* *"We learn most in the university (classroom) for sure". (ST - P 02 – SA)* *"We did not do anything just shadowing the pharmacist and the instructor said observe here and there. And we did not do anything". (ST - P 09 FGM3 (3) – SA)*
	Methods to deliver MS (learning resources) Methods used to teach MS currently or should be used (e.g. IPL, simulation, e-learning, etc.)	*"And the way we were taught was traditionally speaking lecture based with examples of really bad errors which have led to horrible consequences".(ST - P 01 – UK)* *"But when we did the simulations now we think "OK", we know how not to administer Amoxicillin if they are unsure they are allergic or not. Just always be extra cautious. Also, we do a role-play about medication in the dispensing class". (ST - P 02 – UK)* *"It is pharmacy students only … it is mostly a uni-professional learning experience". (ST – P - 01 – UK)* *"Yes. I think inter-professional learning would help a lot. When we were in the third year of university, we had a module called inter-professional learning where we would have classes…". (ST - P02 – UK)* *…….* *"Discussions, lectures, case discussions, role play. We have also cases, case reported form the hospital and we calculated the dose to the scale. It was good we had good cases and*

High level theme	Sub-theme / Definition	Quotes
		results".(ST - P 07 – FGM1 (1) – SA) *"By lectures... we have presentations, workshop, and short video about how to communicate with the patients ... educate the patient about medications treating the disease and just tell the patient, how if he is the real patient how he would deal with it". (ST - P 04 – SA)* *"Teaches us how to report an error using SRS". (ST - P 08 – FGM2 (1) – SA)* *"He took us actually to the hospital and he arrange like a visit, and we review the patient file and discuss this case, what the errors".(ST - P 03 – SA – talking about clinical placement method)* *"During this course we see in practice what we do either by shadowing the pharmacists as we are doing in first year or second year, and by practicing in the third year". (ST - P08 – FGM2 (4) – SA)* *"I do not have an idea regarding the other colleges. But in our college it is a uni-professional".(ST - P 08 – FGM2 (1) – SA)* *"Yes only uni-professional. No inter-professional learning in my college". (ST - P 02 – SA)* *"I think IPL method help to understand teamwork, it's engaged the nurses, doctors, pharmacist all of them. From the beginning everyone knows what his role and what he do, and what you do".(ST - P 09 – FGM3 (1) – SA)* *"I think this is great because you see other people perceptions, the other practitioners towards the medication safety". (ST - P 08 – FGM2 (2) – SA – talking about IPL method)* *"I generally prefer this way in the continuous medical education as a professional method to teach, to just collect all the health care providers and teach them regarding any aspects including the medication safety". (ST - P 08 – FGM2 (4) – SA - talking about IPL method)* *"IPL help us to explore different aspects, different angles from medication safety". (ST – P 06 – FGF1 (2) – SA)* *"For me, I prefer to be with Pharmacists only (meant UPL method). But I don't know, maybe,*

High level theme	Sub-theme / Definition	Quotes
		maybe it will be good but for me I prefer to be with Pharmacists, because Pharmacists are drug experts so it is better for me".(ST - P 05 – SA) *"I think both inter-professional and uni professional learning, there are things between pharmacists and there are things with other health care professionals". (ST - P 06 – FGF1 (6) – SA)* *"No. No enough time and staff for that…no simulation lab". (ST - P 01 – SA)* *"No, for pharmacy students no. we don't have simulation class yet".(ST - P 04 - SA)* *"In OSCE usually involves communication. Example how to deal with angry patients and patient counseling also". (ST - P 07 –FGM1 (2) – SA)* *"I think simulation is really good method of teaching because it doesn't only teach you the problem, it teach you how to solve this problem, like if you got this medication safety problem how to or how to solve it and prevent it in the future". (ST – P 09 – FGM3 (1) – SA)* *"It actually it makes us go and learning by doing, it's not learning by seeing or hearing". (ST - P 03 –SA – talking about simulation method)*
	MS feedback **Form of feedback provided** (about MS education: is it positive or negative, methods used in teaching, difficulties faced during training, etc.) **Good and bad practices** **(**seen during clinical practices (e.g. double checking – bad communication))	*Form of feedback provided about medication safety education:* *"Very, very important! At the end of the day our main focus should be the patient, and sometimes in this day and age, sometimes, sometimes it can be overlooked, because you just want to keep the work flowing as much as possible and take the least amount of time. But whatever we can do to improve patient safety and prevent the harm from happening to them so that would be amazing, so it is crucial, it is very important". (ST - P 01 – UK– talking about medication safety)* *"I think it would be a really good idea to have simulation for medication safety, yes. So it would be very interesting and it would add to the degree definitely". (ST - P 01 – UK)* *"So you do not get it so much as in community but definitely going into hospital the IPL side of things would definitely be more helpful, because you are applying what would be in a natural setting like a hospital already from a uni level so going out into practice will be*

High level theme	Sub-theme / Definition	Quotes
		much, much easier". (ST – P 01 – UK) *"It would be better to be, I have done IPL before and it was really interesting to see how other healthcare professionals operate". (ST – P01 – UK)* *"So yes, inter-professional learning was very helpful in preventing medication errors". (ST – P 02 – UK)* *…….* *"I think it's important to have simulation sessions, I think it's like preparing you after college like it's when happened drug-drug interaction. How will you tell the patient that it happened. How you will you convince him to take another medication". (ST - P 09 – FGM3 (3) – SA)* *"For me the more practical the better because it's stick in your mind because you did it, the more practical the better because it will stick in your memory for a very long time…so I think we need more clinical placement".(ST - P03 – SA)* *"The best way is to bring the students in the hospital and see the real cases. This is the best way to teach the students, to involve them in the situation". (ST - P 07 – FGM1 (3) – SA)* *"Inter-professional learning is very beneficial because it will break the barriers between pharmacy, nursing and medical students…and the case-based study is helpful".(ST - P 01 – SA)* *"I think that case discussion about medication safety will be more beneficial to us".(ST - P 09 – FGM3 (2) – SA)* *"Try self-study for example tell your student this is the subject go and search for answers. It's a lot better than spoon feeding". (ST – P 03 – SA)* *"I think workshops are the best because when we discuss these things it adds a lot… they have more examples to discuss and these things so we can understand the things more correctly and more practically".(ST - P 02 - SA)* *"What's good about reporting is that it reflects our practice so we had good reporting. We*

High level theme	Sub-theme / Definition	Quotes
		can know which part we are lacking. Let's say missing or malpractice…we have a problem and we could improve ourselves like by good reporting so it's a way of improving". (ST - P 07– FGM1 (1) – SA) *"So again maybe the root cause analysis in the introductory is very helpful". (ST - P08 – FGM2 (2) – SA)* *"I don't like spoon feeding it is an old method you know, lecturers they are just reading from the presentation …, sorry long presentation or book they just tell you don't do this you know an old method, I don't like it". (ST - P 04 – SA)* *"Mainly lectures, mostly lectures, yah, I know that it's not enough, sorry; we need to do more practice".(ST - P 05 –SA)* *"I don't like the lectures, it's really boring. We want to practice it". (ST - P 01 –SA)* *"I think medication safety is very important". (ST - P 02 – SA)* *"...it is really an important thing to educate the students about the medication errors and how to prevent it". (ST - P 01 – SA)* *"…by applying medication safety principle, we can save some money from the hospital, from the government". (ST - P 05 – SA)* *……* *Good and bad practices seen:* *"Usually if the strengths are being mixed like Citalopram they are always next to each other on the shelf so you would separate that out, put different strengths in different places, and there was also Carbamazepine with the Tegretol, there is Tegretol normal release and prolonged 200, 400 and 100 and that is always been mixed up. So we just put all the Carbamazepine in a box so now you have to go through the whole lot to know that you are picking up the right one. So that was quite good. It takes time but at least you are getting the right one". (ST - P 01 – UK - good practice of separating different strengths from the same medication)* *"the gentleman pharmacist who gave us a medication safety incident was when the wrong*

High level theme	Sub-theme / Definition	Quotes
		dose was calculated of I cannot remember which drug it was and one of the patients suffered a massive reaction to it, seizures and passed away and that was because nearly fourfold of the medication was given, 360 milligrams was given instead of 60 milligrams. So that was quite bad. So that was one of the stories we had illustrating the importance of dose calculations and stuff like that, and to double check etc". (ST - P 02 – UK – pharmacy trainers provide many stories and examples on medication errors during hospital training) *…….* *"Yes this is the new technology and its called script-pro device…which is not available in all the hospitals. So instead pharmacist calculating the number of tablets, and these things, they just enter it in the system and it will calculate it and the bottle of the tablet. It's mainly used for filling and labeling of medication for outpatient patients... Yes, it was very accurate and even it reduces the time of preparing these medications, so you dispense it in faster way for patients". (ST - P 02 – SA – using automated dispensing cabinet)* *"We noticed that the duration of the dose was wrong, so the pharmacist called the physician, and then he tell the physician, he tell him I checked the dose and used the internet medication resources as a reference and found out it is not the right duration and he explain to the physician and the physician said that I will change the duration so he mentioned his name, so which is he is inpatient pharmacist, he didn't say that you wrote it wrong and he said I noticed that and is it the correct one, are you sure of that?" (ST - P 06 – FGF1 (1)– SA)* *"Good communication… for example like for antibiotics for children and I see the pharmacist call the physician and tell him this dose is for adult not for pediatric". (ST - P 04 – SA)* *"Usually the Pharmacist reviews the files of the patient to make sure if there is any interaction between medications". (ST - P 05 – SA)* *"Double check… So the pharmacist will check and then the technician and then after that the pharmacists will recheck, that is how they do it". (ST - P 06 – FGF1 (2) – SA)* *"Yah. Verifying the orders you know, to see if the right medication is delivered to the right patient, in the right dosage and to the right route". (ST - P 08 – FGM2 (4) – SA)* *"The flags they put in the system for allergy documentation is a good thing". (ST - P 08 –*

High level theme	Sub-theme / Definition	Quotes
		FGM2 (2) – SA) *"The inpatient pharmacists report, they report the allergy a rush or hypersensitivity of the patient". (ST - P 04 – SA)* *…….* *"Yeah…actually it was surprising for me like if you are clinical pharmacist and you are recommending something to a doctor maybe he will refuse it and you know this is right you have the evidence for this but he might you know refuse it so how to deal with this problem". (ST - P 09 – FGM3 (1) – SA)* *"Some physicians, they were always ignoring and become upset from the pharmacists when they tell them that there is an error or something like that". (ST - P 01 – SA)* *"Bad handwriting is the most I mean is one of the most leading causes of a Medication Error". (ST - P 07 – FGM1 (2) – SA)* *"Illegible hand writing prescriptions seen in the community pharmacy, when we took rotation. They're so many, isn't it?" (ST - P 07 – FGM1 (1) – SA)* *"They just give the medication to the patient without giving any consultation, any reviewing, anything, they just give him. Sometimes without even the indication, they don't tell the patient the indication, so just give them and that's it". (ST - P 05 – SA)* *"In outpatient pharmacy for example, there were no education for the patient, they did not educate them how to use the syringe, how to use the inhalers. It may not be the first time for patient to use these medications, but they have to ask the patients if they know how to use these medications or not". (ST - P02 – SA – lack of proper patient education regarding medication use)* *"Yes, during the dispensing sometimes, the pharmacists don't give the patient full education on how to use medications for example how to use insulin pen". (ST - P 03 – SA)* *"I spent last summer training in the hospital, there's a lot of missing information in patient files". (ST - P 03 – SA)* *"Also the arrangement of the medication for example sometime the technician or the staff*

High level theme	Sub-theme / Definition	Quotes
		know where the medication they are new and sometime they don't return them back in the proper places you know and waste a lot of time searching for the medication and then they ask for them and they say oh it's up there. I changed place but we don't know". (ST - P 03 – SA) *"I think the patient is not engaged in the treatment plan. It's like solid eye. Physicians and pharmacist do all the job". (ST - P 09 – FGM3 (1)– SA)*
3. Evaluation of MS education	**Perceptions of students on adequacy of current education** Views and perceptions of students on the quality and adequacy of the current medication safety education (i.e. is the portion of medication safety education is sufficient to satisfy the requirement and meet the need for safe medication practice)	*"More medication safety component is needed in the classroom and in the clinical placement settings as well". (ST – P02 – UK)* *"No, at this time we have to know the basics, but in general it's not enough. For example, practicing in the hospital will add a lot for us, will teach us how to prevent these errors correctly. So practice is very important and we haven't been to a real practice until now".(ST - P 02 – SA)* *"In the hospital we do practice but still not that much". (ST - P 05 – SA)*
	Barriers to positive MS educational outcomes Difficulties and obstacles which prevent or block improvement in medication safety education	*"To be honest it is for grades if we have a presentation, we will go to look we will research through Google and other sources… I'm sorry to say this but it's all about grades. Grade oriented only". (ST - P09 – FGM3 (7)– SA)* *"We are focusing on the grade we score… we think about the grades not the information that presented to us". (ST - P 06 – FGF1 (6) – SA)* *"Actually there is a problem with the curriculum, the way that they teach us about herbals medication because it's an American curriculum. I think there is no information about herbals and other things that it's not in our curriculum. The curriculum is an American curriculum, which lack the information about herbal medication, which is an important part of our medication list". (ST - P 09 – FGM3 (3) – SA)* *"The problem that there is no medication safety research like maybe implementing some medication safety research as a graduating research". (ST - P 09 – FGM3 (1) – SA)* *"We did not do anything just shadowing and Dr. said observe here and there. And we did*

High level theme	Sub-theme / Definition	Quotes
		not do anything". (ST - P09 – FGM3 (6) – SA) *"So sometimes, there is a gap between theories that is taught in the school and the real practice". (ST - P07 – FGM1 (5) – SA)*
	Strategies to improve MS education Ideas, methods and plans suggested by teaching staff or students to improve medication safety education	*"Also some people work during placements for our university. I know I did for all four years or like weekend jobs. Or get us to relate our experiences to the other students' experiences so the more experiences you have had about the more you will be cautious when dispensing that drug next time or if that mistake was made be careful with that so it does not get mixed up next".(ST - P 01 – UK)* *"The simulation idea was a good one".(ST - P01 – UK)* ……. *"Yes, we can implement it in physiology course". (ST - P 08 – FGM2 (1) – SA)* *"We can implement medication safety in pharmacology course".(ST - P 08 – FGM2 (2)– SA)* *"I think medication safety can be taught mainly in Therapeutic".(ST - P 05 – SA)* *"The idea should be included in every lecture objectives. So this is I think the optimal way to integrate medication safety". (ST – P 08 – FGM2 (4) – SA)* *"There is an opinion, which was mentioned in the beginning that medication safety be as a specific course (meant stand-alone course) …". (ST - P 09 – FGM3 (6) – SA)* *"I think medication safety is good to be started the first year in the college". (ST - P 08 – FGM2 (3) – SA)* *"Medication safety teaching should be divided throughout the years". (ST - P 06 – FGF1 (6) – SA)* *"Yes, more medication safety teaching in the Internship year".(ST - P 08 – FGM2 (2) – SA)* *"I suggest that there is a class in the hospital and why we wait for the fourth year to go to hospital and why we didn't have class in the hospital from the beginning". (ST - P 04 – SA – talking about early exposure to clinical placement)*

High level theme	Sub-theme / Definition	Quotes
		"If there is a practice session and we have the chance to practice with real situation and get deeper with medication safety and medication errors issues, this would be very good for us to learn". (ST - P 05 – SA - – talking about early exposure to clinical placement) *"Be more engaged in what they do ah. Not only a lecture we need to see the practice what pharmacists really do because after study we will only remember practical things". (ST - P 09 – FGM3 (3) – SA -– talking about early exposure to clinical placement)* *"In the training maybe involve us as a student in the clinical rounds, with more practice". (ST - P 05 – SA)* *…….* *"I think we can if we participate more in the rounds and not the shadowing, we can look for the reported medication errors in the same hospital and check if the reported medications were put on alert in the system so did they benefit from the report or not". (ST - P09 – FGM3 (2) – SA)* *"I think they can give us the topic and say that tomorrow we will discuss this topic and you can search about it and we come and discuss what we have… it is a self-directed learning". (ST - P 06 – FGF1 (2) – SA)* *"Yes, I think it would be a very good experience to have IPL as we can share knowledge. They can tell us the errors that they have done before or we can discuss these errors and how it occurs, what's the role of each healthcare professional in preventing these errors. So it will make a difference". (ST - P02 – SA – discussing errors during IPL session)* *"I think yes, we never had a discussion for medication error but I think it would be helpful". (ST - P 06 – FGF1 (4) – SA)* *"Regarding the entire curriculum. If its case based learning, so for example in Therapeutics, if we have hypertension lecture, we can build it on a case so we follow on recommendations, all of the Therapeutics". (ST - P 08 – FGM2 (2) – SA)* *"shadowing pharmacists on quality improvement topic in 4th and 5th year…students will be already studied a lot of pharmacy, they had enough pharmacy knowledge and they can comprehend all the terms used in the discussion but in early years, I believe it's not that really beneficial". (ST - P 07 – FGM1 (3) –SA)*

High level theme	Sub-theme / Definition	Quotes
		"I think in the medicine, in the medical education they use some learning skills like the problem-based learning (PBL). So they expose to this things to solve the problem by problem based learning". (ST - P 08 – FGM2 (1)– SA) *"I think we need to improve the research in medication safety in the medical field, so we can cover the topic in more details and depth, and information will be more available, because the student do not expose to enough information during studying in the college. We study for 6 years and I think most of information that we will keep can be obtained by doing research …I think it is important that we have research on medication safety as the clinical pharmacist will be working in research centers". (ST - P 09 – FGM3 (3) – SA)* *"Maybe, improving the clinician's skills dealing with critical, and the cases that need critical thinking. This might help". (ST - P 08 – FGM2 (1) – SA)* *"Critical thinking component should be integrated in every course, even Therapeutics itself". (ST - P 08 – FGM2 (2) – SA)* *"How to prevent Medication Errors?".(ST - P 07 – FGM1 (6) – SA)* *"How to deal with Medication Errors after happening? I think the healthcare provider should be involved in the root cause analysis (RCA) to see what's the consequence of this error. They have to be involved not only in the reporting". (ST - P 07 – FGM1 (2) – SA)* *"Yah, how to report and how to deal with Medication Error when it happens". (ST - P 07 – FGM1 (3) – SA)* *"To encouraging students to do a reporting for Medication Safety issues.". (ST - P 07 – FGM1 (6) – SA)* *"Adding of topics like how to deal with the stress, how to deal with the load, Yes". (ST - P 08 – FGM2 (3) – SA)* *"I think the main point is how to educate the patient and to raise awareness about medication". (ST - P 09 – FGM3 (4)– SA)*

High level theme	Sub-theme / Definition	Quotes
		"using technology to educate about medication safety issues like computer applications and twitter accounts". (ST - P09 – FGM3 (3) - SA) *"Yes of course there will be a load, but this will be for the benefit of the students, for example in the medicinal chemistry module, because we know that there are 15 marks that will be given to the presentation, that is why we go and spend time in searching for information and we make sure that we digest all the information which we will be asked about. So when there are marks we will study and focus more on the topic". (ST - P 09 – FGM3 (7) –SA)* *"If students become science oriented or knowledge oriented from early school years, that will have good impact on student's future and they will be more caring about knowledge or will prioritize knowledge over grades". (ST - P 09 –FGM3 (3)– SA)* *"The only thing that will attract the students to patient care is the grades. We need more grades on presentations, case study and research on medication safety". (ST - P 09 – FGM3 (6) –SA)*

MS = medication safety

Appendix 17: Summary of suggested strategies to improve medication safety based on methods recommended and barriers identified – interview study

Summary of suggested strategies to improve medication safety based on methods recommended and barriers identified by teaching staff in nursing and pharmacy schools in the UK and Saudi Arabia

Profession	Curriculum guide	Methods recommended	Barriers to improving medication safety education	Suggested strategies to improve medication safety education
Nursing teaching staff in the UK	Using national guides like NMC standard and NICE. Use of the WHO curriculum guide is very limited in few nursing programmes.	Doing more simulation and inter-professional learning sessions.	1. Aspects of medication safety are available but not addressed properly with details. 2. Pharmacokinetics as part of pharmacology course not embedded yet in the theory. 3. Aspects of medication safety that should be taught but they are not available currently medicine management. 4. Need more focus on calculation as many students fail it. 5. Getting enough facilitators to facilitate teaching in simulation sessions is always a dilemma.	1. Teaching medication safety earlier can protect students from developing bad practices 2. Strategies - better co-ordination across the programme and more structured model 3. More co-ordinated through the course 4. Having more time and more facilitators 5. Nursing curriculum - plans for changing- including more simulation sessions 6. Doing more simulation and inter-professional learning 7. Nursing students should shadow pharmacists and realise the scope of their practice 8. Using technology to improve medication safety teaching
Nursing teaching staff in Saudi Arabia	Using national guides like Saudi Commission For	Doing more simulation and integrating of	1. Poor calculation skills taught in classroom which was observed	1. Medication safety component should be integrated and taught earlier starting in the second year as part of nursing student's orientation then should be repeated

Profession	Curriculum guide	Methods recommended	Barriers to improving medication safety education	Suggested strategies to improve medication safety education
	Health Specialties (SCFHS) and Saudi FDA and some online resources. Using international guide like the American Nursing Association WHO curriculum guide is used very limited in few nursing programmes	inter-professional learning sessions in the curriculum. In addition longer exposure to clinical placement.	by nursing trainers or preceptors. 2. Not allowing students to have hand-on training when doing their clinical placement. 3. Not allowing students to have hands-on training on certain medication administration route such as IV and IM injections. 4. Students can't practice medication administration via all routes of administration. 5. Time allocated for clinical placement including teaching of medication safety issues is not enough 6. Time constraints during lectures 7. Students don't have basic knowledge about medication safety before coming to clinical placement … medication safety	throughout the programme. 2. Medication safety component should be emphasised and repeated to keep students' attention. 3. Strategies to improve teaching methods: expose students to IPL, including medication safety concept at different levels and complexity use of high fidelity simulation, adding practical component of medication safety to pharmacology. 4. Strengthen pharmacology. 5. Teaching students about error reporting. 6. Medication error topic should be emphasized during clinical practice. 7. Using technology like videos related to medication safety … students can collect these videos and discuss it with the instructors. 8. Using electronic learning (e-learning) and blackboard to learn about medication safety. 9. Co-operation between college, clinical and training objectives. 10. Strengthen medication safety teaching in the classroom and simulation lab so students will get maximum benefit of clinical placement. 11. Nursing students should be taught about medication administration techniques in the college and simulation skill lab before coming to clinical training in the hospital. 12. Strategy for improving clinical training – instructors' involvement should be higher. 13. Strategy to improve medication safety learning in the clinical training – have quiz on medication related issues (pharmacology) including calculation. 14. Medication safety component integrated in all nursing

Profession	Curriculum guide	Methods recommended	Barriers to improving medication safety education	Suggested strategies to improve medication safety education
			education provided in the classroom is not enough: 8. Poor medication knowledge (pharmacology). 9. Busy training sites and busy preceptors who don't provide students with appropriate training.	subjects (existing courses).
Pharmacy teaching staff in the UK	Using national guides like GPhC standard WHO curriculum guide is used very limited in few pharmacy programmes	Doing more simulation and more inter-professional learning sessions	1. Clinical placements are relatively short and can affect the time of actual practice (hospital experience) 2. Limited exposure to medication safety practices like error reporting. 3. Time allocated is not enough and insufficient time resources. 4. Difficulties in finding external speakers to teach medication. 5. Limited educational methods. 6. Limited space available in lecture rooms (physical	1. Teaching medication safety topics earlier and throughout the programme. 2. Focusing on the practice and application of medication and patient safety in the final year. 3. Using multiple methods such as having recognized experts in medication safety field, making it clear that patient and medication safety is the role of pharmacists and other healthcare professionals. 4. Embedding medication errors topic in other clinical teaching (clinical courses). 5. Building up medication safety through the course (spiral curriculum). 6. Doing more work based practice assignments and developing research and evidence-based practice. 7. Teaching clinical reasoning and critical thinking. 8. Explicitly covering adverse drug reactions (ADRs) and error reporting topics. 9. Having more real life examples. 10. Using of videos on medication safety and patient stories. 11. Having more clinical practicing and role models (clinical tutors).

Profession	Curriculum guide	Methods recommended	Barriers to improving medication safety education	Suggested strategies to improve medication safety education
			location). 7. Barrier related to personal ability of the students (whether they are active or passive learners).	12. Developing online module about medication errors. 13. Running virtual simulation and follow a patient's journey. 14. Using technology, virtual learning and more clinical placement. 15. Having more case-based studies, inter-professional learning (IPL) and online self-directed learning. 16. Teaching more medication safety in clinical placement (hospital practice). 17. Allocating more time for medication safety teaching. 18. Re-designing of community pharmacy training in the future.
Pharmacy teaching staff in Saudi Arabia	Using national guides like Saudi Commission For Health Specialties (SCFHS) & Saudi FDA and some online resources. Using international guides like ISPM alerts, JCI recommendations and other online materials and textbooks like medication errors by Michael Cohen. WHO curriculum guide is used very	Integration of simulation and inter-professional learning methods in the curriculum. In addition early and longer exposure to clinical placement.	1. Congested curriculum will not allow enough time for medication safety teaching. 2. Students are grade oriented. 3. Lack of simulation labs. 4. Shortage of lecturers and trainers to teach in simulation labs. 5. Shortage of qualified clinical pharmacists and trainers in training sites, especially with big number of students who come for clinical placement in the hospital. 6. Preceptors are very	1. Medication safety should be integrated from the first year and throughout pharmacy programme. 2. Making medication safety an objective in each lecture and course. 3. Providing clear definition for medication safety 4. Strengthening medication safety component within therapeutics 5. Including reporting of medication errors topic. 6. Manage errors after it happens. 7. Engaging students in medication safety research and projects. 8. Teaching medication errors cases, theories, how to prevent medications errors and no blame environment. 9. Teaching students'real cases on error prevention and patient education. 10. Teaching quality tools as part of medication safety. 11. Adding a section on role of technology in reducing medication errors (e.g. bar coding). 12. Early exposure to clinical placement and more contact hours in clinical training. 13. Using simulation method to train students in safe

Profession	Curriculum guide	Methods recommended	Barriers to improving medication safety education	Suggested strategies to improve medication safety education
	limited in few pharmacy programmes		busy and have no time to train students in the hospital.	environment and real life scenarios. 14. Launching of simulation labs and satellite pharmacies to train students inside the colleges 15. Using inter-professional learning method to allow students to understand other healthcare professions role and to conceptualise communication and teamwork concepts which lead to reducing of errors related to miscommunication. 16. Self-directed learning method 17. Training students in medication safety centre in the hospital to expose to real cases. 18. Study the history of medication safety. 19. using videos on medication errors

A summary of key points arising from pharmacy and nursing teaching staff interviews such as curriculum guides used, methods recommended and preferred as reported by participants, barriers to positive medication safety outcomes and strategies to improve medication safety education outcomes.

Summary of suggested strategies to improve medication safety based on methods recommended and barriers identified by nursing and pharmacy students in the UK and Saudi Arabia

Profession	Medication safety guidelines and reference	Methods currently used and recommended	Barriers to improving medication safety education	Suggested strategies to improve medication safety education
Nursing students in the UK	British National Formulary (BNF) and National Institute for Health and Clinical Excellence (NICE)	Lectures, simulation, observation during clinical placement, E-learning, inter-professional learning (IPL), uni-professional learning (UPL), workshops, discussions, role-play scenarios, self-directed learning, using videos on medication errors methods Method recommended: simulation and inter-professional learning.	1. Insufficient pharmacology being taught which makes learning about medication safety harder. 2. Lack of a clear link between medication safety and pharmacology.	1. Integration of the medication safety component throughout the course as it is an essential component. 2. Development of a course on medication safety as a requirement for registration, 3. Increasing pharmacology portion and including more medication safety component within it to improve their understanding of both components 4. Inter-professional learning (IPL) should be used to teach medication safety starting from the first year of nursing programme. 5. More simulation should be used. 6. E-learning could be used to support pharmacology learning. 7. Participants also indicated that it would be useful to have exposure and hands-on training like using IV route.
Nursing students in Saudi Arabia	Did not specify any guidelines or references related to medication safety	Lectures, case-based study, simulation, role-play and using blackboard for communication, using e-library, using e-learning,	1. Lack of proper training and poor supervision during clinical placement. 2. Time specified for hospital training is limited. 3. Students scoring	1. Including new teaching methods such as inter-professional learning and shadowing pharmacists. 2. Including research on medication safety. 3. Including more examples of medication errors. 4. Including more videos on medication safety and errors. 5. Practising nurses should train the students and be instructors.

Profession	Medication safety guidelines and reference	Methods currently used and recommended	Barriers to improving medication safety education	Suggested strategies to improve medication safety education
		group discussion, research about medication safety and observing the preceptor. Method recommended: simulation, inter-professional learning, workshops and case-based study.	low marks in pharmacology as they don't understand it properly. 4. Students feeling uncomfortable to question nurses when observing incorrect practices during clinical placement. 5. Being poor at medications calculation. 6. Lack of hands-on training on different medication administration routes (e.g. intra-muscular (IM) injection). 7. Shortage of materials and supplies used for training purposes and some medications being prohibited for use in training made learning about	6. Students should receive training in reporting of medication errors. 7. Using technology to improve medication safety teaching such as smart phone applications.

Profession	Medication safety guidelines and reference	Methods currently used and recommended	Barriers to improving medication safety education	Suggested strategies to improve medication safety education
			medication safety problematic.	
Pharmacy students in the UK	British National Formulary (BNF) as reference for medication information, but nothing specific for medication safety component	Lectures, simulation methods including role-play scenario, mostly uni-professional learning (UPL and some inter-professional learning (IPL). Methods recommended simulation and inter-professional learning (IPL)	No barriers mentioned	1. Having practical experience early during studying 2. Adding simulation method
Pharmacy students in Saudi Arabia	1. Did not specify any guidelines and references related to medication safety. 2. ISMP recommendations for prohibited abbreviation and medication warnings and alerts which are mentioned pharmacy college website.	Lectures, case-based study, role-play, group and case discussions, workshops, presentations, clinical placement, shadowing, videos on medication errors, uni-professional learning (UPL) and simulation especially during OSCEs examinations.	1. Students are grades oriented more than knowledge oriented 2. American curriculum taught to the students in the college lacks a section on herbal medications which can lead to medication errors 3. No research on medication safety 4. Hospital training is	1. Integrating the medication safety component In physiology, pharmacology and therapeutic Courses 2. Medication safety concept should be included in all lecture/course objectives 3. Early and more hospital training is needed. 4. Medication safety should be taught from the first year and practised throughout the pharmacy programme. 5. Medication safety should be maximized in intern year. 6. Integrating a specific medication safety course (a stand-alone course) 7. Involving students in clinical rounds during hospital training 8. Self-directed learning method should be used to teach

Profession	Medication safety guidelines and reference	Methods currently used and recommended	Barriers to improving medication safety education	Suggested strategies to improve medication safety education
		Methods recommended: simulation, inter-professional learning (IPL) and more clinical placement.	not efficient and training sites are too crowded. 5. No hands-on practice in hospital training 6. Gap between theories taught in the classroom and practice during clinical placement.	medication safety 9. Inter-professional learning method (IPL) is a very good method to share knowledge. 10. Group discussions and case-based study on medication safety component. 11. Including shadowing of pharmacists on quality improvement component in advance years of study. 12. Including problem based learning method (PBL) 13. Encouraging students to do research on medication safety. 14. Critical thinking skills component is needed and can be implemented in all courses 15. Including a topic on how to prevent and deal with medication errors after they happen. 16. Including reporting of medication errors. 17. Including a topic on how to deal with stress and load 18. Including quality tools like route cause analysis (RCA) 19. Raising awareness about medications by teaching patient education topic 20. Using technology to improve medication safety learning. 21. Allocating marks/grades to encourage students to study medication safety

A summary of key points which emerged from pharmacy and nursing students' interviews such as medication safety guidelines and reference used, method recommended and preferred as reported by participants, barriers to positive medication safety outcomes and strategies to improve medication safety education outcomes.

Appendix 18: Correspondence emails acknowledging permission to use the H-PEPSS tool from Dr. Liane Ginsburg

[redacted]@hotmail.com

From: Liane Ginsburg <lgins@yorku.ca>
Sent: 28 October 2014 01:30
To: Albadali, Hind
Subject: Re: the H-PEPSS: an instrument to measure health professionals perceptions of patient safety competence at entry into practice

Dear Hind,
Y ou are most welcome to use the H-PEPSS survey.
The only formatted version i can direct you to is on our website at: http://www.yorku.ca/patientsafety/H-PEPSS/H-PEPSS_Generic_2010.pdf
Note that this is the full version of the H-PEPSS that was used with our sample. The index BMJQ&S paper we published on the psychometrics led to a reduced version . We don't have a nicely formatted version of the reduced H-PEPSS but that first paper shows which items we retained and which fell out.

You may choose to use either the full or reduced version depending on your purpose for doing the survey (eg the full version is useful for item-specific (rather than scale level) analysis) as it covers a broader array of PS issues. I think both the index paper and the 2nd paper describe the scoring and scale construction (means of reduced scales if >50% of items in the scale are answered)

Good luck with your work. If you are willing, we would very much like to be able to see anonymized H-PEPSS data as we continue to explore the utility of this tool. Please let us know if you might be willling to share that or even early summary results. You are welcome to use the survey regardless.
Regards,
Liane

Faculty of Health
Liane Ginsburg | Associate Professor | School of Health Policy & Management | **Tel.** 416 736 2100 ext 33925 | **Fax.** 416 736 5227 | **Email.** lgins@yorku.ca | http://www.yorku.ca/patientsafety/
York University | HNES Building, Suite 413 | 4700 Keele Street Toronto, Ontario, Canada M3J 1P3

-----"Albadali, Hind" wrote: -----
To: "'lgins@yorku.ca'"
From: "Albadali, Hind"
Date: 10/27/2014 06:10PM
Subject: the H-PEPSS: an instrument to measure health professionals perceptions of patient safety competence at entry into practice

Dear Dr Liane

Good evening, hope this e mail finds you well.

I had the pleasure to read the article " the H-PEPSS: an instrument to measure health professionals perceptions of patient safety competence at entry into practice".

I'm a Postgraduate Researcher doing a PhD about Patient Safety Education in the Pharmacy and Nursing undergraduates , I'm in my 2nd year at Imperial College London.

1

I will conduct a mixed methods doing qualitative and quantitative studies, I'm intending to distribute a questionnaire to measure the perceptions of the students and the faculty members in pharmacy and nursing schools on Patient Safety Education.

I was interested about the survey which was distributed to medical, nursing and pharmacy schools in the mentioned study (published in BMJ Quality and Safety, 2011).

I want to ask you if I can get an access to the survey items / questions for research purpose, I think the study approach you chosen is very similar to what I'm planning to do in my quantitative study.

Kindly can you help me in this matter?

Thank you,

Hind Ahmed Al Badali

Postgraduate Researcher

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Appendix 19: H-PEPSS tool

H-PEPSS

Health Professional Education in Patient Safety Survey

Instructions:

- The H-PEPSS questionnaire asks about:
  - **clinical safety issues** such as hand hygiene, transferring patients, medication safety)
  - **system issues that effect safety** such as aspects of the organization, management, or the work environment including policies, resources, communication and other processes
- The survey is seeking your **perceptions** and **opinions** only. There are no right or wrong answers. Indicate the extent to which you agree or disagree with each question statement. If you are unsure whether you agree or disagree, mark "neutral".

What do we mean by:

- **Patient Safety**: The pursuit of reduction and mitigation of unsafe acts within the health care system, as well as the use of best practices shown to lead to optimal patient care outcomes

Research funded by the Canadian Patient Safety Institute (CPSI) and York University

For information about or permission to use the H-PEPSS, please contact Professor Liane Ginsburg in the School of Health Policy & Management at York University at lgins@yorku.ca

SECTION 1: Learning about specific patient safety content areas

Here we ask about 7 areas that have to do with keeping patients safe. We would like to know about the extent to which you feel confident about what you learned in each of these areas. We ask you to think about both your classroom and clinical practice setting experiences—and evaluate them separately.

	...in the classroom						...in clinical settings					
	strongly disagree	disagree	neutral	agree	strongly agree	don't know	strongly disagree	disagree	neutral	agree	strongly agree	don't know
Clinical safety: *"I feel confident in what I learned about..."*												
1. hand hygiene	○	○	○	○	○	○	○	○	○	○	○	○
2. infection control	○	○	○	○	○	○	○	○	○	○	○	○
3. safe medication practices	○	○	○	○	○	○	○	○	○	○	○	○
4. safe clinical practice in general	○	○	○	○	○	○	○	○	○	○	○	○
Working In Teams with Other Health Professionals: *"I feel confident in what I learned about..."*												
5. team dynamics and authority/power differences	○	○	○	○	○	○	○	○	○	○	○	○
6. managing inter-professional conflict	○	○	○	○	○	○	○	○	○	○	○	○
7. debriefing and supporting team members after an adverse event or close call	○	○	○	○	○	○	○	○	○	○	○	○
8. engaging patients as a central participant in the health care team	○	○	○	○	○	○	○	○	○	○	○	○
9. sharing authority, leadership, and decision-making	○	○	○	○	○	○	○	○	○	○	○	○
10. encouraging team members to speak up, question, challenge, advocate and be accountable as appropriate to address safety issues	○	○	○	○	○	○	○	○	○	○	○	○
Communicating Effectively: *"I feel confident in what I learned about..."*												
11. enhancing patient safety through clear and consistent communication with patients	○	○	○	○	○	○	○	○	○	○	○	○
12. enhancing patient safety through effective communication with other health care providers	○	○	○	○	○	○	○	○	○	○	○	○
13. effective verbal and nonverbal communication abilities to prevent adverse events	○	○	○	○	○	○	○	○	○	○	○	○
Managing Safety Risks: *"I feel confident in what I learned about..."*												
14. recognizing routine situations in which safety problems may arise	○	○	○	○	○	○	○	○	○	○	○	○
15. identifying and implementing safety solutions	○	○	○	○	○	○	○	○	○	○	○	○
16. anticipating and managing high risk situations	○	○	○	○	○	○	○	○	○	○	○	○
Understanding Human and Environmental Factors: *"I feel confident in what I learned about..."*												
17. the role of human factors, such as fatigue, that effect patient safety	○	○	○	○	○	○	○	○	○	○	○	○
18. safe application of health technology	○	○	○	○	○	○	○	○	○	○	○	○
19. the role of environmental factors such as work flow, ergonomics, resources, that effect patient safety	○	○	○	○	○	○	○	○	○	○	○	○
Recognize, Respond to and Disclose Adverse Events and Close Calls: *"I feel confident in what I learned about..."*												
20. recognizing an adverse event or close call	○	○	○	○	○	○	○	○	○	○	○	○
21. reducing harm by addressing immediate risks for patients and others involved	○	○	○	○	○	○	○	○	○	○	○	○
22. disclosing an adverse event to the patient	○	○	○	○	○	○	○	○	○	○	○	○
23. participating in timely event analysis, reflective practice and planning in order to prevent recurrence	○	○	○	○	○	○	○	○	○	○	○	○

H-PEPSS version 2010

	...in the classroom						...in clinical settings					
	strongly disagree	disagree	neutral	agree	strongly agree	don't know	strongly disagree	disagree	neutral	agree	strongly agree	don't know
Culture of safety: *"I feel confident in what I learned about..."*												
24. the ways in which health care is complex and has many vulnerabilities (e.g. workplace design, staffing, technology, human limitations)	○	○	○	○	○	○	○	○	○	○	○	○
25. the importance of having a questioning attitude and speaking up when you see things that may be unsafe	○	○	○	○	○	○	○	○	○	○	○	○
26. the importance of a supportive environment that encourages patients and providers to speak up when they have safety concerns	○	○	○	○	○	○	○	○	○	○	○	○
27. the nature of systems (e.g. aspects of the organization, management, or the work environment including policies, resources, communication and other processes) and system failures and their role in adverse events	○	○	○	○	○	○	○	○	○	○	○	○

SECTION 2: How broader patient safety issues are addressed in health professional education

Please think about your health professional education overall (both classroom and clinical practice training) as you answer the following items.

	strongly disagree	disagree	neutral / unsure	agree	strongly agree
28. As a student, my scope of practice was very clear to me	○	○	○	○	○
29. There is consistency in how patient safety issues were dealt with by different preceptors in the clinical setting	○	○	○	○	○
30. I had sufficient opportunity to learn and interact with members of interdisciplinary teams	○	○	○	○	○
31. I gained a solid understanding that reporting adverse events and close calls can lead to change and can reduce reoccurrence of events	○	○	○	○	○
32. Patient safety was well integrated into the overall program	○	○	○	○	○
33. Clinical aspects of patient safety (e.g. hand hygiene, transferring patients, medication safety) were well covered in our program	○	○	○	○	○
34. "System" aspects of patient safety were well covered in our program (e.g. aspects of the organization, management, or the work environment including policies, resources, communication and other processes)	○	○	○	○	○

SECTION 3: Comfort speaking up about patient safety

Now that you are working as a licensed health professional indicate how you currently feel about the following:

	strongly disagree	disagree	neutral / unsure	agree	strongly agree
35. If I see someone engaging in unsafe care practice in the clinical setting, I feel I can approach them	○	○	○	○	○
36. If I make a serious error I worry that I will face disciplinary action	○	○	○	○	○
37. It is difficult to question the decisions or actions of those with more authority	○	○	○	○	○
38. In clinical settings, discussion around adverse events focuses mainly on system-related issues, rather than focusing on the individual(s) most responsible for the event	○	○	○	○	○

H-PEPSS version 2010

Appendix 20: Paper format questionnaire

Questionnaire seeking students' views of medication safety education

By PhD student: Hind Al Badali

Dear Participant

We would like your kind assistance by completing this medication safety education questionnaire. The aim of this study is to explore your views as pharmacy or nursing students on medication safety education. This is an opportunity to participate in research related to your field of study and get some experience as a research participant. Your insights as a pharmacy or nursing student are important to us. We plan to use what we learn from this study to improve medication safety education.

The questionnaire is ***anonymous*** *and no one, not even the research team, will know who completed the responses.* ***Please only complete the survey once****, to ensure the results are not affected.*

The questionnaire has three parts as listed below that ask about medication safety education at your pharmacy or nursing school, or during your clinical placement. Completion of the questionnaire will take you about 20 – 30 minutes. The parts are:

(1) Demographic information
(2) Medication safety education
(3) The Health Professional Education in Patient Safety Survey.

I thank you in advance for your time in completing the questionnaire.

Please note: in completing the questionnaire, you are consenting to participate in this study.

Best regards,

Hind Al Badali,
PhD student, Imperial College London.
h.al-badali10@imperial.ac.uk

Questionnaire Study - Medication Safety Education in KSA

Part 1: DEMOGRAPIC INFORMATION

(1) Current Status	(2) Current year of degree	(3) Previous educational level before starting degree	(4) Age	(5) Gender	Please answer the following questions in relation to your current degree	
					(6) Previous experience working in a clinical setting (hospital, clinic, pharmacy, care home, etc.)	(7) Have you had any experience in a clinical setting as part of your current degree? (whether organised by you or the university)
◯ Pharmacy student ◯ Nursing student	◯ 1st year ◯ 2nd year ◯ 3rd year ◯ 4th year ◯ Other (specify)	◯ High school certification ◯ Diploma – (Please name) ..... ◯ Bachelor degree ..... ◯ Master degree ..... ◯ Other (specify)	◯ < 20 ◯ 20 – 30 ◯ 31 – 40 ◯ > 40 ◯ Prefer not to say	◯ Female ◯ Male ◯ Prefer not to say	◯ Yes, (specify) – no. of months ..... – Setting ..... ◯ No ◯ Unsure	◯ Yes, (specify) – no. of months ..... – Setting ..... ◯ No ◯ Unsure

Part 2: MEDICATION SAFETY EDUCATION (IN THIS SECTION YOU WILL BE ASKED YOUR PERCEPTIONS ABOUT YOUR EDUCATION)

(1) Is medication safety explicitly taught in your university (clearly labelled as medication safety)?	(2) How is medication safety taught at your university? (Please tick all that apply)
◯ Yes ◯ No ◯ Unsure	◯ **Uni-professionally** *(This is where students learn together as a single group, e.g. pharmacy students or nursing students, and do not learn with or alongside other professional groups)* ◯ **Inter-professionally** *(This is when two or more students from different professional groups learn with, from and about each other to improve collaboration)* ◯ Other (*please specify*).....

(4) Who teaches medication safety at your college? (Please tick all that apply)	(5) What modules or topics have helped you to understand medication safety? (Please give examples from your course)	(6) In which of the following settings do you learn the most about medication safety? (Please tick all that apply)	(7) In your opinion, does your current medication safety education supports your understanding of…….. (Please tick all that apply)	(8) Based on your answers to question 7, to what extent do you agree that current medication safety education supports your understanding of medication safety? (Please tick **one option** only)
◯ Internal teaching staff ◯ A practicing pharmacist or Nurse (i.e. who works in a clinical setting: hospital, community pharmacy or primary care) ◯ Teaching staff from other colleges (e.g. lecturers from college of medicine) ◯ Unsure ◯ Other (please specify) ……	◯ …… …… ◯ …… …… ◯ …… …… ◯ …… ……	◯ Classroom/ lecture theatre ◯ Skills lab/ simulation lab ◯ During clinical placement (e.g. in hospital, primary care, GP surgery, community pharmacy) ◯ Other (please specify) ……	◯ Definitions of medication errors (e.g. near misses) ◯ Causes of medication errors (wrong drug, etc) ◯ Types of medication errors (e.g. prescribing errors) ◯ Strategies to reduce medication errors (e.g. double checking) ◯ How to manage the situation after medication error happens ◯ Unsure	◯ Strongly agree ◯ Agree ◯ Neutral/ Unsure ◯ Disagree ◯ Strongly disagree

(9) In your opinion, do you think that medication safety teaching should be…….. (Please tick **one option** only)

◯ A stand-alone course ◯ Part of existing courses ◯ Both

Kindly read the definitions given in the box below, and then answer questions 10, 11 and 12.

Knowledge is defined *as facts, information, and skills acquired through experience or education; the theoretical or practical understanding of a subject. (Oxford dictionary)*

Skills are defined as *the ability to do something well; expertise. (Oxford dictionary)*

Attitudes are defined as *a settled way of thinking or feeling about something. (Oxford dictionary)*

(10) In your opinion, what **knowledge** do you believe a qualified pharmacist or nurse will need to practise medication safety? (Please give up to 3 examples)	(11) In your opinion, what **skills** do you believe a qualified pharmacist or nurse will need to practise medication safety? (Please give up to 3 examples)	(12) In your opinion, what **attitudes** do you believe a qualified pharmacist or nurse will need to practise medication safety? (Please give up to 3 examples)	(13) Based on your experience, do you think the time allocated for medication safety at your university is ..... (Please tick one option)
○	○	○	○ Too much
.....	.....	.....	○ Too little
○	○	○	○ Just about right
.....	.....	.....	○ Unsure
○	○	○	
.....	.....	.....	

(14) Please **define medication safety** in your own words (write your answer in the box below)

Please use the box below for any additional comments relating to this section

Part 3: HEALTH PROFESSIONAL EDUCATION IN PATIENT SAFETY SURVEY

IN THE THREE SECTIONS THAT FOLLOW, WE ASK ABOUT PATIENT SAFETY EDUCATION.

SECTION 1: LEARNING ABOUT SPECIFIC PATIENT SAFETY CONTENT AREAS

A) CLINICAL SAFETY: I feel confident in what I learnt about.....	In the classroom						In the clinical setting					
	Strongly agree	Agree	Neutral/ unsure	Disagree	Strongly disagree	Not Applicable	Strongly agree	Agree	Neutral/ unsure	Disagree	Strongly disagree	Not Applicable
1. Safe clinical practice	○	○	○	○	○	○	○	○	○	○	○	○
2. Hand hygiene	○	○	○	○	○	○	○	○	○	○	○	○
3. Infection control	○	○	○	○	○	○	○	○	○	○	○	○
4. Safe medication practices	○	○	○	○	○	○	○	○	○	○	○	○

B) CULTURE OF SAFETY: I feel confident in what I learnt about.....	In the classroom						In the clinical setting					
	Strongly agree	Agree	Neutral/ unsure	Disagree	Strongly disagree	Not Applicable	Strongly agree	Agree	Neutral/ unsure	Disagree	Strongly disagree	Not Applicable
5. The ways in which health care is complex and has much vulnerability (e.g. workplace design, staffing, technology and human limitations)	○	○	○	○	○	○	○	○	○	○	○	○
6. The importance of having a questioning attitude and speaking up when you see things that may be unsafe	○	○	○	○	○	○	○	○	○	○	○	○
7. The importance of a supportive environment that encourages patients and providers to speak up when they have safety concerns	○	○	○	○	○	○	○	○	○	○	○	○
8. The nature of the systems (e.g. aspects of the organization, management or the work environment including policies, resources, communication and other processes) and system failures and their role in adverse events	○	○	○	○	○	○	○	○	○	○	○	○

C) WORKING IN TEAMS WITH OTHER HEALTH CARE PROFESSIONALS: I feel confident in what I learnt about……..

	In the classroom						In the clinical setting					
	Strongly agree	Agree	Neutral/ unsure	Disagree	Strongly disagree	Not Applicable	Strongly agree	Agree	Neutral/ unsure	Disagree	Strongly disagree	Not Applicable
9. Team dynamics and authority / power differences	○	○	○	○	○	○	○	○	○	○	○	○
10. Managing inter-professional conflict	○	○	○	○	○	○	○	○	○	○	○	○
11. De-briefing and supporting team members after an adverse event or near miss	○	○	○	○	○	○	○	○	○	○	○	○
12. Engaging patients as a central participant in the health care team	○	○	○	○	○	○	○	○	○	○	○	○
13. Sharing authority, leadership, and decision-making	○	○	○	○	○	○	○	○	○	○	○	○
14. Encouraging team members to speak up, question, challenge, and advocate and be accountable as appropriate to address safety issues	○	○	○	○	○	○	○	○	○	○	○	○

D) COMMUNICATING EFFECTIVELY: I feel confident in what I learnt about……

	In the classroom						In the clinical setting					
	Strongly agree	Agree	Neutral/ unsure	Disagree	Strongly disagree	Not Applicable	Strongly agree	Agree	Neutral/ unsure	Disagree	Strongly disagree	Not Applicable
15. Enhancing patient safety through clear and consistent communication with patients	○	○	○	○	○	○	○	○	○	○	○	○
16. Enhancing patient safety through effective communication with other health care providers	○	○	○	○	○	○	○	○	○	○	○	○
17. Effective verbal and non-verbal communication abilities to prevent adverse events	○	○	○	○	○	○	○	○	○	○	○	○

E) UNDERSTANDING HUMAN AND ENVIRONMENTAL FACTORS: I feel confident in that I learnt about……

	In the classroom						In the clinical setting					
	Strongly agree	Agree	Neutral/ unsure	Disagree	Strongly disagree	Not Applicable	Strongly agree	Agree	Neutral/ unsure	Disagree	Strongly disagree	Not Applicable
18. The role of human factors such as fatigue, and competence that affects patient safety	○	○	○	○	○	○	○	○	○	○	○	○
19. Safe application of health technology	○	○	○	○	○	○	○	○	○	○	○	○
20. The role of environmental factors such as workflow, ergonomics and resources that affects patient safety	○	○	○	○	○	○	○	○	○	○	○	○

F) RECOGNISE, RESPOND TO AND DISCLOSE ADVERSE EVENTS AND NEAR MISSES: I feel confident in what I learnt about……..	In the classroom						In the clinical setting					
	Strongly agree	Agree	Neutral/ unsure	Disagree	Strongly disagree	Not Applicable	Strongly agree	Agree	Neutral/ unsure	Disagree	Strongly disagree	Not Applicable
21. Recognising an adverse event or near miss	○	○	○	○	○	○	○	○	○	○	○	○
22. Disclosing the adverse event to the patient	○	○	○	○	○	○	○	○	○	○	○	○
23. Participating in timely event analysis, reflective practice and planning in order to prevent recurrence	○	○	○	○	○	○	○	○	○	○	○	○

G) MANAGING SAFETY RISKS: I feel confident in what I learnt about……..	In the classroom						In the clinical setting					
	Strongly agree	Agree	Neutral/ unsure	Disagree	Strongly disagree	Not Applicable	Strongly agree	Agree	Neutral/ unsure	Disagree	Strongly disagree	Not Applicable
24. Recognising routine situations in which safety problems may arise	○	○	○	○	○	○	○	○	○	○	○	○
25. Identifying and implementing safety solutions	○	○	○	○	○	○	○	○	○	○	○	○
26. Anticipating and managing high risk situations	○	○	○	○	○	○	○	○	○	○	○	○

Please note that if you have not had any training in a clinical setting please stop here and feel free to use the box below for any comments

If you are stopping here, thank you for participating in this questionnaire.

Kindly complete sections 2 & 3 if you have had training in a clinical setting please

SECTION 2: HOW BROADER PATIENT SAFETY ISSUES ARE ADDRESSED IN HEALTH PROFESSIONAL EDUCATION

	Strongly agree	Agree	Neutral/unsure	Disagree	Strongly disagree
27. As a student, the scope of what was "safe" for me to do in the practice setting was very clear to me	○	○	○	○	○
28. There is consistency in how patient safety issues were dealt with by different instructors in the clinical setting	○	○	○	○	○
29. I had sufficient opportunity to learn and interact with members of inter-disciplinary or multi-disciplinary teams	○	○	○	○	○
30. I gained a solid understanding that reporting adverse events and 'near miss' can lead to change and can reduce re-occurrence of events	○	○	○	○	○
31. Patient safety was well integrated into the overall degree.	○	○	○	○	○
32. Clinical aspects of patient safety (e.g. hand hygiene, transferring patients and medication safety) were sufficiently covered in our degree	○	○	○	○	○
33. "System" aspects of patient safety were well covered in our programme (e.g. aspects of the organisation, management, or the work environment including policies, resources, communication and other processes)	○	○	○	○	○

SECTION 3: FEELING COMFORTABLE SPEAKING UP ABOUT PATIENT SAFETY EXPERIENCE IN CLINICAL SETTINGS

	Strongly agree	Agree	Neutral/unsure	Disagree	Strongly disagree
34. In clinical settings, discussion around adverse events focuses mainly on system-related issues, rather than focusing on the individual(s) most responsible for the event	○	○	○	○	○
35. In clinical settings, reporting a patient safety problem will result in negative repercussions for the person reporting it	○	○	○	○	○
36. If I see someone engaging in unsafe care practice in the clinical setting I feel safe to approach them	○	○	○	○	○

Dear Participant,

Thank you for taking the time to complete this questionnaire. It is appreciated very much.

My very best wishes for the successful completion of your studies.

Sincerely,

Hind Al Badali
PhD student

Questionnaire Study - Medication Safety Education in the UK

Part 1: DEMOGRAPIC INFORMATION

(1) Current Status	(2) Current year of degree	(3) Previous educational level before starting degree	(4) Age	(5) Gender	Please answer the following questions in relation to your current degree	
					(6) Previous experience working in a clinical setting (hospital, clinic, pharmacy, care home, etc.)	(7) Have you had any experience in a clinical setting as part of your current degree? (whether organised by you or the university)
◯ Pharmacy student ◯ Nursing student	◯ 1st year ◯ 2nd year ◯ 3rd year ◯ 4th year ◯ Other (specify)	◯ GCSEs ◯ A Levels ◯ Diploma – (Please Name) ..... ◯ Bachelor degree ..... ◯ Master degree ..... ◯ Other (specify)	◯ < 20 ◯ 20 – 30 ◯ 31 – 40 ◯ > 40 ◯ Prefer not to say	◯ Female ◯ Male ◯ Prefer not to say	◯ Yes, (specify) – no. of months ..... – Setting ..... ◯ No ◯ Unsure	◯ Yes, (specify) – no. of months ..... – Setting ..... ◯ No ◯ Unsure

Part 2: MEDICATION SAFETY EDUCATION (IN THIS SECTION YOU WILL BE ASKED YOUR PERCEPTIONS ABOUT YOUR EDUCATION)

(1) Is medication safety explicitly taught in your university (clearly labelled as medication safety)?	(2) How is medication safety taught at your university? (Please tick all that apply)
◯ Yes ◯ No ◯ Unsure	◯ **Uni-professionally** *(This is where students learn together as a single group, e.g. pharmacy students or nursing students, and do not learn with or alongside other professional groups)* ◯ **Inter-professionally** *(This is when two or more students from different professional groups learn with, from and about each other to improve collaboration)* ◯ Other (*please specify*).....

(3) What methods are used to teach medication safety at your university? (Please indicate yes or no to all that apply). In addition please rate the effectiveness of each method you indicate yes using a scale of 1 to 5 where 1 is very effective and 5 is completely ineffective.

	Yes	No	Very effective	Effective	Neither satisfied nor dissatisfied	Ineffective	Completely ineffective
Lectures	○	○	1	2	3	4	5
Simulation	○	○	1	2	3	4	5
Role play	○	○	1	2	3	4	5
Case base study	○	○	1	2	3	4	5
Problem based learning (PBL)	○	○	1	2	3	4	5
Interactive (e.g. structured workshop)	○	○	1	2	3	4	5
E-learning / Online courses	○	○	1	2	3	4	5
Observation (e.g. shadowing)	○	○	1	2	3	4	5
Inter-professional learning (IPL)	○	○	1	2	3	4	5
Clinical placement	○	○	1	2	3	4	5
Self-directed learning (e.g. personal research)	○	○	1	2	3	4	5

Based on your answers to question 3, which are the best methods for teaching medication safety? And why?

Please mention any other methods that are not listed in question 3.

Kindly read the definitions given in the box below, and then answer questions 10, 11 and 12.

Knowledge is defined *as facts, information, and skills acquired through experience or education; the theoretical or practical understanding of a subject. (Oxford dictionary)*

Skills are defined as *the ability to do something well; expertise. (Oxford dictionary)*

Attitudes are defined as *a settled way of thinking or feeling about something. (Oxford dictionary)*

(10) In your opinion, what **knowledge** do you believe a qualified pharmacist or nurse will need to practise medication safety? (Please give up to 3 examples)	(11) In your opinion, what **skills** do you believe a qualified pharmacist or nurse will need to practise medication safety? (Please give up to 3 examples)	(12) In your opinion, what **attitudes** do you believe a qualified pharmacist or nurse will need to practise medication safety? (Please give up to 3 examples)	(13) Based on your experience, do you think the time allocated for medication safety at your university is …… (Please tick one option)
○ …… …… ○ …… …… ○ …… ……	○ …… …… ○ …… …… ○ …… ……	○ …… …… ○ …… …… ○ …… ……	○ Too much ○ Too little ○ Just about right ○ Unsure

(14) Please define medication safety in your own words (write your answer in the box below)

Please use the box below for any additional comments relating to this section

Part 3: HEALTH PROFESSIONAL EDUCATION IN PATIENT SAFETY SURVEY

IN THE THREE SECTIONS THAT FOLLOW, WE ASK ABOUT PATIENT SAFETY EDUCATION.

SECTION 1: LEARNING ABOUT SPECIFIC PATIENT SAFETY CONTENT AREAS

A) CLINICAL SAFETY: I feel confident in what I learnt about.....	In the classroom						In the clinical setting					
	Strongly agree	Agree	Neutral/ unsure	Disagree	Strongly disagree	Not Applicable	Strongly agree	Agree	Neutral/ unsure	Disagree	Strongly disagree	Not Applicable
1. Safe clinical practice	○	○	○	○	○	○	○	○	○	○	○	○
2. Hand hygiene	○	○	○	○	○	○	○	○	○	○	○	○
3. Infection control	○	○	○	○	○	○	○	○	○	○	○	○
4. Safe medication practices	○	○	○	○	○	○	○	○	○	○	○	○

B) CULTURE OF SAFETY: I feel confident in what I learnt about.....	In the classroom						In the clinical setting					
	Strongly agree	Agree	Neutral/ unsure	Disagree	Strongly disagree	Not Applicable	Strongly agree	Agree	Neutral/ unsure	Disagree	Strongly disagree	Not Applicable
5. The ways in which health care is complex and has much vulnerability (e.g. workplace design, staffing, technology and human limitations)	○	○	○	○	○	○	○	○	○	○	○	○
6. The importance of having a questioning attitude and speaking up when you see things that may be unsafe	○	○	○	○	○	○	○	○	○	○	○	○
7. The importance of a supportive environment that encourages patients and providers to speak up when they have safety concerns	○	○	○	○	○	○	○	○	○	○	○	○
8. The nature of the systems (e.g. aspects of the organization, management or the work environment including policies, resources, communication and other processes) and system failures and their role in adverse events	○	○	○	○	○	○	○	○	○	○	○	○

C) WORKING IN TEAMS WITH OTHER HEALTH CARE PROFESSIONALS: I feel confident in what I learnt about.....	In the classroom						In the clinical setting					
	Strongly agree	Agree	Neutral/ unsure	Disagree	Strongly disagree	Not Applicable	Strongly agree	Agree	Neutral/ unsure	Disagree	Strongly disagree	Not Applicable
9. Team dynamics and authority / power differences	○	○	○	○	○	○	○	○	○	○	○	○
10. Managing inter-professional conflict	○	○	○	○	○	○	○	○	○	○	○	○
11. De-briefing and supporting team members after an adverse event or near miss	○	○	○	○	○	○	○	○	○	○	○	○
12. Engaging patients as a central participant in the health care team	○	○	○	○	○	○	○	○	○	○	○	○
13. Sharing authority, leadership, and decision-making	○	○	○	○	○	○	○	○	○	○	○	○
14. Encouraging team members to speak up, question, challenge, and advocate and be accountable as appropriate to address safety issues	○	○	○	○	○	○	○	○	○	○	○	○

D) COMMUNICATING EFFECTIVELY: I feel confident in what I learnt about.....	In the classroom						In the clinical setting					
	Strongly agree	Agree	Neutral/ unsure	Disagree	Strongly disagree	Not Applicable	Strongly agree	Agree	Neutral/ unsure	Disagree	Strongly disagree	Not Applicable
15. Enhancing patient safety through clear and consistent communication with patients	○	○	○	○	○	○	○	○	○	○	○	○
16. Enhancing patient safety through effective communication with other health care providers	○	○	○	○	○	○	○	○	○	○	○	○
17. Effective verbal and non-verbal communication abilities to prevent adverse events	○	○	○	○	○	○	○	○	○	○	○	○

E) UNDERSTANDING HUMAN AND ENVIRONMENTAL FACTORS: I feel confident in that I learnt about.....	In the classroom						In the clinical setting					
	Strongly agree	Agree	Neutral/ unsure	Disagree	Strongly disagree	Not Applicable	Strongly agree	Agree	Neutral/ unsure	Disagree	Strongly disagree	Not Applicable
18. The role of human factors such as fatigue, and competence that affects patient safety	○	○	○	○	○	○	○	○	○	○	○	○
19. Safe application of health technology	○	○	○	○	○	○	○	○	○	○	○	○
20. The role of environmental factors such as workflow, ergonomics and resources that affects patient safety	○	○	○	○	○	○	○	○	○	○	○	○

F) RECOGNISE, RESPOND TO AND DISCLOSE ADVERSE EVENTS AND NEAR MISSES: I feel confident in what I learnt about.....	In the classroom						In the clinical setting					
	Strongly agree	Agree	Neutral/ unsure	Disagree	Strongly disagree	Not Applicable	Strongly agree	Agree	Neutral/ unsure	Disagree	Strongly disagree	Not Applicable
21. Recognising an adverse event or near miss	○	○	○	○	○	○	○	○	○	○	○	○
22. Disclosing the adverse event to the patient	○	○	○	○	○	○	○	○	○	○	○	○
23. Participating in timely event analysis, reflective practice and planning in order to prevent recurrence	○	○	○	○	○	○	○	○	○	○	○	○

G) MANAGING SAFETY RISKS: I feel confident in what I learnt about.....	In the classroom						In the clinical setting					
	Strongly agree	Agree	Neutral/ unsure	Disagree	Strongly disagree	Not Applicable	Strongly agree	Agree	Neutral/ unsure	Disagree	Strongly disagree	Not Applicable
24. Recognising routine situations in which safety problems may arise	○	○	○	○	○	○	○	○	○	○	○	○
25. Identifying and implementing safety solutions	○	○	○	○	○	○	○	○	○	○	○	○
26. Anticipating and managing high risk situations	○	○	○	○	○	○	○	○	○	○	○	○

Please note that if you have not had any training in a clinical setting please stop here and feel free to use the box below for any comments

If you are stopping here, thank you for participating in this questionnaire.

Kindly complete sections 2 & 3 if you have had training in a clinical setting please

SECTION 2: HOW BROADER PATIENT SAFETY ISSUES ARE ADDRESSED IN HEALTH PROFESSIONAL EDUCATION

	Strongly agree	Agree	Neutral/unsure	Disagree	Strongly disagree
27. As a student, the scope of what was "safe" for me to do in the practice setting was very clear to me	○	○	○	○	○
28. There is consistency in how patient safety issues were dealt with by different instructors in the clinical setting	○	○	○	○	○
29. I had sufficient opportunity to learn and interact with members of inter-disciplinary or multi-disciplinary teams	○	○	○	○	○
30. I gained a solid understanding that reporting adverse events and 'near miss' can lead to change and can reduce re-occurrence of events	○	○	○	○	○
31. Patient safety was well integrated into the overall degree.	○	○	○	○	○
32. Clinical aspects of patient safety (e.g. hand hygiene, transferring patients and medication safety) were sufficiently covered in our degree	○	○	○	○	○
33. "System" aspects of patient safety were well covered in our programme (e.g. aspects of the organisation, management, or the work environment including policies, resources, communication and other processes)	○	○	○	○	○

SECTION 3: FEELING COMFORTABLE SPEAKING UP ABOUT PATIENT SAFETY EXPERIENCE IN CLINICAL SETTINGS

	Strongly agree	Agree	Neutral/unsure	Disagree	Strongly disagree
34. In clinical settings, discussion around adverse events focuses mainly on system-related issues, rather than focusing on the individual(s) most responsible for the event	○	○	○	○	○
35. In clinical settings, reporting a patient safety problem will result in negative repercussions for the person reporting it	○	○	○	○	○
36. If I see someone engaging in unsafe care practice in the clinical setting I feel safe to approach them	○	○	○	○	○

Dear Participant,

Thank you for taking the time to complete this questionnaire. It is appreciated very much.

My very best wishes for the successful completion of your studies.

Sincerely,

Hind Al Badali
PhD student

Appendix 21: ICREC 16IC3171 JRCO HOD Full approval - Questionnaire Study – from Imperial College London

Imperial College London

Imperial College Research Ethics Committee
Imperial College London
Room 221
Medical School Building
St Marys Campus
London
W2 1PG
Tel: +44 (0)207 594 9484

researchethicscommittee@imperial.ac.uk

Dr Maria Woloshynowych
Imperial College London
Centre for Patient Safety and service Quality
St Marys Campus
London
W2 1PG

21 March 2016

Dear Dr Woloshynowych,

Study Title: A questionnaire study to explore the perceptions of undergraduate pharmacy and nursing students on medication safety teaching in the UK.

ICREC reference: 16IC3171.

The above study was approved by your Head of Department on 02/02/16 and by the Joint Research Compliance Office on the 18/03/16.

Under the Imperial College Research Ethics Committee process, a study that has been reviewed by the Joint Research Compliance Office and Head of Division/Department (or Principal), where no significant ethical issues have been identified in the protocol or ethics application, can be approved without requiring it to go to full committee.

Documents
The documents reviewed were:

- ICREC Application form
- Protocol (v6 16/03/16)
- Sponsorship and Insurance Registration Form
- Questionnaire (v1 01/02/16)
- Participant info sheet (v2 12/02/16)
- Sample survey (v5 25/01/16)
- Email – Manchester University (15/12/15)
- Email – UCL (07/03/16)

Yours sincerely,

[redacted]

Gary Roper,
Head of Regulatory Compliance,
Imperial College London

Appendix 22: Participant Information Sheet - Questionnaire study

Imperial College London

Participant information sheet (version 1.0)

Title: A questionnaire study to explore the perceptions of undergraduate pharmacy and nursing students on medication safety teaching in the UK.

We would like to invite you to take part in a research study. Please take time to read the following information carefully and let me know if anything is at all unclear or if you would like more information. Also please do take time in deciding whether you would like to take part in the study.

What is the purpose of the study?

There have been a number of recommendations over the recent years about medication safety education. This study will focus on exploring the perceptions of undergraduate pharmacy and nursing students on medication safety education. In addition, it will seek to describe the content of medication safety courses currently being taught, and identify the methods used to teach medication safety.

Why have I been chosen?

You have been chosen to participate in this study because you are a student currently studying at a pharmacy or nursing school.

Do I have to take part?

Taking part in this questionnaire study is entirely voluntary and there is no obligation on you to participate. By completing the questionnaire you are indicating that you agree to take part in the study.

What will happen to me if I take part?

You will be sent a link to an electronic version of a questionnaire or will be asked to fill out a hard copy of the questionnaire distributed at your school. After receiving your completed questionnaire the data in the questionnaire will be analysed and checked by the research team.

What I will be asked in the questionnaire?

You will be asked about medication safety issues and your views on medication safety education in general. There are no right or wrong answers. It is your views we are seeking.

What are the possible disadvantages and risks of taking part?

We do not foresee any disadvantages of taking part in the study other than your time. The completion of the questionnaire will take no longer than 20 minutes.

What are the possible benefits to taking part?

There are no direct benefits to you in taking part. However you may benefit from using some of the information, and from positive insights which could improve your own work.

Hind Al Badali (1 February 2016) version 1.0

Imperial College of Science, Technology and Medicine

What if there is a problem?

We do not foresee any problems. However if you have a concern about any aspect of this study, you should inform me or other members of the research team. We will do our best to answer your questions, and you are free to terminate your participation at any time.

Will my taking part in this study be kept confidential?

All information that is collected from the questionnaires will be kept strictly confidential; and will only be used by the research team to analyse the questionnaire. As all questionnaires will be anonymous no-one, including the research team will know who completed which responses. Raw data will not be shown to anyone outside the research team, and the electronic copies and hardcopies will be destroyed as soon as they have been analysed and checked. We may include some information from your questionnaire in any reports and publications arising from this work but neither you nor your school will be identifiable.

What will happen if I don't carry on with the study?

You can stop completing the questionnaire at any time. Incomplete questions will not be included in the analysis.

What will happen to the results of the research study?

The results will be used to make recommendations for education in medication safety, and will be presented in departmental meetings, international conferences and/or peer reviewed journals. All data presented will be anonymous.

Who is funding the research?

The research is part of my PhD study, which is funded by Ministry of Education in K.S.A.

Who has reviewed the study?

This study was reviewed by Imperial College Research Ethical Committee.

Contact details of investigators:

Hind Al Badali h.al-badali10@imperial.ac.uk

Dr Maria Woloshynowych m.woloshynowych@imperial.ac.uk

Professor Bryony Dean Franklin bryony.deanfranklin@imperial.nhs.uk

Appendix 23: Determining sample size of a known population

N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	346
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	354
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	191	1200	291	6000	361
45	40	170	118	400	196	1300	297	7000	364
50	44	180	123	420	201	1400	302	8000	367
55	48	190	127	440	205	1500	306	9000	368
60	52	200	132	460	210	1600	310	10000	370
65	56	210	136	480	214	1700	313	15000	375
70	59	220	140	500	217	1800	317	20000	377
75	63	230	144	550	226	1900	320	30000	379
80	66	240	148	600	234	2000	322	40000	380
85	70	250	152	650	242	2200	327	50000	381
90	73	260	155	700	248	2400	331	75000	382
95	76	270	159	750	254	2600	335	100000	384

*Note: **N** is Population Size, **S** is Sample Size* *Source: Krejcie & Morgan 1970*

Appendix 24: T-test for the pharmacy and nursing students rating of effectiveness of methods in the UK

Independent sample T-test for the pharmacy and nursing students rating of effectiveness of methods in the UK.

Methods	Pharmacy Mean (SD)	Nursing Mean (SD)	*t*	*p*
Lectures	3.35 (1.31)	3.00 (0.90)	0.97	.338
Simulation	3.08 (1.75)	3.20 (1.30)	-0.16	.875
Role play	3.56 (1.50)	2.20 (1.30)	1.82	.085
Case-based study	3.55 (1.60)	3.15 (1.21)	0.80	.447
Problem-based learning	3.53 (1.70)	3.13 (1.25)	0.60	.548
Interactive (workshop)	3.71 (1.30)	3.00 (1.63)	0.96	.351
E learning/online	3.11 (1.20)	3.00 (1.30)	0.21	.837
Observation	3.33 (1.50)	3.20 (1.32)	0.21	.839
Inter-professional learning	3.29 (1.20)	2.33 (1.15)	1.25	.231
Clinical placement	3.50 (1.62)	3.33 (1.64)	0.31	.761
Self-directed learning	3.06 (1.25)	3.15 (1.40)	-0.20	.846

Appendix 25: Chi-square test for rating of effectiveness for pharmacy and nursing students in the UK

Chi-square test was used for pharmacy and nursing students' rating of effectiveness of methods, and rating of effectiveness across year of study in the UK.

Chi-Square test for rating of effectiveness of educational methods across pharmacy and nursing students in the UK.

Educational methods	Pharmacy			Nursing			Chi-Square test	
	Low effective (1 to 3)	High effective (4 to 5)	Total	Low effective (1 to 3)	High effective (4 to 5)	Total	X2	p
Lectures	9	11	20	12	5	17	2.45	.117
Simulation	6	7	13	2	3	5	0.05	.814
Role-play	6	10	16	4	1	5	2.76	.097
Case-based study	8	12	20	8	5	13	1.46	.226
Problem based learning (PBL**)**	6	11	17	5	3	8	1.63	.201
Interactive (workshop)	7	10	17	3	1	4	1.48	.223
E-learning/ online	6	3	9	8	6	14	0.20	.648
Observation	5	4	9	5	5	10	0.06	.809
Inter-professional learning (IPL)	9	5	14	3	0	3	1.51	.218
Clinical placement	8	10	18	9	9	18	0.11	.738
Self-directed learning (research)	10	7	17	7	6	13	0.07	.785

Chi-Square test for rating of effectiveness of educational methods across year of study for pharmacy and nursing students in the UK.

Educational method	Year 1		Year 2		Year 3		Year 4		Total	Total	Chi-Square test	
	I	E	I	E	I	E	I	E	I	E	X^2	*p*
Lectures	5	0	4	9	7	3	5	4	21	16	8.10	**.044**
Simulation	0	2	2	3	3	2	3	3	8	10	2.20	.531
Role-play	2	0	2	3	3	3	3	5	10	11	2.66	.447
Case-based study	1	0	5	7	5	5	5	5	16	17	1.30	.728
Problem- based learning (PBL)	1	0	4	5	3	4	3	5	11	14	1.41	.702
Interactive (workshop)	1	1	2	3	3	2	4	5	10	11	0.46	.927
E-learning /online	2	1	7	3	4	3	1	2	14	9	1.40	.708
Observation	1	0	5	4	2	3	2	2	10	9	1.26	.738
Inter-professional learning (IPL)	1	0	4	0	3	1	4	4	12	5	3.75	.289
Clinical placement	2	1	4	1	7	4	4	4	17	19	3.62	.305
Self-directed learning (research)	1	1	6	5	4	4	6	3	17	13	0.57	.904

I= ineffective, E= effective, year 4 = only for pharmacy programme in the UK

Appendix 26: 'What modules or topics have helped you to understand medication safety?'

'What modules or topics have helped you to understand medication safety?'

The following four tables present modules or topics which include a medication safety component and helped students to understand medication safety topics and include the number of responses per module or topic.

Modules which helped pharmacy students in understanding medication safety in Saudi Arabia

Modules	Responses
Pharmacology	26
Medicinal chemistry	21
Therapeutics*	18
Pharmaceutical care**	10
Pharmacy practice**	9
Communication skills**	4
Microbiology	4
Therapeutic drug monitoring*	3
Drug therapy problems*	3
Medication management services*	3
Introduction to pharmacy**	3
Medication error topics***	3
Medication safety cases/lectures***	3
Hand hygiene***	2
Antibiotics	2
Medication therapy management*	1
Drug management*	1
Emergency medicine*	1
Medication surveillance*	1
Severity assessment*	1
Drug information subjects*	1
Introductory Pharmacy Practice Experiences (IPPE)*	1
Management courses & PPL (pharmaceutical packaging labels)	1
Look-alike sound-alike***	1
Root cause analysis (RCA) + Failure mode and effect analysis (FMEA) (as Quality tools)***	1
Chemotherapy topics	1
Educational methods (Clinical placement (internship), Case base learning (2), Journals and Internet/(YouTube)	5

*therapeutics and therapeutics related topics
**pharmacy practice and pharmacy practice related topics
***medication errors and safety related topics

Modules which helped nursing students in understanding medication safety in Saudi Arabia

Modules	Responses
Pharmacology	47
Fundamentals of nursing	24
Adult 1&2	21
Medication administration	14
Medication rights (5,6 and 10)	14
Medication safety topics	11
Medical-surgical	**7**
Critical-care	**7**
Allergies	4
Calculation	4
Paediatrics	2
Clinical courses	1
Pharmacy practice lab	1
Pharmacotherapy	1
Methods (lectures, simulation, clinical placement, case-based study, role-play, self-directed learning, online courses, video on medication issues and using Apps (e.g. Medscape)).	16

Modules which helped pharmacy students in understanding medication safety in the UK

Modules	Responses
Pharmacy practice	13
Clinical pharmacology & therapeutics	7
Pharmaceutical care	7
The role of the pharmacist in professional practice	4
Therapeutics	3
Clinical & professional pharmacy	2
Medicine, design and manufacture	2
Patient safety	1
Public health for pharmacists	1
Drug information resources (e.g. manuals)	1
Educational methods	5
Others (Design, Formulation and Quality Assurance of Medicinal Products (PH3114), Medicinal analysis and aseptic control, Making safe and effective medicines)	3

Modules which helped nursing students in understanding medication safety in the UK

Modules	Responses
Medication management	6
Safe Medicate	6
Pharmacology	3
Medication administration	1
Calculation	1
Drug information & resources	1
Medication 5-Rights	1
Methods (lectures, clinical placement, case-based study, self-directed learning, E-learning/online courses)	3
Other (Mental health nursing, Anatomy and physiology)	2

Appendix 27: 'What knowledge do you believe a qualified pharmacist and nurse will need to practise medication safety?'

The following four tables presents knowledge needed to practise medication safety and the number of responses per category.

Knowledge needed as perceived by pharmacy students in Saudi Arabia

Knowledge	Response
Pharmacology	55
Therapeutics	31
Medication errors & safety topics	21
Drug-drug interaction*	14
Medication system & policy	7
Drug information	6
Drug-food interaction*	5
5-Rights	3
Anti-dotes*	3
Pharmacokinetics*	2
Pharmaceutical care	2
Patient care	2
Drug-lab interaction*	1
Others (1-Soft skills knowledge, 2-Self-reading scheduled lectures	2

*Pharmacology related topics

Knowledge needed as perceived by nursing students in Saudi Arabia

Knowledge	Response
Pharmacology	58
Calculation	21
Medication rights (5 rights = 14, 6 rights = 1, 10 rights = 6)	21
Medication errors and safety topics (including double checking and medicine disposal)	18
Therapeutics	10
Patient education	4
Medication administration technique	3
Drug information and resources	3
Others (online courses, patient rights, information and practice skills)	3

Knowledge needed as perceived by pharmacy students in the UK

Knowledge	Response
Pharmacology	13
Therapeutics	11
Medication errors topics	6
Medication safety topics	6
Medication preparation, administration and dispensing	2
Drug information & resources	2
Pharmacy practice	1
Patient counselling	1
Patient care	1
Other (labelling and packaging)	1

Knowledge needed as perceived by nursing students in the UK

Knowledge	Response
Pharmacology	16
Medication administration technique	5
Therapeutics	4
Medication errors topics and reporting	3
Drug information and resources (BNF)	3
Medication 5-Rights	2
Patient care	1

Appendix 28: 'What skills do you believe a qualified pharmacist and nurse will need to practise medication safety?'

Skills needed as perceived by pharmacy students in Saudi Arabia

Skills	Response
Communication skills	36
Critical thinking*	17
Medication safety topics (including double checking)	12
Medication preparation, administration and dispensing skills	10
Clinical judgment and reasoning*	9
Problem solving skills*	5
Patient care skills	5
Drug information	4
Patient education	3
Therapeutics	3
Pharmacology	3
Professionalism	2
Medication system & policy	2
Calculation skills	1
Teamwork	1
Personal skills (Sociability, Fast learning and to be a good learner, Accuracy and honesty, Leadership)	6
Other (educational methods, knowledge application and CPR)	7

*Decision making skills

Skills needed as perceived by nursing students in Saudi Arabia

Skills	Response
Medication administration skills	37
Communication skills	33
Calculation skills	21
Critical thinking*	10
Safety related issues (including double checking)	6
Clinical judgment*	3
Re-assessment	3
Legible hand writing	3
Labelling	3
Pharmacology (Anti-dotes)	3
Clinical reasoning *	2
Medication errors	2
Teamwork	2
Problem solving skills*	1
Others (self-learning, co-operation, how to deal with patient age and gender problems, knowledgeable, be focused during medication preparation)	5

*Decision making skills

Skills needed as perceived by pharmacy students in the UK

Skills	Response
Medication preparation, administration and dispensing skills	7
Communication skills	6
Medication errors	5
Safety related issues (including double checking)	4
Patient education and counselling	4
Drug information and resources and research skills	4
Attention to details and critical thinking*	3
Calculation skills	2
Teamwork	2
Clinical skills	2
Reflection	2
Listening skills	1
Patient care skills	1
Problem solving skills*	1
Other (Organisational skills, good arithmetic, good memory, efficient working practices and confidence to question)	4

*Decision making skills

Skills needed as perceived by nursing students in the UK

Skills	Response
Medication administration skills	8
Calculation skills	5
Medication safety topics	4
Confidence (as attitude)	3
Personal attitudes (competent, concentrate, avoid distraction and clear focus)	3
Communication skills	2
Medication management and process	1
Clinical assessment	1
Inter-personal skills	1
Diagnostics skills	1
Other (organisation experience)	1

Appendix 29: What attitudes do you believe a qualified pharmacist and nurse will need to practice medication safety?

The following four tables' presents attitudes needed to practise medication safety and the number of responses per category.

Attitudes needed as perceived by pharmacy students in Saudi Arabia

Attitudes	Response
Medication errors topics (including double checking) *	8
Questioning attitude	7
Professionalism	7
Assertiveness	7
Patient care and education	7
Responsibility	6
Medication safety attitude	6
Confidence	6
Calm and friendly	4
Ethics	4
Awareness (Self-awareness, Awareness of ethical and legal responsibility)	3
Teamwork	3
Good communication	3
Reporting errors and learning from errors*	3
Good spirit and good attitude	3
Hard working	2
Speaking up	2
Accountability	2
Just-culture*	2
Error disclosure*	1
Additional personal attitudes (Wise, Efficient/Fast, Willingness, Respect, Punctuality, Optimism, Objectivity, Honest, Equality, Cooperative, Collaboration)	10
Other (Stay updated, search for knowledge and read more (*self-development*), Practice change, Decision making skills and Critical thinking skills)	4

*Medication safety related issues

Attitudes needed as perceived by nursing students in Saudi Arabia

Attitudes	Response
Reporting of medication errors, learning from errors and admitting errors	20
Listening and tolerance towards patient	17
Calm and friendly	12
Questioning attitude and speaking up	10
Double checking	8
Communication with patient, sitter and colleagues, error disclosed to patient	5
Confidence	5
Following infection control policy and doing allergy test	5
Patient care	4
Co-operative	3
Patient identification	2
Teamwork	2
Professionalism	1
Other (Truthful, respectful, Need to know about ethics, Decision making skills, Critical thinking skills, Always want to learn)	6

Attitudes needed as perceived by pharmacy students in the UK

Attitudes	Response
Patient-centred care and patient safety	9
Calm, friendly and patient	4
Up to learning and improving and up to date	3
Positive	3
Responsibility and accountability	2
Honest	2
Respectful	2
Questioning attitude and speaking up	1
Professionalism	1
Confidence	1
Other (Thoroughness and enthusiasm, good attitude towards doing clinical checks efficiently, able to recognise the importance of medication safety, interest, self-awareness, reflective, impartial, diligent, helpful, understanding, authoritative, mindful, focused, hard-working, passionate, ensuring everything is followed correctly (adherence), competence, compassion , trustworthy)	20

Attitudes needed as perceived by nursing students in the UK

Attitudes	Response
Confident and competent	5
Admit errors and learn from errors	3
Communication with patient, sitter and colleagues	3
Careful and cautious	2
Questioning attitude and speaking up	1
Ask for help and support	1
Listening to patient	1
Openness	1
Professionalism	1
Calm and relaxed	1
Double checking (MS)	1
Teamwork attitude	1
Medication management	1
Allergy (MS)	1
Other (Reassurance, Flexible attitudes, Not be arrogant, Honesty, Approachable, Assertive, Determined, Hardworking, Patient, Organised, Encourage more self-care, follow duty of candour, Continual focus on quality and safety)	13

Appendix 30: Definition medication safety

The following four tables provide various definitions of medication safety as perceived by pharmacy and nursing students and the number of responses per definition category/theme in addition example definitions will be presented for each definition category or theme.

Definition of medication safety by pharmacy students in Saudi Arabia

Definition category/theme	Response	Example of definition
Safe use	18	*"the **use of medication in safe** way"* *"Appropriate and **safe use** of medication in all steps to ensure positive patient outcome and decrease incidence of adverse effects"*
Harm	15	*"using medication with less possible **harm**"* *"do no **harm** to the patient"*
Prevention of errors	13	*"should **prevent** any unexpected errors"*
Side effects	12	*"Minimise the **side effect**"* *"best use of medication with lower side effects"*
Five rights of medication administration (right patient, medication, dose, route and time)	8	*"doing the five rights; right dose, time, patient, medication and route"*
Semi-Five rights (mentioning some parts of the definition)	6	*"administrate medication to right patient, at the right time, right dose"*
Unclear or wrong definition	3	*"Medication safety is unexpected or undesirable health situation that happen to the patient"* *"usual problem that pharmacists face"*
Efficiency and Safety	2	*"using of medication **efficiently and safely**"*
Reducing errors	1	*"is about **reducing** medication errors"*

Definition category/theme	Response	Example of definition
Other (**(1)** To have knowledge about medication, **(2)** the best medication plan for each case and patient. **(3)** Skills and attitudes that the one should gain to reduce medication errors, and increase patient safety and quality of life. **(4)** Maximise medication benefits to patient. **(5)** Managing the drug, Knowing the correct dose and antidotes. **(6)** Knowing the correct dose, adverse effects, indications, and contraindications of a drug and the extent of danger of the drug with the disturbance of each/all of them. **(7)** It's the errors that may occur in the practice. **(8)** And the strategies to avoid and overcome them. **(9)** It is a technique of ensuring that medication given appropriately to the patient as prescribed. **10)** How to manage errors.)	10	*The examples are presented in definition category/theme column*

Definition of medication safety by nursing students in Saudi Arabia

Definition category	Response	Example of definition
Five rights of medication administration (*right patient, medication, dose, route and time*)	38	"*protecting patient from medication errors by applying **5-Rights**"* *"give the right medication to right patient in right route, dose and time"* *"administer medication safely using **5-Rights**"*
Harm	16	"administer medication safely to patient without causing **harm**" ….. "do no **harm** to patient"
10-Rights (6-rights + history and assessment, drug approach and right to refuse, drug-drug interaction and evaluation, education and information)	11	*"administer the medication without making errors following the **10-Rights**"*
6-Rights (*5-rights + documentation*)	9	"*follow the **6-Rights** when giving medication"*
Safe use, correct and effective	9	*"it is how to use medication **correctly** and **effectively** in right and **safe way** without side effect"*
Prevention of errors	6	*"**prevent** reoccurrence of errors" ….. "instruction to **prevent** any error or complication related to any medication*"
Reducing errors	4	*"is to **reduce** medication error" …. "**decrease** errors of given medication"*
Semi-Five rights (mentioning some parts of the definition)	3	*"giving the right medication to the right patient with minimum errors"*
Side effects and contra-indication	3	*"it is how to use medication correctly and effectively in right and safe way without **side effect**"*
No errors	3	*"administration of medication **without an error**"*
Allergy	2	*"check allergy"*
Other (the process and behaviour for managing of medication administration, it is the specific steps or rights of patient that we should follow during preparing and giving the medication to him)	*2*	*The examples are presented in definition category/theme column*

Definition of medication safety by pharmacy students in the UK

Definition category/theme	Response	Example of definition
Harm	12	"*Minimising **harm** to the patient".* *"The use and dispensing of medicines **without harm** coming to the patient or others".* *"Ensuring that **no harm** is done to patients due to incorrect medications being administered or dispensed, and minimising any damage and errors that may have occurred"*
Semi-Five rights (mentioning some parts of the definition)	7	*"Medication safety is ensuring that medicines get to the right patient, with the right medicine, at the right dose, at the right time".* *"The safe and effective practice of making sure the medicines prescribed for a patient are the right drug, dose, at the right time".*
Safe use, effective	7	*"The **safe** and **effective** practice of making sure the medicines prescribed for a patient are the right drug, dose, at the right time".* *"Ensuring the **safe use** of medicines"*
Pharmacology terms (side effects and interactions)	5	*"Use and monitor for **side effects** for medications correctly causing the least amount of harm".*
Therapeutics and clinical pharmacy practices	3	*"medicines are effectively **monitored"***
Patient counselling	3	*"patients given correct counselling on the use of their medicines"*
Prevention of errors	2	***"preventing** harm caused to patients by medicine"*
Reducing errors	2	*Medication safety is the collective efforts of staff and patients to try and **reduce the risks** of harm caused by medication errors, This can include: dispensing the wrong drug/dose/form/strength"*
Patient-centred care.	2	*"give the patient **maximum care** as you can by give him right medication with right advice and right **seamless care"***
Patient adherence and compliance	1	*"patient **adherence** and **compliance** to their treatment"*
Other (**Optimising** and maintaining the way patients use their medications **Identifying allergies** and patients with **high risk medicines** in order to ensure the best treatment)	2	*The examples are presented in definition category/theme column*

Definition of medication safety by nursing students in the UK

Definition category/theme	Response	Example of definition
Safe use, correct and effective	11	*"Medication safety is the notion of being able to **safely**, **correctly** and **effectively**"* *"Prescribe/administer medication for a patient ensuring all medication given is **correct** and **safe** at all times"* *"Assuring medication is given to patients in a **safe**, **accurate** and **effective** way".*
Pharmacology terms	4	*"Medication safety is being aware of **correct doses**, **interactions**, **side effects** and purpose of drugs".* *"It is a combination of **pharmacology knowledge** combined with skills gained via practising with a suitable mentor".*
Semi-Five rights (mentioning some parts of the definition)	3	*"Looks at giving the right drug, in the right form and dose, to the right patient at the right time"*
Prevention of errors	3	*"To **prevent** drug errors".*
Patient education and counselling	3	*"Patients have **knowledge of the medication** they are being given".* *"give **patient advice** about medications"*
Allergy	3	*"They do not have an **allergy** to the drug"*
Five rights of medication administration (*right patient, medication, dose, route and time*)	2	*"Constantly being aware of the **5-Rights** to prevent drug errors".*
Therapeutics	2	*"Knowing enough about the **condition being treated**, the current meds being taken, current guidelines about recommended treatment"*
Patient-centred	2	*"To give a medication to a patient the safest way possible using a **patient- centred approach** for their needs"*
Medication errors	2	*"Being able to spot **medication errors"**.*

Definition category/theme	Response	Example of definition
Medication use process***	2	*"Looks at how drugs are prescribed, stored, prepared and delivered to patients"*
10-Rights (*6-rights plus history and assessment, drug approach and right to refuse, drug-drug interaction and evaluation, education and information*)	1	*"It involves giving the right drug to the right patient the right dose at the right time in the right form. It requires competency of drawing up, calculating and successfully ensuring the patient has taken the medication and if they haven't taken it documenting this. It also involves recording medications taken and refused by patients, correctly responding to drug errors and being able to understand medication charts".*
Harm	1	*"A situation of being protected from or unlikely to cause danger, risk or **harm"***
Reducing or minimising errors	1	***"minimising** risk"*
No errors	1	*"The ability to prescribe medications **without error"**.*
Double checking	1	*"Two nurses **checking medications** known as controlled medications such as Morphine"*

***The medication use process is the outline of the steps involved in providing medications to patients (prescribing, dispensing) and what happens after the medication is administered (monitoring)