Exploring the Acceptability of Frugal Innovation at the Individual Level within the NHS

Chandni N Hindocha

Imperial College London, School of Public, Department of Primary Care and Public Health, Faculty of Medicine

Submitted for the Degree of Doctor of Philosophy

Statement of Originality

I, Chandni N Hindocha confirm that the work presented in this thesis is my own. Information that has been derived from other sources has been indicated in the thesis in forms of references.

_____ _____

Chandni N Hindocha Date

Copyright Declaration

The copyright of this thesis rests with the author. Unless otherwise indicated, its contents are licensed under a Creative Commons Attribution-Non Commercial 4.0 International Licence (CC BY-NC). Under this licence, you may copy and redistribute the material in any medium or format. You may also create and distribute modified versions of the work. This is on the condition that: you credit the author and do not use it, or any derivative works, for a commercial purpose. When reusing or sharing this work, ensure you make the licence terms clear to others by naming the licence and linking to the licence text. Where a work has been adapted, you should indicate that the work has been changed and describe those changes. Please seek permission from the copyright holder for uses of this work that are not included in this licence or permitted under UK Copyright Law.

Table of Contents

Chapter 1: Introduction 20
1.1 Frugal Innovation 20
1.1.1 Origins of FI 20
1.1.2 Principles of FI 21
1.1.3 A Critical Review of Conceptualising FI 23
1.1.3.1 Aim of Review 24
1.1.3.2 Defining FI 25
1.1.3.3 'BOP Innovation' 26
1.1.3.4 'Good-Enough Innovation' 27
1.1.3.5 'Doing More with Less' 27
1.1.3.6 'Resource Scarcity' 28
1.1.3.7 'Sustainable Innovation' 28
1.2 Identifying FI 31
1.3 The Diffusion Challenge for FIs 35
1.4 Reverse Innovation 38
1.4.1 Origins of RI 38
1.4.2 Principles of RI 38
1.4.3 Has the NHS Adopted FI? 39
1.4.4 Successful Examples of RI 43
1.5 Towards An Inclusive View of FI 43
1.6 Next Steps for Policy, Practice and Research 45
1.7 Conclusion 46
1.8 Rationale for the Study 47
1.8.1 Aims and Objectives 48
Chapter 2: Theoretical Background 49
2.1 The Consumer Decision-Making Process 49
2.2 The Country of Origin (COO) Effect 50
2.2.1 COO Cues 51
2.2.2 COO Effect on Consumer Behaviour 51
2.2.3 COO Dimensions (Cognitive, Affective and Normative) 53
2.2.4 Practical Context of the COO Effect 59
2.3 Application of Theories of Acceptability 60
2.3.1 What is Acceptability? 60
2.3.2 Acceptability Factors of FI 61
2.4 Acceptability Models (Theory and Application) 62

2.4.1 Diffusion of Innovation Theory (DOI) 63
2.4.2 Theory of Reasoned Action (TRA) 66
2.4.3 Theory of Planned Behaviour (TPB) 71
2.4.4 Reasoned Action Approach – Integrative Model (RAA-IM) 74
2.4.5 Theory of Interpersonal Behaviour (TIB) 77
2.4.6 Social Cognitive Theory (SCT) 81
2.5 Key Acceptability Model 86
2.5.1 Using SCT to Explore Acceptability of FI 86
2.5.2 Core Principles of the SCT 86
2.5.3 Why Choose SCT to Explore Acceptability? 87
2.5.4 SCT in Exploring Healthcare Behaviours 88
2.5.5 Application of SCT in Healthcare 89
Chapter 3: Methodology 99
3.1 Conceptualisation of Risk 99
3.2 Risk Assessment Models 101
3.3 Components of Risk Assessment 102
3.4 Sentiment Analysis Techniques 110
3.4.1 Deep Learning Approach 111
3.4.2 Rule-Based Approach 111
3.4.3 Lexicon-Based Approach 112
3.5 Sentiment Analysis Methods 114
3.6 Chosen Examples of FI for Presentation 115
3.7 Study Design 119
3.8 Factorial Design 119
3.9 Setting 120
3.10 Study Population 121
3.11 Eligibility Criteria 121
3.11.1 Patient Representatives 121
3.11.2 NHS Staff 121
3.12 Recruitment Strategy and Consent Procedures 122
3.12.1 Patient Representatives 122
3.12.2 NHS Staff 122
3.13 Data Collection 124
3.14 Ethics Approval 126
3.15 Analysis of Qualitative Interviews: SCT, COO Effect, TA, CA and SA 126
3.16 Epistemological and Ontological Position 130
3.17 Reflexivity 132
Participant Descriptive Results 135

Chapter 4: Results for Sayeba's Method 137
4.1 Group A (Frugal and COO) 137
4.1.1 Patient Representatives 137
4.1.1.1 Risk 137
4.1.1.2 Design 138
4.1.1.3 Cost 138
4.1.1.4 Useability 139
4.1.1.5 Clinical Effectiveness 139
4.1.1.6 Shared Decision-Making 140
4.1.2 NHS Staff 141
4.1.2.1 Risk 141
4.1.2.2 Design 141
4.1.2.3 Cost 142
4.1.2.4 Useability 142
4.1.2.5 Clinical Effectiveness 142
4.1.2.6 Shared Decision-Making 143
4.2 Group B (Only Frugal) and C (Only COO) 143
4.2.1 Patient Representatives 143
4.2.1.1 Risk 143
4.2.1.2 Design 144
4.2.1.3 Cost 144
4.2.1.4 Useability 145
4.2.1.5 Clinical Effectiveness 146
4.2.1.6 Shared Decision-Making 147
4.2.2 NHS Staff 147
4.2.2.1 Risk 147
4.2.2.2 Design 148
4.2.2.3 Cost 149
4.2.2.4 Useability 150
4.2.2.5 Clinical Effectiveness 151
4.2.2.6 Shared Decision-Making 151
4.3 Group D (No Frugal and No COO) 152
4.3.1 Patient Representatives 152
4.3.1.1 Risk 152
4.3.1.2 Design 153
4.3.1.3 Cost 153
4.3.1.4 Useability 154
4.3.1.5 Clinical Effectiveness 155

4.3.1.6 Shared Decision-Making 156
4.3.2 NHS Staff 156
4.3.2.1 Risk 156
4.3.2.2 Design 157
4.3.2.3 Costs 157
4.3.2.4 Useability 158
4.3.2.5 Clinical Effectiveness 158
4.3.2.6 Shared Decision-Making 159
Summary 159
Chapter 5: Results for Mosquito Net Mesh 162
5.1 Group A (Frugal and COO) 162
5.1.1 Patient Representatives 162
5.1.1.1 Risk 162
5.1.1.2 Design 163
5.1.1.3 Cost 164
5.1.1.4 Useability 165
5.1.1.5 Clinical Effectiveness 165
5.1.1.6 Shared Decision-Making 166
5.1.2 NHS Staff 167
5.1.2.1 Risk 167
5.1.2.2 Design 168
5.1.2.3 Cost 168
5.1.2.4 Useability 168
5.1.2.5 Clinical Effectiveness 169
5.1.2.6 Shared Decision-Making 169
5.2 Group B (Only Frugal) and Group C (Only COO) 170
5.2.1 Patient Representatives 170
5.2.1.1 Risk 170
5.2.1.2 Design 171
5.2.1.3 Cost 172
5.2.1.4 Useability 173
5.2.1.5 Clinical Effectiveness 174
5.2.1.6 Shared Decision-Making 175
5.2.2 NHS Staff 175
5.2.2.1 Risk 175
5.2.2.2 Design 176
5.2.2.3 Cost 177
5.2.2.4 Useability 178

5.2.2.5 Clinical Effectiveness 178
5.2.2.6 Shared Decision-Making 179
5.3 Group D (No Frugal and No COO) 180
5.3.1 Patient Representatives 180
5.3.1.1 Risk 180
5.3.1.2 Design 181
5.3.1.3 Cost 181
5.3.1.4 Useability 182
5.3.1.5 Clinical Effectiveness 182
5.3.1.6 Shared Decision-Making 183
5.3.2 NHS Staff 183
5.3.2.1 Risk 183
5.3.2.2 Design 184
5.3.2.3 Cost 184
5.3.2.4 Useability 185
5.3.2.5 Clinical Effectiveness 186
5.3.2.6 Shared Decision-Making 186
Chapter 6: Results for Arbutus Drill Cover System 189
6.1 Group A (Frugal and COO) 189
6.1.1 Patient Representatives 189
6.1.1.1 Risk 189
6.1.1.2 Design 191
6.1.1.3 Cost 192
6.1.1.4 Useability 193
6.1.1.5 Clinical Effectiveness 194
6.1.1.6 Shared Decision-Making 195
6.1.2 NHS Staff 195
6.1.2.1 Risk 195
6.1.2.2 Design 196
6.1.2.3 Cost 197
6.1.2.4 Useability 198
6.1.2.5 Clinical Effectiveness 198
6.1.2.6 Shared Decision-Making 199
6.2 Group B (Only Frugal) and Group C (Only COO) 199
6.2.1 Patient Representatives 199
6.2.1.1 Risk 199
6.2.1.2 Design 201
6.2.1.3 Cost 202

6.2.1.4 Useability 203
6.2.1.5 Clinical Effectiveness 203
6.2.1.6 Shared Decision-Making 204
6.2.2 NHS Staff 205
6.2.2.1 Risk 205
6.2.2.2 Design 206
6.2.2.3 Cost 206
6.2.2.4 Useability 207
6.2.2.5 Clinical Effectiveness 208
6.2.2.6 Shared Decision-Making 208
6.3 Group D (No Frugal and No COO) 209
6.3.1 Patient Representatives 209
6.3.1.1 Risk 209
6.3.1.2 Design 209
6.3.1.3 Cost 210
6.3.1.4 Useability 210
6.3.1.5 Clinical Effectiveness 211
6.3.1.6 Shared Decision-Making 211
6.3.2 NHS Staff 212
6.3.2.1 Risk 212
6.3.2.2 Design 212
6.3.2.3 Cost 213
6.3.2.4 Useability 214
6.3.2.5 Clinical Effectiveness 214
6.3.2.6 Shared Decision-Making 214
Chapter 7: Synthesis Chapter 218
Sentiment Analysis Results – All Groups (A-D) 219
7.1 Trends Between Groups A and D 222
7.1.1 Understanding of FI 222
7.1.2 Association Between Cues and Criticism 224
7.1.3 Structural Changes in Expression 226
7.1.4 COO Effect on the FI Name 228
7.1.5 Country Affinity and Animosity 228
7.1.6 HIC Endorsement Effect 229
7.1.7 Presumed COO Effect 229
7.2 Trends Between Invasiveness of Innovations 233
7.2.1 Degree of Risk and Acceptance 233
7.2.2 The COO Effect on Risk 234

7.2.3 Risk Perceptions Through Observed Learning 237
7.2.4 COO Effect on Clinical Evidence Perceptions 238
7.2.5 Demographics and Perception Development 242
7.3 Trends Between Responses from Patient Representatives and NHS Staff 244
7.3.1 Differences in Narrative Processing and Transitions 244
7.3.2 The Criticism Response to External Cues 246
7.3.3 Communication Changes to External Cues 248
7.3.4 Response Formation to External Cues 250
7.3.5 COO Effect Through the TRD Model 251
Chapter 8: Discussion 257
8.1 Summary of Key Findings 259
8.1.1 Trends Between Groups A and D 259
8.1.2 Trends Between Invasiveness of Innovations 260
8.1.3 Trends Between Responses from Patient Representatives and NHS Staff 262
8.2 Contributions and Implications of Findings 264
8.3 Strengths, Challenges and Limitations of this Study 273
8.3.1 Strengths of this Study 273
8.3.2 Challenges of the Study 275
8.3.3 Limitations of the Study 278
8.4 Future Research on Acceptability of FI 280
Chapter 9: Conclusion 289
References 292

List of Appendices

Appendix 1: Critical Review 331
Appendix 2: Risk Assessment of FI Candidates 341
Appendix 3: Participant Information Sheet – NHS Staff 343
Appendix 4: Participant Information Sheet – Patient Representatives 347
Appendix 5: Consent Form – NHS Staff 351
Appendix 6: Consent Form – Patient Representatives 352
Appendix 7: Case Report Form (CRF) A – NHS Staff 353
Appendix 8: Case Report Form (CRF) B – Patient Representatives 360
Appendix 9: Ethics Approval 367
Appendix 10: Data Coding Tree 368

List of Tables

Table 1: Definitions of Frugal Innovation* 29
Table 2: Commonly Associated Characteristics Coded within Definitions of FI* 31
Table 3: Classification of Consequences* 106
Table 4: Comparison of Different Sentiment Analysis Approaches 113
Table 5: Allocation of Presentation Groups for Patient Representatives 120
Table 6: Allocation of Presentation Groups for NHS Staff 120
Table 7: Demographics of Participants 135
Table 8: Comparative Sentiment Scores for Group A (COO & Frugal) 220
Table 9: Comparative Sentiment Scores for Group B (Frugal Only) 220
Table 10: Comparative Sentiment Scores for Group C (COO Only) 220
Table 11: Comparative Sentiment Scores for Group D (No COO & Frugal) 220
Table 12: Comparative Sentiments of Invasiveness for Group A 241
Table 13: Comparative Sentiments of Invasiveness for Group B 241
Table 14: Comparative Sentiments of Invasiveness for Group C 241
Table 15: Comparative Sentiments of Invasiveness for Group D 242
Table 16: Mean Positivity for Patient Representatives in Group A (All Innovations) 283
Table 17: Mean Positivity for Patient Representatives in Group D (All Innovations) 284
Table 18: Estimated Sample Size for Patient Representatives at 0.05 Probability (All Innovations) 284
Table 19: Mean Positivity for NHS Staff in Group A (All Innovations) 284
Table 20: Mean Positivity for NHS Staff in Group D (All Innovations) 285
Table 21: Estimated Sample Size for NHS Staff at 0.05 Probability (All Innovations) 285
Table 22: Mean Positivity for Patient Representatives in Group A – Sayeba's Method 285
Table 23: Mean Positivity for Patient Representatives in Group A - Mosquito Net Mesh 285
Table 24: Mean Positivity for Patient Representatives in Group A – Arbutus Drill Cover System 286
Table 25: Mean Positivity for Patient Representatives in Group D – Sayeba's Method 286
Table 26: Mean Positivity for Patient Representatives in Group D - Mosquito Net Mesh 286
Table 27: Mean Positivity for Patient Representatives in Group D - Arbutus Drill Cover System 287
Table 28: Mean Positivity for NHS Staff in Group A – Sayeba's Method 287
Table 29: Mean Positivity for NHS Staff in Group A - Mosquito Net Mesh 287
Table 30: Mean Positivity for NHS Staff in Group A - Arbutus Drill Cover System 287
Table 31: Mean Positivity for NHS Staff in Group D - Sayeba's Method 288
Table 32: Mean Positivity for NHS Staff in Group D - Mosquito Net Mesh 288

Table 33: Mean Positivity for NHS Staff in Group D - Arbutus Drill Cover System 288
Table 34: Estimated Sample Sizes for All Three Innovations for Patient Representatives (Groups A vs Group D) at 0.05 Probability 288

List of Figures

Figure 1: Diffusion of Innovation (DOI) Theory (Rogers, 2003) 64
Figure 2: Model of Theory of Reasoned Action (TRA) (Rahimi and Jetter, 2015) 70
Figure 3: Model of Theory of Planned Behaviour (TPB) (Albarracin et al., 2001) 72
Figure 4: Integrative Model (IM) on the Reasoned Action Approach (RAA) (Becker and Gibson, 1998) 74
Figure 5: Tri-Level Theory of Interpersonal Behaviour (TIB) (Taherdoost, 2018) 78
Figure 6: Model of Social Cognitive Theory (SCT) (Claybourn, 2011) 82
Figure 7: A Quantitative Guide to Likelihood Scoring* 104
Figure 8: A Qualitative Guide to Likelihood Scoring* 105
Figure 9: Stages of Sentiment Analysis 109
Figure 10: Different Approaches and Stages of Sentiment Analysis 110
Figure 11: Stages of Our Sentiment Analysis 115
Figure 12: Potential Recruitment of NHS Staff 124
Figure 13: Brief Schema of the Study Process 125
Figure 14: Brief Scheme of Data Collection 126
Figure 15: Comparative Tokens with Polarity Scores 226

Abstract

Background

Frugal innovation (FI) aims to create cost-effective solutions for resource-constrained consumers. FIs could give significant possibilities for cost reduction, sustainability, and accessibility, particularly in advanced healthcare systems such as the United Kingdom's National Health Service (NHS), which are suffering rising expenditures. However, there are impediments to their acceptability, such as implicit negative perceptions towards the term frugality and toward innovations conceived in low-income countries.

The purpose of this study was to investigate the perceptions and challenges to the acceptance of FI at the individual level within the NHS.

Methods

This study used a qualitative factorial design with 60 participants (30 patient representatives and 30 NHS staff), separated into four groups based on exposure to two cues: country of origin (COO) and frugality. Three FIs, varying in invasiveness and risk, were used as examples and participants' attitudes were evaluated using Social Cognitive Theory to identify factors influencing the acceptability of FI. Sentiment analysis was used to provide quantitative rigour to responses.

Results

The findings revealed significant trends: the term 'frugality' generally worsened people's perceptions of FIs, but the term 'innovation' improved them. COO had a significant impact whilst at times facilitated primary perceptions of FI and was frequently criticised. Patient representatives in Group A (received both cues) were more critical of the FIs than Group D (received no cues). Furthermore, differences were noted between the responses of patient representatives and NHS staff, with the former generally more openly critical and expressive.

Discussion

It appears that COO and frugality are important elements in comprehending and increasing acceptance of FI. The findings emphasise the importance of such innovations when presenting them to organisations and populations in a high-income country. We recommend future exploration of a system-wide perspective of FI in healthcare and awareness and training in NHS practices towards FI.

Acknowledgements

Firstly, I would like to thank God for giving me faith and strength and my family (Mum, Dad, Puja, Sandeep, Roshni, and my grandparents) to which without them I would never have had the opportunity to chase my dream in doing a PhD. I thank you for your endless support, everlasting optimism, encouragement, venting sessions and the never give up talks which I will never forget and always depended on. Because of your love and support, I got to live my dream and I dedicate this thesis to you all. "*Whatever happened, happened for the good. Whatever is happening, is happening for the good. Whatever will happen, will also happen for the good.*" (Bhagavad Gita)

I would also like to thank Matt Harris and Laura Lennox for giving me the chance to make my dream a reality in choosing me as your PhD student, which I still to this very day, am incredibly grateful and will never forget that one very special interview that led me here today. Thank you to my supervisors, Matt, Grazia Antonacci and James Barlow for your endless support and guidance both personally and professionally, several iterations, endless encouragement, wild ideas, and optimism. You all have given me the courage to challenge myself and everything, making me a better person and researcher. Your advice and feedback have been invaluable and your enthusiasm for the project gave me more motivation to keep going. I always said from the very first day of my PhD, I truly have the dream team, this was the best academic and PhD experience any student could dream of and I consider myself incredibly lucky and blessed.

Not only has this PhD provided me with a dream supervisory team, but also a work family and that is the Innovation and Evaluation (I&E) team: Matt, Grazia, Laura Lennox, Mark Skopec, Connie Junghans, Allison Williams, Natasha Dsouza, Hessa Al Dossary and Keivan Ahmadi. Though I could express my gratitude to you all for the entire length of a thesis, I must provide a skimmed version. Matt, you alongside Grazia and James, have been the "*bee's knees*" of a supervisor, I am so eternally grateful for all the opportunities you've given me, thank you for all the therapy sessions and motivational chats. Grazia, "*my celebrity supervisor*", you've given me your endless support, time and energy as well as being a friend with a constant smile to which I will always be thankful, and I hope that I've made you proud as your first PhD student. Laura, "*my work confidant*", you've been more like my close friend throughout this entire journey to which I will always hold those memories dearly. Thank you for always giving me more opportunities and rooting me on when I doubted myself. Mark, "*the PhD gold standard student and friend*", thank you for your continuous support and humour throughout my entire PhD

journey, and always responding to my "*quick questions*", you unknowingly set a standard as a student and researcher that I could only aspire to achieve, and I know you'll ace your PhD!

Connie, "*the coolest GP and my cheerleader*", thank you for your continual support, encouragement, advice, and humour that made this journey that much more special. Allison, "*the genius MPH student and now brilliant researcher",* thank you for your kindness, optimism, encouragement, laughter and being a friend that is always there to listen. Natasha, "*my cheerleader, friend and vent machine*", I am incredibly grateful for your constant support and 'always here' attitude to which I will always cherish. I will never forget the "*you've got this girl*" and "*bless bless*" attitude and hold it with me every day. Hessa, "*my PhD buddy*", thank you for your kindness, generosity, and incredible support to which I will always hold dearly. Keivan, "*Kevin*", thank you for always being a breath of fresh air with your humour and continuous support that will never be forgotten. Thank you to the entire team for making me feel like I belonged from the very second, I became a part of the team, I will never forget the laughter and memories. Thank you to Meryem Cicek for your support, advice, friendship, and many laughs. Thank you to Pallavi Nair for the shared wisdom and instant support. You all have made this PhD the best academic experience and one for the books!

I wanted to also thank my ESA and LSR assessors, Dr Yasser Bhatti, and Dr Henock Taddese for their support and contributions towards my PhD and future opportunities. I wanted to express my gratitude to the I&E PPIE representatives and our study participants to which I am hugely grateful. Thank you to the NIHR ARC NWL for funding this project and the team for providing an opportunity to explore this research and your support throughout my PhD.

Relevant Publications and Presentations

Published Article:

Hindocha CN, Antonacci G, Barlow J and Harris, M. (2021) *Defining frugal innovation: a critical review*. BMJ Innovations 2021; **7:**647-656. doi: 10.1136/bmjinnov-2021-000830 [citations: 12].

Conference Presentations:

Hindocha CN, Antonacci G, Barlow J and Harris, M. (2023) *Defining frugal innovation: a critical review*. Poster presentation at Health Services Research (HSR) UK Conference in Birmingham.

Internal Presentations:

Hindocha CN, Antonacci G, Barlow J and Harris, M. (2023) *Defining frugal innovation: a critical review*. Online. Oral Presentation – lunchtime seminar at the Imperial College London, Department of Primary Care and Public Health. Faculty of Medicine.

Hindocha CN, Antonacci G, Barlow J and Harris, M. (2022) *Defining frugal innovation: a critical review*. Poster Presentation – PhD Symposium at the Imperial College London, School of Public Health.

Hindocha CN. (2023) *Exploring the Acceptability of Frugal Innovation at the Individual Level within the NHS*. Online. Oral Presentation – PPIE Representatives at the Imperial College London, School of Public Health, Department of Primary Care and Public Health, Faculty of Medicine.

Other Outputs During PhD:

Lennox L and **Hindocha CN**, Dsouza, N. (2023) *Understanding the Impact of the Compassionate Communities Programme* – evaluation report. Submitted to Imperial Health Charity.

Lennox L, **Hindocha CN**. (2023) *Improving the Health Status of BAME and Vulnerable Communities in Northwest London: evaluating the Compassionate Communities programme*. Oral Presentation at Health Services Research (HSR) UK Conference in Birmingham.

Lennox L and **Hindocha CN**. (2022) *Compassionate Communities programme* – midterm report. Submitted to Imperial Health Charity.

Lennox L, Lambe K, **Hindocha CN**, Coronini-Cronberg S. (2023) What health inequalities exist in access to, outcomes from and experience of treatment for lung cancer? A scoping review. BMJ Open. 13(11): e077610. doi: 10.1136/bmjopen-2023-077610.

Abbreviations

Full Term	Abbreviation
Frugal Innovation	FI
Imperial College London	ICL
Participant Information Sheet	PIS
Low-Income Countries	LICs
High-Income Countries	HICs
Lower-Middle Income Countries	LMICs
Upper-Middle Income Countries	UMICs
National Health Service	NHS
Social Cognitive Theory	SCT
Country of Origin	COO
Arbutus Drill Cover System	ADCS
Mosquito Net Mesh	MNM
Thematic Analysis	TA
Conversation Analysis	CA
United Kingdom	UK
United States of America	USA
Coronavirus-2019	COVID-19
Long Term Plan	LTP
Patient and Public Involvement	PPI
Triadic Reciprocal Determinism Model	TRD Model

Overview of the Thesis

This section provides an overview of the remaining chapters in this thesis to support the aims and objectives outlined above.

FI is the primary perspective explored in this thesis and serves as a driver for the exploration of perceptions, its acceptance, and challenges to diffusion particularly in the NHS which is covered in Chapter 1. Thus, the next Chapter 2 aims to provide a theoretical understanding of all the core concepts involved in this thesis, including an overview of innovation in general, the foundations and steering of what led to the introduction of FI, its current understanding and principles which may differ from other types of innovation by summarising previous and current conceptualisations across various sectors. Due to the overarching principles and concept, reverse innovation is also discussed in the same format as FI. Following, is the discussion about the country of origin (COO) effect, its introduction, principles, and application in the real world. Within Chapter 2, we also discuss the primary assessment of perceptions, acceptability, relevant acceptability models, its application and the chosen acceptability model adopted in this study, its strengths and integration in previous studies. Furthermore, the conceptualisation of risk is discussed as this helps to shape perceptions based on risk and the innovations chosen to assess the general perceptions of FI. Chapter 3 (methodology) describes and justifies the study procedures such as the design, setting, target population, recruitment and consent, data collection, ethics approval, data analysis, epistemological and ontological and reflexivity positions.

Chapters 4, 5 and 6 are empirical chapters, which provides an overview of the results obtained per innovation chosen e.g., Sayeba's method, Mosquito Net Mesh (MNM) and Arbutus Drill Cover System (ADCS). These chapters provide the context for the following Chapter 7, which is a synthesis chapter, summarising the results across all three innovations whilst discussing the discerning trends in the context of the chosen acceptability model, Social Cognitive Theory (SCT) and Sentiment Analysis (SA). Within this chapter, limitations of SCT application are also discussed in conjunction with the analysis being described. Chapter 8 is the discussion chapter which summarises the key findings from the data collected for all three innovations and the synthesis chapters discussing the discerning trends in relevance to previous literature and existing research. The chapters also consider the contributions and implications of the findings for acceptability research for FI. Findings from the analysis are used as the basis for recommendations for future FI and acceptability research in healthcare. The strengths, challenges and limitations of the thesis are discussed alongside suggestions for future research. Lastly, Chapter 9 provides a concluding summary of this study.

Chapter 1: Introduction

This chapter will focus on how frugal innovation (FI) may help to reduce the impact and burden of such challenges on the healthcare system such as staff shortages, financial issues, health inequalities, bureaucracy, patient outcomes, and evolving healthcare needs (Khan, 2023). The context and challenges created or exacerbated by the Coronavirus-19 (COVID-19) pandemic will also be addressed such as backlog clinical appointments, procedures, and staff morale (Khan, 2023). It is important to understand and represent the context of the NHS in order to identify fractures within the system that can be mitigated or resolved using FI as an approach to implement a critical perspective. In this chapter, we aim to evaluate the need and demand for innovative solutions through the introduction to FI, its claimed benefits, and challenges to adoption in the NHS. As the principles of RI mirror those of FI, we provide an introduction to RI. Moreover, we will also address the aspects of adaptation in order for it to be relative to the current needs and demands and whether these 'adaptations' are suitable for the United Kingdom (UK), in addition to exploring the accessibility and acceptability through the assessment of NHS' five year forward plan and the NHS long term plan. Finally, the chapter will summarise the contemporary challenges in the context of FI and its model.

1.1 Frugal Innovation

1.1.1 Origins of FI

The term FI was originally derived from the concept of "*frugal engineering*" which was coined by Carlos Ghosn, the CEO of Renault-Nissan, to conceptualise the utilisation of fewer resources whilst achieving more (Kumar and Puranam, 2012). FI emerged as a concept in The Economist in 2010, after the proposal of reverse innovation by Immelt and colleagues (2009). The conventional ideology of FI is primarily centred on doing 'more with less', providing effective quality solutions through the maximisation of resources whilst reducing the cost of expenditure (Bhatti, 2012; Zeschky et al., 2011) or loosely defined as developing affordable and quality products and services that meet the needs of resources-constrained consumers' (Zeschky et al (2014). The strategy behind frugal was developed and targeted for low-middle income countries (LMICs) to address the lack of resources, funding, and access (Radjou and Prabhu, 2014). FI utilizes the available resources to achieve an outcome when facing bureaucratic hindrances and resource constraints (Leadbeater, 2014). Although FI was not explicitly introduced to a certain market or discipline, it gained significant popularity in the business sector with its literature largely focusing on technology and automobiles (Tiwari et al., 2016). Such innovations redesigns by repurposing materials and processes to cut unnecessary costs (Wooldridge,

2010). FIs are not limited to technologies and products, as they also include processes or policies that aim to do more with less and thus could increase value and provisions of healthcare (Skopec et al., 2019).

1.1.2 Principles of FI

FIs typically target the underserved or lower-end markets as these consumers have limited financial resources and can only afford basic, simple, low-costs, often outdated alternatives to mainstream products and services (Hossain, 2016; Simula et al., 2015). This inspires the core of frugal innovators in that they develop ideas by leveraging, enhancing, and scaling existing outdated but functional products and services that are attainable and familiar to the target consumers (Hossain et al., 2016). Consequently, FI recycle, reuse, and repurpose resources encouraging the scaling of sustainability – *addressing economic, social, environmental challenges which now are deemed as important principles of product development* (Shahid et al., 2023). According to Leadbeater (2014), the design of FI is based on four principles: (1) lean, (2) simple, (3) clean and (4) social.

Firstly, FIs are lean which implies extricating waste with a focus on developing value-generating measures (Rosca et al., 2017). Lean thinking is a continuous, incremental cycle of extracting waste and errors upon detection (Reis et al., 2021). The Japanese lean processes follow the same principles (Soni and Krishnan, 2014). An example of a firm which was able to develop innovative solutions derived from lean manufacturing procedures, is the Narayana Health (NH) hospitals in India. Devi Shetty, a cardiac surgeon, launched the hospital in 2000, that aimed to provide "*high quality, affordable healthcare services to the broader population in India"* (Leadbeater, 2014). The hospitals apply the principles of lean manufacturing and quality standards to improve performance. NH hospitals include over 6000 beds providing 66 specialties (Narayana Health, 2023), all performing procedures at a fraction of the cost in comparison to elsewhere in the world e.g., a heart operation at an NH hospital would cost between $2000 to $5000 compared to $20,000 to $1000,000 in the USA (Richman et al., 2008). Whilst the quality standards remain high, costs are kept low by reducing the expensive expenditures and utilising core equipment and skills to serve more than one activity and thus the lean approach is critical in a resource-scarce environment (Bhatti et al., 2020).

However, these significant cost differences have been questioned particularly between Indian hospitals and those in HICs (Barlow, 2017). Karnani (2007) and Richman et al (2008) among many others, stated that these cost differences between the two economies are largely overestimated as the contextual factors make it difficult to compare costs. These contextual factors include high labour,

administrative and insurance cost, stringent regulatory procedures in a regulated developed market like the USA compared to an unregulated market in India (Barlow, 2017). On the other hand, Petrick and Juntiwasarakij (2011) argue that these contextual factors are too linear and dampen the prospects of innovations conceived in LICs being adopted in HICs.

FIs must be simple ensuring ease of use and affordability (Prabhu, 2017). To ensure simplicity, the innovator must highlight consumers' needs and examine its level of priority in terms of importance to 'defeature', remove unnecessary characteristics (Weyrauch and Herstatt, 2017). 'Defeaturing' an innovation of its extraneous features will reduce and limit cost without sacrificing value and quality to consumers as each component has been integrated according to the level of importance which in turns reflects simplicity and leaning (Hossain, 2018). An example of an innovation with simplicity at its core is Kenya's M-Pesa, the largest mobile-money transfer system in the world (Meagher, 2018).The system applies simple and easy to use features, with registration on mobile phones taking a mere 30 seconds and the act of transferring money taking a minute (Wellen and van Dijk, 2018). The innovation attracted the use for all Kenyans and not just the lower-end market consumers (Kingiri and Fu, 2020).

The third design of Leadbeater's (2014) principles refers to the clean, sustainable, and environmentally friendly nature of an innovation e.g., recycling, restoring, and renewing (Albert, 2019). FIs are far less resource intensive in comparison to more traditional innovation approaches in that FI utilizes the resources at hand and repurposes those using unconventional approaches and thus promotes environmental sustainability and limits costs (Khan, 2016; Leadbeater, 2014; Sharma and Iyer, 2012). Further to this, the analysis of innovations developed during the COVID-19 crisis found that most apply four principles of FI: (1) reuse, *adapting available, typically old, resources for a new approach or use*, (2) repurpose, *adaptation of more valuable resources to provide a new purpose*, (3) recombine, *combining resources, processes and practices across different organisations and industries* and (4) rapidity, *the speed of innovative outputs based on adaptation of reuse, repurpose and recombination* (Bhatti et al., 2020). FIs are challenged with integrating a minimalistic, sustainable, and low-cost approach to developing solutions to address non-systemic issues (Reis et al., 2021). An example of a FI that encompasses being lean, simple, and clean is Husk Power Systems (Levänen et al., 2015). This system provides electricity to many small villages via mini power plants powered by discarded husks from rice production (Numminen and Lund, 2017). Installation of these plants costs less than half of other recyclable power systems as it repurposes recycled and discarded materials (Gupta et al., 2013). Just one mini power plant can service electricity to hundreds of homes for six to eight hours each day,

equivalent to power light bulbs, refrigerators, and television costing just $2 to $4 per month (Leadbeater, 2014).

Lastly, FI must be social in nature by means of inclusivity and provide relative value (Kroll and Gabriel, 2020). These innovations are social as incorporate an outreach to communities and 'create value through empowerments and efficiency' (Fischer et al., 2021). Sometimes medical, scientific, and economic solutions are not enough to initiate acceptability or development and thus requires social solutions developed by the communities themselves targeting its own community members (Khan, 2016b). Thus, such innovators reside and operate within the same communities having lived a similar contextual situation. FIs combine communities and social forms by integrating consumers during the development, adoption, and diffusion of innovations (Khan and Melkas, 2020). The aim of such innovations is to address the needs and improve the lives of 'bottom of the pyramid' (BOP) and marginalized consumers frequently ignored by incumbents (Prahalad, 2012). However, the conceptualisation of frugal is far more complex than the traditionally accepted view of cost and lean (Bhatti et al., 2018). Since one of its most popular introductions by The Economist (2010a), FI has been denoted to cost and affordability due the lack of theoretical foundations explaining its conceptual origins.

The conceptualisation of FI remains tentative which may be attributed to a plethora of definitions (Grover et al., 2014). Its convoluted conceptualisation is further complicated by the use of various terminologies that are often used interchangeably (Bhatti and Ventresca, 2013). This action coupled with the use of frameworks and criteria adds to the complexity and ambiguity, as the exclusive features of what constitutes a FI is often shared by many different types of innovation with similar overarching objectives (Garcia and Calantonea, 2002; Hough, 2020). Although there many overlapping features of other types of innovation with FI, the core ideology of RI significantly mirrors that of FI.

1.1.3 A Critical Review of Conceptualising FI

This section describes a critical review published in BMJ Innovations (Hindocha et al., 2021). The paper and supplementary information can be found in Appendix 1. A critical review was chosen as there is limited literature exploring the conceptualisation of FI. Special acknowledgements are made to the corresponding authors of this paper for their contributions. CNH designed the study, performed the literature review, completed the first draft, and revised subsequent drafts for important intellectual content. GA, JB, and MH proposed the study, read the first draft, and revised subsequent drafts for important intellectual content. All authors read and approved the final manuscript prior to

submission. This section will include some extracts from the published critical review (Hindocha et al., 2021). The presentation of this critical review will be slightly adapted from the published review; however, all tables will be extracted from the original published review.

1.1.3.1 Aim of Review

The focus for this review was exploring and examining available literature on FI since its introduction and how it is defined and used across multiple disciplines of research. An initial brief literature review was conducted before the research aims were concluded. We wanted to explore how FI is interpreted and how it is identified in practice and research to assess whether such interpretations are grounded in a theoretical concept or wholly based on application and practice. With this approach, it could provide a sensible conceptualisation of FI and enlightenment to when, how and why the current understanding of FI is far from linear and is polysemous, *word or term having multiple similar meanings*. Alongside the initial literature review, we know that FI has been frequently used interchangeably with other types of innovation, but within this critical review, we can establish some of the characteristics used in this interaction and ascertain what factors overlap, why and how they can be dissociated. Furthermore, the term 'frugal', though used frequently in literature when discussing innovation, particularly conceived in LICs and LMICs, lacks its own conceptualisation which is further complicated using various synonyms across different ranges of organisational and industrial sectors and thus it is important to include studies from all perspectives. This critical review explores literatures across management, entrepreneurship, business, and organisation studies, to assess the various definitions of FI that have been cited since its introduction, investigate the similarities and differences, provide a summary of the fundamental attributes and characteristics, and provide appropriate recommendations for policy and practice.

FI has gained popularity worldwide since it was first mentioned in The Economist (2010) in several industries including healthcare, manufacturing, food, automotive, energy, and academics (Prabhu, 2017; Ratten, 2019; The Economist, 2010b; Tiwari et al., 2016). However, as a result of its popularity, other definitions have emerged, most of which are illustrated through case studies and lack a scientific or conceptual underpinning (Arshad et al., 2018; Bhatti et al., 2018; Bhatti and Ventresca, 2013; Grover et al., 2014; Ratten, 2019). FI can be thought of as a reflexive approach to repurposing of resources, adaptability, efficiency, affordability, and sustainability (Bencsik et al., 2016). It has gained traction in the developed markets due to the unprecedented, reduced government spending, declining salaries and wages and constrained budgets, whereby consumers and organisations are now, more so than ever, conscious of spending trends (Radjou et al., 2012b; Winkler et al., 2020).

Protagonist, those who champion a specific action or intervention, see this adaptive and innovative concept as possessing the ability to create appropriate solutions using the available resources at hand and providing this service or product to the underserved market typically in LMICs. This narrative and approach allow FI to develop new markets that can support an improved sustainable, tailored and inclusive medium through contributing towards a more circular economy whilst catering to all consumers even with affordability and accessibility issues. On the other hand, FI can be referred to as a cheap, ineffective, and invaluable option for an acute problem as consumer demands and expectations continue to evolve (Tiwari et al., 2017). In this review, we first explored how FI is defined and how it is identified.

1.1.3.2 Defining FI

There are many different abstractions, perceptions, and criteria (Basu et al., 2013; Kumar and Puranam, 2012; Prahalad and Mashelkar, 2010; Radjou et al., 2012b) as a result of the growing interest in FI (Agarwal and Brem, 2017; Soni and Krishnan, 2014; Tiwari et al., 2016, 2017). Through case study and innovation development research across different markets and industries (Brem and Wolfram, 2014; Weyrauch and Herstatt, 2017; Zeschky et al., 2014), it is frequently described by the parallels and contrasts with other forms of innovation and how it relates to other core ideas such as affordability and adaptation and its association with sustainability and subsequent circular economy (Kuo and Ng, 2016; Pansera and Sarkar, 2016; Rosca et al., 2017; Tiwari et al., 2016). There is a general agreement that the definition of FI and what makes up a FI lacks accuracy and coherence (Simula et al., 2015). Currently, there is no universal standard definition of FI which may be partly attributed to the term being used interchangeably with other types of innovation due to overlapping similar characteristics despite stemming from different backgrounds (Barlow, 2016; Grover et al., 2014; Hossain, 2016, 2020) such as jugaad (Radjou et al., 2012a), reverse innovation (Govindarajan and Trimble, 2009), Gandhi (Prahalad and Mashelkar, 2010), shanzhai (Wooldridge, 2010), bricolage (Wooldridge, 2010), disruptive (Christensen et al., 2001), resource-constrained innovation (Ray and Ray, 2010), good-enough (Gadiesh et al., 2007), grass root innovation (Brem and Wolfram, 2014; Hossain, 2016), cost innovation (Williams and van Triest, 2009; Zeschky et al., 2014). The method to defining FI is represented by a number of fundamental characteristics which will be discussed such as ‘bottom-of-the-pyramid (BOP) innovation’, ‘good-enough innovation’, ‘doing more with less’, ‘resource scarcity’ and ‘sustainable innovation’.

1.1.3.3 'BOP Innovation'

BOP innovation can be defined as "*innovative solutions to support more than four billion people who live on less than $2 a day"* (Prahalad, 2006, 2012). FI was created in developing markets at low expenditure in order to address the requirements of underserved or low-income consumers whilst preserving quality and added value (Pisoni et al., 2018; Prahalad, 2006; Radjou et al., 2012b, 2012a). However, research also shows this same narrative when explaining disruptive innovation (Christensen and Raynor, 2003) and the idea of 'disrupting the pyramid' in developing countries in addition to considering those with a restricted budget or cost-conscious consumers in developed markets, which is increasing as consumers compare necessities to value. Furthermore, this ideology mirrors the intention of jugaad innovation (Grover et al., 2014), which strives to develop affordable solutions to common everyday issues. However, it can be argued that FI incorporates problems from the BOP and adapts them to serve the high-end markets by simply focusing on the necessary issues which may differ significantly from the current alternatives, "*frugal innovation is a new management philosophy, which integrates specific needs of the bottom of the pyramid markets as a starting point and works backward to develop appropriate solutions which may be significantly different from existing solutions designed to address needs of up market segments"* (Gupta, 2011). This refers to a different approach that uses the requirements of consumers with limited budgets or low purchasing power as a baseline to create solutions that could differ from conventional options to meet the needs of usual market groups further up on the pyramid (Gupta, 2011).

According to Gupta (2011), FI was a solution to situational issues and are created through available resources to cater to the needs of underserved demographic consumers. This model approach was supported by Brem and Wolfram (2014) who stated that FI involves some level of sophistication to meet the needs or attention of emerging markets, "*low to medium sophistication, medium sustainability, and medium emerging market orientation*" (Hossain, 2018). This understanding is also shared by Christensen (2006), Pisoni and colleagues (2018) and Prahalad (2006) as affordable innovations to enhance the standard of living for consumers at the BOP in emerging markets. Within these similar narratives, it is important to consider that the BOP does not just include LICs but also markets within HICs, particularly those who earn less than the average national income which exists in every country "*frugal innovations can target customers in any segment of the economic pyramid who are price-sensitive by choice or looking for 'simpler' products that best meet their real needs*" (Koerich and Cancellier, 2019).

1.1.3.4 'Good-Enough Innovation'

Good-enough innovation can be defined as "*imperfect adapted innovations which involve simple and essential functions that are good-enough to meet the needs of underserved consumers and offered at low-cost*" ((Brulé and Munier, 2021; Christensen, 1997). However, these terms together have been used to define FI in a temporary context as a "good-enough" (Angot and Plé, 2015) option that is dependent on restricted and affordable resources to address problems of resource scarcity (Agarwal and Brem, 2017; Angot and Plé, 2015). This idea tends to overlap with other definitions of FI which refers to it as a 'good enough' low-cost product that sufficiently meets the needs of resource-constrained consumers. The general interpretation of FI refers to products and services developed under limited resources (Agnihotri, 2015) and derived from resource scarcity which mirrors the understanding of resource constraints to address the needs of LICs (Sharma and Iyer, 2012). As FI is commonly understood to be created from available resources which is often constrained, the cost advantage over incumbent alternatives adds to its appeal and in doing so, address issues of resource scarcity (Zeschky et al., 2011). In the same paper, the authors also defined FI as "*good-enough, affordable products that meet the needs of resource-constrained consumers*" (Zeschky et al., 2011). Among the two definitions, the overarching characteristics include cost, simplicity, basic functionality and targeted towards resource-constrained consumers.

1.1.3.5 'Doing More with Less'

This notion of 'doing more with less' can be defined as "*creating significantly more value while minimising the use of resources*" (Radjou and Prabhu, 2014). The epitome of FI was defined as "*doing more with less*" (Radjou and Prabhu, 2014) and "*the affordable use of products and service that have been innovated under conditions of resource scarcity*" (Ratten, 2019) to which both definitions collate an understanding that FI is a process of creating simplistic, easy to use and affordable solutions. Whilst such an understanding of FI does not involve any dependency variables, it does incorporate a psychological perspective through behavioural change and prospective outlook on FI as this type of innovation can be seen as an opportunity as opposed to a constraint (Radjou and Prabhu, 2014). This mentality represents an inventive space in which innovators aim to provide high quality at an affordable price compared to more conventionally offered alternatives. Here, FI was also referred to as an opportunity to create affordably and sustainably whilst facing resource constraints. This narrative of FI refers to its original conceptualisation provided by The Economist (2010), such that the ideology of FI is a strategy to reevaluate the construction of the production process and incorporate resources with a conscious mindset to reduce wastage and increase sustainable approaches, "*FI is not*

just about redesigning products; it involves rethinking entire production processes and business models." (The Economist, 2010).

1.1.3.6 'Resource Scarcity'

Resource scarcity can be defined as "*FI occurs when there is a lack of sufficient or adequate equipment, qualified personnel, finance, institutional support or infrastructure during the development of innovative solutions*" (Bhatti, 2014; Bianchi et al., 2017). Although FI is typically associated with LMICs, the issues that FI aims to address are present in both emerging and developed markets (Hossain, 2016), particularly those with low purchasing power due to earning a less than average income or cost-conscious consumers. Furthermore, according to Gupta (2011) definition of FI, resource scarcity is an issue taking place everywhere in the world to some capacity and varies according to industry and populations, thus it is not confined to those at the BOP. This narrative was exacerbated and made apparent during the COVID-19 pandemic, which saw FI reach beyond aspects of affordability into adaptability to various contextual issues that influenced others around the world irrespective of economic market to follow-suit and become adaptable with limited resources, "*FIs are products and services that focus on crucial needs, spare resource use or eliminate non-essential features in the design process*" (Kuo, 2014). The global pandemic elicited a demand for efficient, creative, and scalable solutions which in turn provoked a growth in the creation and use of FIs as HICs lacked the luxury of time and resources to adhere to conventional processes of trials and testing (Bhatti et al., 2017; Bhatti et al., 2017; Corsini et al., 2020). According to Harris et al (2020), LICs such as India and Africa adapted to the global urgency far better than HICs such as USA and Europe. Due to this acknowledgement and whilst facing significant resources constraints, FI induced a competitive, challenging market that increased overall sustainability (Herstatt and Tiwari, 2020).

1.1.3.7 'Sustainable Innovation'

Sustainable innovation can be referred to as "*the development of innovative solutions that contributes towards sustainable development and provides economic, ecological and social benefits*" (Khan, 2016; Yoon and Tello, 2009). As previously highlighted, numerous amounts of literature make associations between FI and concerns of sustainability or by means to create sustainable solutions at a low-cost whilst maintaining quality. However, despite these associations, the assessment of such constructs may vary accordingly depending on the perspective (Albert, 2019). There are arguments to contest whether FI is in fact a sustainable solution such that some believe that FI encourages a "*more sustainable world*" (Basu et al., 2013) and "*sustainable development*" (Rao, 2014) whilst others feel

that FI does not provide a sustainable impact (Rosca et al., 2017), does not automatically incorporate sustainability (Weyrauch and Herstatt, 2017) and is not originally eco-friendly (Sharma and Iyer, 2012). Furthermore, FI was understood to involve various multilevel changes such as revising business models, reconstructing value chains, remodelling products to those with low purchasing power and underserved consumers, develop a new market whilst employing a sustainable and scalable strategy (Hindocha et al., 2021). On the other hand, sustainability was deemed as a non-requirement for FI and was believed to be comprised of three attributes "*substantial cost reduction, concentration on core functionalities and optimised performance level*" (Weyrauch and Herstatt, 2017).

Overall, FI may be regarded as a polysemous term as it has numerous different meanings with similar attributes (Hindocha et al., 2021). Table 1 summarises these definitions.

Table 1: Definitions of Frugal Innovation*

Definition(s)	Reference(s)
"Frugal innovation is a new management philosophy, which integrates specific needs of the bottom of the pyramid markets as a starting point and works backward to develop appropriate solutions which may be significantly different from existing solutions designed to address needs of up market segments"	(Gupta, 2011)
"…low to medium sophistication, medium sustainability, and medium emerging market orientation"	(Brem and Wolfram, 2014)
"*Frugal innovations can target customers in any segment of the economic pyramid who are price-sensitive by choice or looking for "simpler" products that best meet their real needs*"	(Koerich and Cancellier, 2019)
"*The affordable use of products and services that have been innovated under conditions of resource scarcity*"	(Ratten, 2019)
"*Good enough" solutions that rely on limited and cheaper resources to face the resources' scarcity*"	(Angot and Plé, 2015)
"*Frugal innovation is "good-enough," affordable products that suffice the needs of resource-constrained consumers*"	(Agarwal and Brem, 2017)
"*Frugal innovation refers to products and services that are developed under resource constraints*"	(Agnihotri, 2015)
"*Frugal innovations are products and services that focus on crucial needs, spare resource use or eliminate non-essential features in the design process*"	(Kuo, 2014)
"*Frugal innovation stems from resource scarcity: utilizing limited resources to meet the needs of low-income customers*"	(Sharma and Iyer, 2012)
"*Responding to severe resource constraints with products having extreme cost advantages compared to existing solutions"* "G*ood-enough, affordable products that meet the needs of resource-constrained consumers*"	(Zeschky et al., 2011)

"*Frugal innovations are not re-engineered solutions but products or services developed for very specific applications in resource constrained environments*" - Technical novelty - Market novelty - Refers to market, rather than product or service	(Zeschky et al., 2014)
"*Frugal innovation refers to products, services or combination of them that are affordable, sustainable, easy-to-use, and have been innovated under the resource scarcity. In general, frugal innovations are developed in and for low-income market contexts and are seen to differ from innovations in developed markets*"	(Hossain, 2016)
"*…characterized by affordability, robustness, user friendliness, scalability and having an attractive value proposition*"	(Tiwari and Herstatt, 2013)
"*Doing with more less*" Principles of FI: "*(1) engage and iterate, (2) flex your assets, (3) create sustainable solutions, (4) shape customer behaviour, (5) co-create value with prosumers and (6) make innovative friends*"	(Radjou and Prabhu, 2014)
"*Frugal innovation is not just about redesigning products; it involves rethinking entire production processes and business models"*	(The Economist, 2010)
"*…Three attributes: substantial cost reduction, concentration on core functionalities, and optimized performance level*"	(Weyrauch and Herstatt, 2017)
"*Meeting the desired objective with a good- enough, economical means"*	(Soni and Krishnan, 2014)
"*Frugal innovation is a design innovation process in which the needs and context of citizens in the developing world are put "first in order to develop appropriate, adaptable, affordable, and accessible services and products for emerging markets*"	(Basu et al., 2013)
"*Scarcity-induced-, minimalist- or reverse innovation*" "*By economizing the usage of resource-use and aiming for simple products and services, albeit sometimes using cutting edge technology, frugal-innovations have a lot to offer for sustainable-development*"	(Rao, 2013)
"*Frugal innovations are not only lower in cost, but outperform the alternative, and can be made available at large scale*"	(Bound and Thornton, 2012)
"*Frugal innovation is a means and ends to do more with less for more people*"	(Bhatti and Ventresca, 2013)
"*…a means or an ends, to do more with less, for the many*"	(Bhatti et al., 2018)
"*Frugal innovation can be defined as a product, service or a solution that emerges despite financial, human, technological and other resource constraints, and where the final outcome is less pricey than competitive offerings (if available) and which meets the needs of those customers who otherwise remain un-served*"	(Simula et al., 2015)

*Extracted from Hindocha et al (2021)

1.2 Identifying FI

Alongside the challenges in defining FI, it imposes a significant difficulty in how it is identified due to its multiplicity of concepts (Agarwal and Brem, 2017; Prabhu and Gupta, 2014). Commonly associated characteristics typically used to identify FI and dissociate from other types of innovation include technical novelty, market novelty, functionality, and resource scarcity (Weyrauch and Herstatt, 2017). The variation in attributes and perhaps according to given definitions is illustrated in Table 2. As a consequence of its scaled global adoption and implementation, there is an understanding and need for a standardised multifaceted criteria to define FI across various contexts of study (Weyrauch and Herstatt, 2017).

Table 2: Commonly Associated Characteristics Coded within Definitions of FI*

Key Characteristic	Associated Key Words	Reference(s)
Affordability	- Unnecessary costs - Low cost - Cost-conscious - Cost-effective - Minimum-cost - Non-essential costs - Significantly lower costs - Low budget - Low purchasing power - Low income - Low priced - Economic means	(Koerich and Cancellier, 2019)
Adaptability	- Addressing specific needs - Flexible - Conforming to needs - Suffice the needs - Focus on crucial needs - Developed for very specific applications - Meeting the needs - Innovated under - Doing more for less - Means or an ends - Needs and context of citizens in the developing world are put first	(V. Gupta, 2011)
Accessibility	- Availability - Convenience - Ease of access - In any segment of the economic pyramid - Both emerging and developed markets	(Agarwal and Brem, 2017; Agnihotri, 2015; Angot and Plé, 2015; Basu et al., 2013; Bhatti et al., 2018; Bhatti and Ventresca, 2013; Hossain, 2016; Koerich and Cancellier, 2019; Sharma and Iyer, 2012;

	- For the many - For more people	Simula et al., 2015; Zeschky et al., 2011)
Sustainability	- Eco-friendly - Eco-system - Low environmental impact - Repurposing - Low environmental intervention - Ecological - Renewable - Spare resource use - Sustainable development	(Brem and Wolfram, 2014; Hossain, 2016; Kuo, 2014; Radjou and Prabhu, 2014; Rao, 2013)
Scalability	- Volume - Profitable - Expanding - Scaling - Changing markets - Market orientation - Reverse innovation - Large scale	(Brem and Wolfram, 2014; Gupta, 2011; The Economist, 2010; Zeschky et al., 2014)
Simplicity	- Easy to use, - User-friendly - User-friendliness - No previous training required - Low competency - Strip back - Essential - Basic - Simple - Simpler - Sophistication - Non-essential - Minimising the use of material - Reduces material waste	(Brem and Wolfram, 2014; Hossain, 2016; Koerich and Cancellier, 2019; Kuo, 2014; Rao, 2013; Tiwari and Herstatt, 2013)
Emerging Market	- Bottom of the pyramid - Low-income market - Developing countries - Developing world - Low- to middle-income countries - Low purchasing power - Resource-constrained - Resource scarcity - Un-served customers - Underserved consumers	(Basu et al., 2013; Brem and Wolfram, 2014; Gupta, 2011; Hossain, 2016; Koerich and Cancellier, 2019; Sharma and Iyer, 2012; Simula et al., 2015; Zeschky et al., 2014)
Developed Market	- Top of the pyramid - High-income market - Developed countries - Developed world	(Gupta, 2011; Koerich and Cancellier, 2019)

	- High income countries - Medium to high purchasing power	
Functionality	- Essential - Appropriate - Minimalistic - Minimalism - De-featuring - Unnecessary frills stripped out	(Agarwal and Brem, 2017; Rao, 2013)
Performance	- Optimisation - Robust - Outperform - Enhanced - Advanced - High quality	(Bound and Thornton, 2012; Weyrauch and Herstatt, 2017)
Process	- Approach - Procedure - Moving counterparts	(Basu et al., 2013; Bhatti et al., 2018; Bhatti and Ventresca, 2013)
Outcome	- Result - Conclusion - Consequence - Reaction	(Hossain, 2016; Simula et al., 2015)
Mindset	- Psychological - Cognitive - Behaviour - Lifestyle - Mentality - Attitude - Ethos - Decision-making - Thought process	(Radjou and Prabhu, 2014; Soni and Krishnan, 2014)
Resource Scarcity/Constrained	- Limited resources - Sparing resources - Budget constraints - Insufficiency - Resource shortages - Limited or no access - Shortages	(Agarwal and Brem, 2017; Agnihotri, 2015; Angot and Plé, 2015; Hossain, 2016; Rao, 2013; Ratten, 2019; Sharma and Iyer, 2012; Simula et al., 2015; Zeschky et al., 2011; Zeschky et al., 2014)
Good-Enough	- Sufficient - Suffice - Functional - Acceptable - Appropriate - Passable - Decent - Satisfactory - Contention	(Agarwal and Brem, 2017; Angot and Plé, 2015; Basu et al., 2013; Soni and Krishnan, 2014; Zeschky et al., 2011)

High Value	- Potential - Profitable - Scalable - Attractive - Novelty	(Radjou and Prabhu, 2014; Tiwari and Herstatt, 2013; Zeschky et al., 2014)

*Adapted from Weyrauch and Herstatt (2017) and extracted from Hindocha et al (2021)

There have been efforts to explore and assess lesser-known examples of FIs developed in LMICS that have comparable prospects as the more known and successful examples such as general electric's (GE) US$800 portable ECG machine, Aravind's US$30 cataract surgery, non-electric Mitticool fridge and the cheapest car in the world, Tata Motors' Nano car (Bhatti et al., 2017). Organisations known as "innovation curators" identified and complied many of these prospective FIs, allowing for a more accessible pathway for knowledge to all exploring or searching for new practices, policies, or products (Bhatti et al., 2017). Nonetheless, there still remains a statement towards a standard approach, framework, or criteria, if any, to classify an innovation as frugal (Hindocha et al., 2021). Some have contributed efforts to help better identify FI against a criteria of characteristics such as Kumar and Puranam's (2012) six principles which included (1) robustness, (2) portability, (3) defeaturing, (4) leapfrog technology, (5) mega-scale production and (6) service ecosystem. Another criteria identified 10 core competencies to identify a FI, which included (1) ruggedisation, (2) lightweight, (3) mobile enabled solutions, (4) human centric design, (5) simplification, (6) new distribution models, (7) adaptation, (8) use of local resources, (9) green technologies and (10) affordability (Basu et al., 2013). These competencies are often used to provide products and services that are financially effective, compatible, adaptable and accessible to meet requirements in times of significant resource constraints with a specific focus on the developing markets. It is also used to evaluate the prospective diffusion (Bhatti et al., 2018). Though these contributions help to form supportive basis for conceptualising FI, there is no understanding that a FI must comply with these principles nor reach a minimum number of attributes in order to be classified as a FI.

Weyrauch and Herstatt (2017) proposed a criteria to develop a unified definition of FI which aims to differentiate it from other types of innovations. During the development of this criteria, the authors identified that the discussions of FI typically fall into one of three categories such as (1) significant cost reduction, (2) focus on core functionalities and (3) optimised performance level. However, unlike the previous aforementioned criteria, an innovation must include all three components concurrently, to be classified as a FI (Weyrauch and Herstatt, 2017). Though the requirements must be adhered to by all, irrespective of markets, this criteria will vary according to the context in which the actual products

and services are used (Weyrauch and Herstatt, 2017). This is attributed to environment of the consumer and its context as both have a substantial impact on the basic capabilities (Weyrauch and Herstatt, 2017).

1.3 The Diffusion Challenge for FIs

The implementation of such innovations into HICs remains a difficult challenge due to the stringent regulations fuelled by complex and perpetual understanding of accepting ideas and knowledge from the developing world. Despite the claimed advantages of adopting FIs into the developed world (Bhatti et al., 2017; Harris et al., 2020), HICs who are typically risk averse such that if all requirements are not met for a certain product or service, they are quick to dismiss it altogether, have abandoned many beliefs and values when accepting innovations conceived in LMICs in the state of an emergency. It brings to question why is the reality of a global emergency deemed an acceptable condition to adopt FI but not in everyday mandated policy-making? One can argue that in a global crisis, there is an imperative to have thorough testing and a high-quality product more so than ever, so why are the conservative western beliefs of FIs absent when accepting its adoption during this climate. Thus, it remains tentative on whether a global emergency will permanently challenge how innovation is implemented in healthcare and such perceptions during the time of an emergency. The cognitive biases may be negated with the potential of increased bidirectional knowledge and social acceptance regarding the efficacy of FI in HICs, consequently leading to its increased diffusion.

The Health Foundation supports teams in the NHS to innovate and spread ideas, which led them to initiate ‘the spread challenge’, a report sharing information about the real-life challenges of spread and adoption (Horton et al., 2018). The report revealed the ‘replicability problem’, the challenge with replicating the impact of an intervention, so whilst an intervention may be successfully adopted in one place, it is very frequently unfavourable or unsuccessfully adopted in another and this is typically observed with complex health interventions that seek to make improvements in clinical processes and pathways (Horton et al., 2018). The replicability problem highlights that adoption is often more difficult and challenging than assumed even whilst the intervention has been successfully piloted with clinical evidence. This problem is pertinent to the NHS as it seeks to introduce an eventual mandate to uptake new innovations, particularly ones that help to address the main objectives. Since the beginning of the NHS, there has been a continual challenge with achieving desired changes in outcomes with mandated actions.

The report stated that complex interventions or innovations are 'context-sensitive' by means of three aspects: (1) they are embedded within an organisation's systems and culture, (2) they are contingent upon human behaviour and relationships and (3) they are dynamic and evolve in different ways in different settings (Horton et al., 2018). As research has shown, there is a need for a cultural change, relationship building and untangling entrenched habits and preconceptions, which cannot be achieved through coercion (Horton et al., 2018). It is important to note that whilst there is an urgent challenge to implement solutions everywhere within the NHS, unlike what is stated in the report, identifying areas for improvement and potential solutions are equally valuable for the diffusion of any innovation.

Although adaptation is an essential component to implementation and adoption and is seen as a facilitator of innovation, it is also a challenge as adaptation to local needs does not always result in success (Horton et al., 2018) and is further complicated when the adaptation is seen as frugal (Gerhold and Horton, 2023). Adoption requires adaptation to the specific setting and is often dictated by the willingness of staff to develop new skills or learn to use new techniques or methods (Horton et al., 2018). Clinicians from The Health Foundation programmes were asked if any adaptations were made to the intervention during the process of implementation in their own setting, by which over 80% responded "*yes*" and almost all stating that these adaptations were necessary for a successful implementation (94%) (Horton et al., 2018). Other challenges such as capabilities and skills required or the method for implementing the innovation or even the organisational culture required were also highlighted as hindering adoption (Horton et al., 2018). But perhaps the most defining challenge is the conceptualisation of adoption that often starts with the so-called 'gatekeepers' - made up of healthcare professionals at multi-level. Evidence has shown that gatekeepers have a significant impact on patient decision-making, perspectives and subsequent acceptance (Gan et al., 2016; Garrido et al., 2011; Sripa et al., 2019).

The 'spread challenge' report acknowledged that perception of an intervention was perhaps central to the success of adoption and spread – does the conceptualisation of the intervention involve underlying behaviours or cultural factors, the skills and capabilities required for its use, the areas of improvement or does it address a specific need and many more (Horton et al., 2018). The conceptualisation is not limited to process innovations, quality improvement approaches, new service models, health technologies or medical devices, though health technology is often popularised in medical and public health literature and media (Horton et al., 2018). The impact of context reveals the important role adopters play in translating innovations into new settings, which poses a challenge for traditional approaches to spreading innovations, once successfully adopted in one setting, it can be

easily ‘diffused’ in another. But a plethora of evidence refutes this and has been reflected as part of the ‘replicability problem’ (Horton et al., 2018; Tornatzky and Klein, 1982).

The Health Foundation argues that the focus should be on the adopters rather than the ‘innovators’, to some extent reversing the conventional practice (Horton et al., 2018). At the centre of this challenge the focus should be on supporting adopters with implementation, i.e., building capability and readiness or acceptance for implementation, providing them with sufficient and effective resources, time, and capacity to adapt and translate the intervention into their own setting which may be coupled with practical ways to implement the innovation with a higher chance of its successful longevity (Horton et al., 2018). However, part of this challenge may also be attributed towards the lack of understanding of what FI is and how it is identified. To date, the conceptualisation of FI remains tentative which may be attributed to a plethora of definitions (Grover et al., 2014). Its convoluted conceptualisation is further complicated by the use of various terminologies that are often used interchangeably (Bhatti and Ventresca, 2013). This action coupled with the use of frameworks and criterias adds to the complexity and ambiguity, as the exclusive features of what constitutes a FI is often shared by many different types of innovation with similar overarching objectives (Garcia and Calantonea, 2002; Hough, 2020). To implement or adopt a FI to serve the various identified advantages in the UK’s NHS, its conceptualisation needs to be understood so that it can be applied to the specific context appropriately. We have identified a gap in the literature relating to the convoluted conceptualisation of FI across multiple industrial and organisational sectors. To address this gap and identify useful concepts and understanding for its identification and subsequent application, an in-depth critical review exploring the current understanding of FI and its identifying characteristics is required.

Furthermore, to build on existing knowledge and provide a better more practical understanding to FI, its implementation and acceptance in a HIC, it is important to understand its conceptualisation, identification and how such innovations are being implemented or adopted around the world. It should be noted that though we seek to explore the acceptance of FI in a HIC’s healthcare system, we do not endorse any specific FI. The first step towards this aim was to carry out a critical review of research published over the past two decades on FI irrespective of specific organisational and industrial sector.

1.4 Reverse Innovation

1.4.1 Origins of RI

Reverse innovation (RI) was introduced by Jeff Immelt in 2009, who defined the concept as a new and/or old idea developed or adopted in a LMIC and implemented in a HIC in response to local issues (DePasse and Lee, 2013; Govindarajan and Ramamurti, 2011; Immelt et al., 2009). The term 'reverse' connotes the direction of flow, innovations developed in poor countries and adopted in rich countries which refers to the opposite flow of the traditional forms of innovation development (Hadengue et al., 2017; von Zedtwitz et al., 2015). Immelt et al (2009) postulated that reverse innovation are affordable innovations that successfully diffuse from emerging markets into developed markets (Simula et al., 2015). The constraints surrounding RI may not always be attributed to cost but also infrastructural voids, culture and etc. (Malodia et al., 2020). Such innovations tend not to involve technology as its main breakthroughs but rather a combination of new and/or pre-existing processes to address non-systemic challenges and develop new business models (Govindarajan and Ramamurti, 2011). von Zedtwitz et al (2015) argued that RI may occur at any stage such as ideation, development and diffusion and further developed a typology of innovation flow.

1.4.2 Principles of RI

RI is perhaps the most complex innovation to implement among those previously mentioned and only a small number of corporations have been successful as it involves a thorough understanding of convoluted social, economic, and technical contexts of both the emerging (Winter and Govindarajan, 2015) and developed markets. RI remains a complex phenomenon as there is little knowledge available detailing the process and challenges when developing and implementing such a variant (Leavy, 2011; von Zedtwitz et al., 2015). Immelt et al (2009) suggested one of the main strategies towards developing and adopting such an innovation is for large corporations to localise their research and development (R&D) sectors to eliminate the threat of local domestic firms. Additionally, this included investing in restructuring the geographical-specific organization structures and financial liberty (Cannavale et al., 2021; Hadengue et al., 2017), which led to the success of GE's diffusion into both the emerging and developed markets (Immelt et al., 2009). Furthermore, redesigning the manufacturing methods and sales strategy (Govindarajan, 2012) can result in radical changes needed for a successful diffusion (Leavy, 2011; Li et al., 2013).

However, much of its evidence and results is anecdotal and circumstantial to the context, consequently limiting its constructional definition (Furue and Washid, 2014). This may be attributed

to the low success rate of the diffusion of reverse innovation in developed markets because of the complex nature in understanding the concept, process, outcomes, challenges, and consequences to expect (Bhatti et al., 2017). According to Malodia et al (2020) reverse innovation comes directly after the development and adoption of a FI in a developed market. This study also suggests that FIs that fail in the developing markets may be accepted in the established market and become a successfully diffused reverse innovation (Immelt et al., 2009; Malodia et al., 2020). Some examples of large corporations who have failed at diffusion include, Brazil's Fiat 147 and Renault's Logan was not accepted in Europe's automobile market and ST Microelectronics' TV set-top box was not accepted in the technology developed markets (Bhattacharyya et al., 2017; Govindarajan and Ramamurti, 2011; Malodia et al., 2020; Ostraszewska and Tylec, 2015; Snowdon et al., 2015; von Zedtwitz et al., 2015).

1.4.3 Has the NHS Adopted FI?

The NHS is a public sector healthcare organisation in the UK, introduced in 1948, that aims to provide healthcare based on seven key principles, (1) NHS is comprehensive in that it is able to provide a wide array of healthcare services and is available to all, (2) accessibility is based on a clinical need, not affordability, (3) aims to deliver high quality and standards of excellence and professionalism, (4) the patient is at the core of its organisation, (5) operates across different organisational networks, (6) offers to deliver best value for taxpayers' money and lastly, (7) is responsible for the public and communities to which it promises to serve (Department of Health and Social Care, 2021; Department of Health, 2011). The NHS marked a historical moment around the world as it became the first free healthcare service in the western world available to all and was funded by the British tax system (Delamothe, 2008; Shapiro, 2010). However, despite its momentous introduction, it fairs significantly different from its introduction 75 years ago. Though the NHS is referred to as "*world class*" at its best and is consistently voted as one of the world's leading health systems for quality and value for money by The Commonwealth Fund's regular international surveys, the system still and continuously faces challenges fuelled by various factors such as staff shortages, funding, resources e.g., hospital beds, radiology scanners, rapid access to diagnostics, field based solutions for access to health workers (Khan, 2023; NHS England, 2013; Taylor et al., 2017).

Some of these challenges are dictated by the growing and ageing population, which by its own capability increases the rate complex comorbidities, in addition to advances in knowledge, science and technology which provoke adaptations in healthcare needs and societal expectations (NHS, 2019; NHS England, 2013). FI has shown to leverage economies of scale, utilise an assembly line approach for surgery and triaging, Aravind Cataract Eye Surgery (Namperumalsamy, 2020), signposting and

assisting at community level, Brazil's Family Health Strategy - Community Health Workers programme (Krieger et al., 2021), reducing the average length of stay, Mosquito Net Mesh (Skopec et al., 2021) and Sayeba's Method (Anger et al., 2021) and reconfiguring the design, material and use of medical equipment to reduce the overall cost (Bhatti et al., 2018; Scarbrough and Kyratsis, 2022).

The NHS have sought upon mitigating such challenges and adapting the healthcare system for the future by drawing on its staff to identify "possible gatekeepers" and develop tools and improve the current ways of working (NHS, 2019; NHS England, 2013). The NHS also leverages its current partnerships with the industry and organisations to seek a ready supply of new medicines, devices, and technology (NHS, 2019; NHS England, 2013). To meet the everchanging and challenging demands imposed on the NHS, such objectives must be met in standing with the current funding whilst enhancing quality as increasing their efforts on current practices by doing more is no longer a viable option (NHS, 2019; NHS England, 2013).

The NHS are focused on resolving three main challenges as part of its Long Term Plan (LTP), (1) funding, (2) staffing and (3) increasing inequalities and pressures from the ageing population. The plan explicitly states that the NHS aims to push extra funding as far as possible and is triggered by the implementation of its Five Year Forward Plan (NHS England, 2014), which has shown successful integration in parts of the NHS (NHS, 2019). However, this success remains vague in that its implementation is described to be as "*somewhere in the NHS*" without any clarification of changes or adaptation, if any. Though the Long Term Plan explains the NHS' aim to introduce a new service model which will provide more options to patients, better support, and improved aligned care at the right time in the optimal care setting, it does not specifically explain how and what will be involved, nor does it evaluate the impact it will have on the NHS, industry and service users (UK Parliament, 2019). Despite the positive encouragement to incorporate new ideas and innovations, the plan does not set out the implications involved when adopting or implementing an innovation.

In 2011, The Innovation and Health and Wealth: Accelerating Adoption and Diffusion in the NHS report highlighted the need to "*radically transform the way we deliver services*" through innovation which should "*become the core business for the NHS*" (Department of Health, 2011a). Though the report summarises successful examples of different types of innovation, much like the 'The King's Fund, Adoption and Spread of Innovation in the NHS' report (Collins, 2018), it does not state any figures or costs of implementation to the NHS and merely mentions the projection cost savings to the NHS and the capacity of patients it will be able to support (Department of Health et al., 2011). The NHS' 'Five

Year Forward View', acknowledges that change is needed, but relies significantly on the current NHS stature and forming new partnerships with local communities, local authorities and employers (NHS, 2016). Though the so-called 'homegrown' innovations can boost economic value and reputation, innovations typically developed in HICs do not prioritise low expenditure but rather focuses on the unique components or modelling (Department of Health, 2011a).

Most of the focus is on these so-called expensive technological influences such as Artificial Intelligence, Digital Health or restructuring and transformational changes such that at times results in 'pilotitis', *pattern of launching several small pilot projects without the intention for widespread scaling* due to sustainability issues (Kuipers et al., 2008) or provoking a 'not invented here syndrome' such that innovations developed in one NHS Trust may not be acceptable in another Trust or in one health system another not in others. Furthermore, the Innovation and Technology Payment (ITP) programme supports the NHS to adopt innovations by eliminating some of the economical and procurement barriers to implementation of new technologies (NHS England, 2023a), though these relate to homegrown solutions. So, despite the claimed benefits and evidence of FI, the ability to consider innovations from around the world remains ambivalent. Some could argue that if the same innovations were developed in a high-income country (HIC), there would be no reluctancy to accept its use and subsequent adoption. If the NHS are to address such challenges through the use of innovative approaches to delivering healthcare, it must look to external options, by means of outside of current partnerships and the UK itself, particularly if innovation is to "*be an integral part of the way the NHS does business*" (Department of Health, 2011a) and to develop a more sustainable model for further implementation of innovations (Department of Health, 2011a). But this is where the problem may resonate when it comes to acceptability, adoption, and diffusion of healthcare innovation.

Currently, there remains a paucity of innovations developed in LMICs that have successfully and explicitly been adopted in a HIC (Issa et al., 2021). However, during the global Coronovirus-19 (COVID-19 (COVID-19) pandemic, the need for resolution irrespective of the country of origin (COO) was catapulted into healthcare and accelerated the demand for innovative solutions and leveraged reciprocal partnerships (Issa et al., 2021). Further, this challenge identified fractures in the UK's healthcare system which consequently denoted clear opportunities to learn from LMICs whom of which responded in a more coordinated, effective, and sustainable manner by leveraging available resources and focused on addressing specific and demanding needs (Issa et al., 2021). The quick responses to COVID-19 from countries in the developing world such as India and Africa are progressing far better in comparison to countries in the developed world such as USA and Europe (Harris et al.,

2020). The shift in adopting such innovations has suggested that "*there is much to be learned from times of crisis for times of plenty*" (Harris et al., 2020). Whilst there are many forms of innovation, which may contribute towards the paucity, they tend to involve similar or the same attributes towards serving the same goal. It is important to note that many countries around the world utilised the premises of FI without consciously acknowledging the term, which questions the importance placed on the typology of such innovation. It is important to understand the premise of an innovation prior to its consideration and subsequent implementation or adoption.

The global crisis has also seen an increase in bidirectional learning and international health partnerships (IHPs) between the developing and developed world (Fanelli et al., 2020; Olufadewa et al., 2021; Skopec et al., 2022). Though, developments from HICs are reported far more than developments made in LMICs despite being experts in managing epidemic crisis with significant resource constraints (Harris et al., 2020). Evidence would suggest that HICs have far more to gain by learning from the developing world, particularly when these countries have experienced similar challenges (Assefa et al., 2021; Park and Ranabhat, 2022; Skopec et al., 2019; Vigo et al., 2020; Walker et al., 2020). For example, India and Pakistan (Nandi, 2020) repurposed and refitted trains to serve as COVID-19 isolation wards and testing centres and China (Ankel, 2020) constructed a 1,000-bed hospital in ten days. Similarly, the UK (NHS Barts Health, 2020) renovated the ExCel London into a temporary 4000-bed hospital and USA repurposed the use of parking lots to serve as testing centres and a distillery in India (India Today, 2020) shifted to producing bottles of hand sanitisers. An effective approach to addressing the challenges reported in the NHS LTP, is the utilisation of IHPs which aims to improve healthcare systems and services between HICs and LMICs (Skopec et al., 2022). These partnerships collaborate with global health institutions and partners to exchange knowledge, offer strategic advice and training and implementation support for strengthening health systems around the world (NHS Health Education England, 2023).

FI has been applauded for its ability to accomplish the needs of the underprivileged and underserved, by also addressing health inequalities which is also reported as a concern and issue within the NHS, as it continuously presents the capacity to fulfil the needs without sacrificing the quality and safety in the most optimal circumstances (NHS England, 2023b). Subsequently, these innovations provoke a competitive market which also promotes an increase in sustainability despite significant constraints (Shahid et al., 2023). Although the predominant emphasis relies heavily on resource constraints such as materials, money and manufacturing, the adoption of such innovation is not exclusive to these and

should also consider the cognitive bias involved when thinking about its implementation into HICs such as the UK's NHS.

Although there has been an increase in healthcare investments by corporate companies particularly in developing countries, diffusion of such innovations remains significantly convoluted and far from linear. Some of these challenges may be due to limited resources, marketing, and behaviours such as perceptions towards innovations derived from developing countries (Prime et al., 2018). According to a plethora of existing literature, there is a general perception that developing countries may not have any valuable lessons to teach HICs (Bhatti et al., 2017; Harris et al., 2017; Skopec et al., 2019). However, previous successful innovations have shown to refute this statement. This may be attributed to the absence of strict regulatory procedures and environment, low threshold of standard approaches and a demand for sustainability and frugality (Prime et al., 2018). Consequently, many of these innovations established in LMICs have shown to reduce costs, improve quality, efficiency, and accessibility with their implementation into the developed world. Given the global need to increase production of protective equipment, ventilators, medicines and vaccines, the narrative and perceptions of FI needs be changed and were changed during the global urgency for resources.

1.4.4 Successful Examples of RI

Companies developing reverse innovations typically stem from local areas or international companies with subsidiaries located in developing countries (Ahmed et al., 2017). Examples of successful diffusion of reverse innovations include General Electric's (GE) portable electrocardiogram (ECG) device (Bhatti et al., 2017; Skopec et al., 2019) and GE's Discovery IQ PET/CT scanner (Malodia et al., 2020). GE is a staple example of a successful reverse innovation as it was originally adopted in China (Immelt et al., 2009) and India (Govindarajan and Manikutty, 2010) then later advanced and modified features to meet the needs of mainstream consumers, thereby disrupting the existing products in the market (Corsini et al., 2020; Koerich and Cancellier, 2019).

1.5 Towards An Inclusive View of FI

Over the years and particularly recently, contributors have developed a collaborative inclusive view of FI that incorporates commercial, psychology, lifestyle, affordability, target markets, functionality, useability, and technological components (Hindocha et al., 2021). An example of this integrative perspective is Hossain's (2016) definition of FI, "*a product, service or a solution that emerges despite financial, human, technological and other resource constraints, and where the final outcome is less pricey than competitive offerings (if available) and which meets the needs of those customers who*

otherwise remain unserved." (Hossain, 2016; Simula et al., 2015). Here, FI is a process of developing simplistic affordable solutions to create value for consumers with restricted or constrained budgets (Simula et al., 2015). This narrative is corroborated by Tiwari and Herstatt's (2013) definition of FI, "…*characterised by affordability, robustness, user friendliness, scalability and having an attractive value proposition*" (Tiwari and Herstatt, 2013).

On the other hand, FI was described as a process that involved a psychological or cognitive paradigm to produce a specific outcome (Soni and Krishnan, 2014). At the basic level, FI can be perceived as a lifestyle or norms of everyday living whilst on the activity level, it can be interpreted as a process that results in a desired outcome which represents the product or service, "*meeting the desired objective with a good-enough, economical means*" (Soni and Krishnan, 2014). In this context, FI was understood to be an outcome of frugal engineering (process). Conversely, FI was also understood to be a complicated, sophisticated process rather than a sole outcome, "*a design innovation process in which the needs and context of citizens in the developing world are put 'first in order to develop appropriate, adaptable, affordable and accessible services and products for emerging markets*" (Soni and Krishnan, 2014).

However, a theoretically driven approach to conceptualising FI was also reported in a critical review exploring and evaluating the typology of several definitions of FI (Bhatti and Ventresca, 2013). Bhatti and Ventresca (2013) proposed a definition of FI that was theoretical grounded from a historical and current perspectives within each individual concept, 'frugal' and 'innovation'. Much like FI itself, its concept is not new and stems back to 1939, but with each application and perspective has form different adaptations. The understanding of FI integrates aspects from its initial introduction and newer, more modern concepts through discussions with social entrepreneurs. The authors then defined FI as "*…a means or an ends, to do more with less, for the many*", which are dependent on three attributes, (1) affordability, (2) adaptability and (3) accessibility" (Bhatti et al., 2018; Bhatti, 2014). All three components are applicable to products, services, processes, business model innovations and all markets (Bhatti et al., 2018).

Before considering the possibility of scaling and diffusion, the barriers and challenges hindering the effective acceptance and adoption of FI and its following transition to other sectors such as policy-making, funding regulations and institutions, need to be explored and examined as contextual issues will impose a significant challenge due to its variation which includes social and cognitive aspects, particularly in LMICs versus HICs (Hindocha et al., 2021).

1.6 Next Steps for Policy, Practice and Research

Despite its increasing popularity coupled with its diversity in perspectives and definitions across various sectors, there is a common understanding and need for a standardised approach to identifying FI as it is unanimous among scholars that its characteristics are distinct from other types of innovation, particularly those with a different geographical context (Rao, 2013), diffusion trends (Hossain et al., 2016), business models (Zeschky et al., 2011) and distribution channels (Simula et al., 2015). Whilst these characteristics may differ against other types of innovations coupled with the lack of a universal definition, many do tend to mirror the basic components of cost or affordability, functionality, accessibility, and sustainability (Basu et al., 2013; Bhatti et al., 2018; Khan, 2016; Weyrauch and Herstatt, 2017). The fundamental tenet of FI is that greater value may be produced while spending less money and utilising existing resources. According to Ratten (2019), a clear definition should comply to three criterions, (1) "*measurable design elements*", (2) "*validity, application to setting or context*", and (3) "*theoretical foundation, supported by research*" (Ratten, 2019). Conforming to this approach for a clear definition, Bhatti and colleagues (2018) developed a definition that is theoretically grounded and integrates the fundamental components present in earlier definitions which are substantiated by examples. A global definition of FI would have various technical advantages including a singular and universal understanding of what it is, how it works, how can it be applied and what is required (Hindocha et al., 2021).

A consistent approach must be created to understand what FI is and how to identify it. One could contest that FI involves a political perspective such that its actual issues surrounding its development such as health inequalities, socioeconomic classification of nations, resource allocation and geopolitical dominance, is dismissed and merely seen as an innovation being developed to cope with the needs of a specific population for that specific time (Hindocha et al., 2021). This challenges the notion of how HICs have accessibility to unlimited resources as opposed to some LMICs who struggle to have the same access. Conversely, one could suggest that this is a unique selling point (USP) or expertise of LMICs that can overcome such barriers as they are consistently exposed to these issues. With this, the identification and application of FI across different contexts through shared learning between different nations, can address some geopolitical power imbalances and assist the acknowledgement that HICs have much to learn from LICs (Hindocha et al., 2021). Perhaps the numerous attempts to conceptualise FI leads to its over-theorisation adding further ambiguity to defining FI resulting in a plethora of definitions and perspectives (Bhatti and Ventresca, 2012; Knorringa et al., 2016; Nari Kahle et al., 2013; Pansera, 2018). However, its comparison to its closest

alternative as opposed to an ill-defined concept may produce a more practical technique to identifying a FI (Hindocha et al., 2021).

Furthermore, upon reflection of this critical review, we concluded that some sources were not peer-reviewed, e.g., The Economist and statements from books. Peer-reviewed articles and information enables a lens to ensure that high-quality research is being published and improves the quality suitable for publication. On the other hand, it could also lower research quality by constricting creativity among researchers. One could argue that to limit or remove articles which are not peer-reviewed, represses scientific knowledge and innovators from pursing novel research ideas and bold research questions that could lead to major advancements and developments in the field of FI. The inclusion of non-peer reviewed articles could dampen or control a westernised ideology of what an innovation is and what belongs in a HIC. In this space, much of the literature is not peer-reviewed. Thus, without considering such knowledge from The Economist and books, the narrative of FI will be controlled by a westernised ideology to which continuous the trajectory of non-acceptance of a FI.

When using this recommended approach to comparing a FI with its closest alternative and incorporating it with the only definition grounded in a theory, if its more affordable, accessible, and adaptable, then it may be classified as a FI (Dallera et al., 2022; Skopec et al., 2021). Irrespective of its plethora of definitions and perspectives, its development and implementation continued and increased attention to knowledge of and market for FI (Hindocha et al., 2021). Nevertheless, collating and synthesising the available definitions of FI has the potential to significantly improve practice and research through developing a reporting group solely for FIs, evaluating the effects of FIs, develop knowledge with evidence of FI resulting in a consensus on how to 'standardise reporting of FIs' (Hindocha et al., 2021; Sharma et al., 2021).

1.7 Conclusion

FI has been put forward as a solution to health system challenges in HICs which leads to issues around RI and how easy it is to transfer innovations from part of the world to another. Many have pondered some interest in whether LMICs can bring a new perspective on healthcare in HICs (Barlow, 2017; Crisp, 2010; Petrick and Juntiwasarakij, 2011; Wooldridge, 2010). However, the transferability of FI into developed health systems have limits such that this flow of adoption is too linear when the reality is more dynamic (Barlow, 2017; Howitt et al., 2012). FI exists in both parts of the world and are adapted and readapted upon trial and error in practice to demonstrate its effectiveness in local contexts (Howitt et al., 2012). However, the difficulty in conceptualising and identifying FI exists due to its

extensive synonymous components with other types of innovation, despite its increasing popularity and attempts to understand and develop FIs with the purpose of resolving issues efficiently and effectively, but this problem may be one that is reciprocal (Hindocha et al., 2021). This is further exacerbated when the overlap of definitions for other concepts such as sustainability, low-income and good-enough innovation somewhat mirror the definition of FI (Hindocha et al., 2021). Despite the convoluted nature of its conceptualisation, efforts should be focused on its aim rather than its definition (Hindocha et al., 2021). It is recommended that FI may be best identified through its comparison with an incumbent alternative as opposed to an unclear concept (Hindocha et al., 2021). Through this narrative, there is value in creating a universal and shared understanding of FI to assist approaches for its successful adoption, acceptance, and diffusion on a worldwide scale (Hindocha et al., 2021).

1.8 Rationale for the Study

The NHS would benefit from adopting FIs that have originated from, or been scaled in, low-income countries (LICs), however there are specific barriers to explore and overcome such as implicit negative perceptions towards innovations conceived in LICs (Harris, Bhatti, et al., 2016; Harris, Weisberger, et al., 2016; Skopec et al., 2019, 2021) and negative perceptions of the term frugality.

Despite the positive trend in publications on FIs, there is a limited amount of literature and empirical evidence exploring the attitudes towards accepting and adopting such innovations into HICs from the perspective of NHS staff and patient representatives. The findings from this study can provide greater insights into these barriers, how to address them and further improve the diffusion of such innovations into the NHS.

1.8.1 Aims and Objectives

Study Aim

To explore the perceptions and challenges to the acceptance of FI at the individual level within the NHS.

Primary Objective

The study will explore how the cues of frugality and country of origin impact on patient representatives' and NHS staff perceptions of different FIs and how contextual characteristics can increase its acceptance for use and adoption.

Secondary Objectives

- To identify the most common contextual characteristics involved in acceptability.
- To explore how these characteristics may influence decision-making.

Chapter 2: Theoretical Background

This chapter provides a theoretical perspective of frugal and reverse innovation (RI) which serves this study's primary topicalisation and research area. Whilst Chapter 1 provided an introduction to innovation, FI and RI, advantages to the NHS and challenges of diffusion, Chapter 2 dives into the trajectory of these challenges and barriers through the lens of prerequisite factors such as acceptability and cognitive bias towards the COO. The COO effect was described as a potential barrier to the diffusion of FI in a HIC as people prioritise this characteristic over brand name, brand reputation and cost. Thus, this chapter provides its ideology, principles, and application to the real world. Furthermore, the acceptance of FI may be a prerequisite for its initial consideration towards implementation and adoption. This chapter discusses the conceptualisation of acceptability and the application of various grounded theories and models of acceptability. This approach can help elucidate the understanding of the variables involved when accepting FI in a HIC to further support and increase its potential for diffusion by identifying and managing active barriers.

2.1 The Consumer Decision-Making Process

Decision-making is a complex process which lead to the development of various explanations by many socialists, behaviourists, and psychologists (Shayo et al., 2012). The process is multifaceted to which consumers are often faced with the processing of multiple tasks at a given time within one action (Bruch and Feinberg, 2017). Decisions can be thought of as equivalent to intent because the end behaviour of evoking the actual decision, is the intention to carry out the action itself. Depending on the invasiveness, risk, cost, functionality and multiple other factors, the decision-making process is every-changing, one that could change within seconds of being exposed to other external factors, e.g., a consumer picks up an item with the intention of purchasing, but as they continue to browse, a second-thought about the initial item may have changed because of an exposure to a potentially more affordable, sustainable or practical alternative, thus the intention to purchase has changed. This action however has stored an external lived experience with the item itself to which the consumer may exchange the item for the initially intended item, which again could be subjected to exposures to various intrinsic and extrinsic cues (Rezvani et al., 2012). Such decisions and its exposure variables are not only important to consumers, but also the marketer or the industry (Abraham and Patro, 2014). The decision-making process involves the digestion and understanding of information portrayed via various mediums such as advertisements, technical specifications, branding, price, status, reputation, affluent sponsorships through celebrities and brand experience (Chattalas et al., 2008).

However, people do not need to experience using the product or service themselves to understand or judge its quality, it can be provoked by vicarious learning and observed learning through which decisions are made based on the perceived quality as opposed to experienced quality (Profeta et al., 2012). This can lead to an action to accept or reject a specific product (Juric and Worsley, 1998). This suggests that such perceptions are not solely based on the COO (cognitive based evaluation) but also involves the influence of experience in any regard to the country to prompt affective product evaluation through psychographic consumer characteristics in relation to country image (Laroche et al., 2005).

2.2 The Country of Origin (COO) Effect

One of the ways to better understand the brand evaluation, perceptions and purchasing behaviour within decision-making is the country of origin (COO) effect. It is an effect that is often prioritised over other considerations such as price, product experience and brand name (Manrai et al., 1998; Tse and Gorn, 1993). Furthermore, sometimes the brand name is strongly associated to the conception's geographical location, also referred to as *country image* (Laroche et al., 2005; Papadopoulos et al., 2013). Many studies have demonstrated the positive effects that the COO provides to products and service through perceived quality, familiarity, can be through vicarious learning or lived (Thakor and Lavack, 2003) and country perception and values as a so-called 'halo effect' (Foscht et al., 2008; Han, 1989; Piron, 2000). The halo effect refers to the dominant, well-known, and often driver characteristic that takes precedence over unknown characteristics stemming from a cognitive bias in human perception (Nisbett and Wilson, 1977). The halo effect results from a perception of a country based on one's idea or beliefs about its economy, politics, and culture, despite having minimal or no knowledge about the country itself and thus influences the evaluation of the product or service (Woo Jun and Won Choi, 2007). Perceptions based on the country's image can influence perceptions about the quality of products due to image transfer, also referred to as the 'summary effect' (Otter et al., 2018). The summary effect involves somewhat of experience with a product from a specific country or with the country itself which is then transferred to the general perception of products and services conceived in that country (Juric and Worsley, 1998).

Over time, research has contributed to the effect on the product itself depending on where it is made or its brand origin (Samiee, 2011), the perception of the country itself and its population (Roth and Diamantopoulos, 2009) and the combination of the effects on the product (Knight and Calantone, 2000). However there has also been a plethora of studies showing the COO having a significant influence on consumer purchasing behaviour (Martin and Eroglu, 1993). Nevertheless, though the role

of the country can serve as a "*powerful predictor*" of product and service evaluations (Papadopoulos et al., 2017) and can offer significant competitive advantage when viewed as positive (Lambert and Jaffe, 1998), there are specific gaps in knowledge to evaluate its success in decision making. This is relation to the degree of the COO effect on evoking the intention to accept a product or service, "*animosity country*" – negative perceptions towards a specific country (Klein *et al*, 1998) and "*country affinity*" – positive perceptions towards a specific country that can act as an enhancer for product placement and reducing the perceived risk to the product use (Adina et al., 2015; Oberecker and Diamantopoulos, 2011; Oberecker et al., 2008; Papadopoulos et al., 2017).

2.2.1 COO Cues

According to Manrai et al (1998), the COO effect should be analysed and considered as an extrinsic cue. The results from this study showed that consumers do consider information about the COO when evaluating the quality of a product. This is heavily dependent upon how consumers view the country and its image, which again is influenced by preconceived views either internally or externally. With the incorporation of global trading, comes a significant amount of available options for many goods and services. But despite this, consumers often tend to stick to their 'norms' or cues without processing the available information which could be provoked by stereotyping subsequently causing a partisanship. Maheswaran (1994) suggested that the COO demonstrates a stereotyping process that can affect product evaluation in three ways (1) the COO serves a signal – consumers may generalise perceptions of product quality from a specific country against all products from that country (Hong and Wyer, 1989), (2) COO serves as an external cue (Li and Monroe, 1992) and (3) COO as a heuristic cue to simplify product evaluation (Hong and Wyer, 1989). According to Fishbein and Ajzen (1975), attitudes towards products are the expressions of value. The image of a specific country can be described as "*a three-dimensional concept consisting of cognitive, affective and conative components*" (Laroche et al., 2005), which refers to one's beliefs, feelings and behavioural intention towards an attitude or action based on these attitudes (Ajzen, 1989).

2.2.2 COO Effect on Consumer Behaviour

Research on the COO effect on consumer purchasing behavioural research have often led to ineffective associations and contributions of products and services with specific countries and their imagery due to disparate and incompatible positioning. Numerous studies have focused on the attitudes of one specific country or an economically classed set of countries e.g., LICs or HICs. Therefore, the consumer perceptions may not be unique to that country as its subjected to multiple

external factors and specific branding. Chryssochoidis et al (2007) showed the presence of multidimensional factors on the COO effect such as the economic, socio-cultural, political and technology. However, the intention of acceptance or consumer preference is largely based on the cognitive factors on how an individual can process that information with the acquired skill and practice they already possess alongside the self-efficacy in making such decisions. Traditionally and corroborative of previous research, consumers tend to have a positive perception towards products developed in HICs as opposed to those conceived in LICs (Bilkey and Nes, 1982; Orth and Firbasová, 2003; Profeta et al., 2012).

These perceptions are everchanging due to differences in lifestyle, technological advancements, and different marketing mediums (Chuin and Mohamad, 2012). But, whilst this information can demonstrate temporal changes in positive and negative perceptions, it does not illustrate the variables and drivers involved that elicit the change and how they can be identified, managed and monitored over time. Additionally, previous research does not demonstrate the factors involved when accepting products conceived in LICs in a HICs, particularly across different industrial sectors individual versus (vs) together such as automobile vs agriculture or healthcare vs food industry and how they may differ in decision-making e.g., invasive vs non-invasive, GMO vs non-GMO. The potential differences can be attributed to operational country-specific elements such as cultural identity, religion, political climate, language, history, economic, technological development such as history of innovation development and people (Kaynak et al., 2000). According to Brijs et al (2011) these operational country-specific factors can be regarded as a "*triple-component attitude construct*".

However, product categorization has often suggested a conventional mismatch approach to how a country is perceived and its effect on product development. For instance, Germany has a positive perception in the automobile industry but less positive in clothing manufacturing. Nevertheless, there are some product imagery country-specific contradictions whereby the perceptions of the product are positive despite negative perceptions about its COO, e.g., Africa generally has a negative image in regards to political and innovation development but its agricultural industry has a positive image. These perceptions have managed to reduce its attractiveness of products overall except ones that the country is most known for producing. This begs the question, why accept products from a country that has an overall negative imagery. On the other hand, HICs such as the USA and UK whilst have a strong country-specific imagery and overall branding, it has certain negative associations that do not diminish perceived product attractiveness (Martin and Eroglu, 1993; Morgan et al., 2004; Tse and Gorn, 1993) compared to those of Africa. This begs the question, how are HICs able to retain its positive

perceptions and continue to increase sales despite the widely publicised controversies e.g., colonialism, genocides, abortion laws and slavery. Thus, 'the effects imposed by a specific COO are both product category-specific and country-specific' (Adina et al., 2015; Lampert and Jaffe, 1998). The COO effect can be analysed on the cognitive, affective and normative levels (Verlegh and van Ittersum 2001) through the decisions made about a product or service focusing on four dimensions, product attributes, product benefits, emotions about the product and personal values (Chryssochoidis et al., 2007; Dibley and Baker, 2001; Leão and Mello, 2007).

2.2.3 COO Dimensions (Cognitive, Affective and Normative)

According to Nagashima (1970, 1977) there are five dimensions that could affect the COO, namely price and value, service and engineering, advertising and reputation, design and style and consumer profile (Balabanis and Karpova, 2022; Balabanis and Siamagka, 2017). The product's attributes refer to abstract features such as size, shape, colour, smell and material which can promote its benefits or advantages such as lightness, portability, and cost. These benefits lead to values meeting consumer needs, expectations, requirements, and motivations (Keller et al., 2011). On a cognitive level the effect is more surface level as its reflective of the product quality whereas on the affective level, the effect is more rooted as it incorporates the symbolic and emotional association such as status or judgement (Adina et al., 2015). Contrastingly, the normative level explains a consumer's right to reject or dismiss the brand altogether as its COO does not support their values or beliefs such as countries with a high level of child labour or controversial laws such as abortion law in the USA (Verlegh and Steenkamp, 1999). According to Dichter (1962) the COO could have a "*tremendous influence on the acceptance and success of products*". Schooler (1965) found significant differences in the product evaluations that were consistently identical in all elements except for the country named on the product, the "*made in*" label effect. The COO is not just used in decision-making but may also connect a product to the country-product imagery with sensory, affective, and ritual connotations (Ostberg, 2011).

Cognitive Aspects

The COO cue for product quality occurs on a cognitive level, in that consumers inflict self-efficacy, such that their beliefs about a product produced in a specific country is of high quality as is therefore a cognitive evaluation of the country (Otter et al., 2018). This cognitive evaluation can be either positive or negative based on specific country dimensions through its country's overall image (Kaynak et al., 2000) and often deems perceived quality as superior (Zeithaml, 1988). The belief system and its rationality when making decisions involves the processing of cognitive information regarding the

particular country that in turn affects how the product is evaluated. According to Payne (1982) decisions based on such cognitive beliefs should be based on specific situations to reduce the cognitive effort (Shugan, 1980). The contribution of the COO effect can vary to different degrees according to particular circumstances and particularly type of product (Rashid, 2017). Two principles occur within perceived quality, (1) design quality, *evaluates the process from conception to development stage* and (2) manufacturing quality, *refers to the quality of the materials used to develop the product and its assembly* (Adina et al., 2015; Insch and McBride, 2004). The results found in the Schooler (1965) study demonstrates that the effect of the "*made in*" label serves as a quality dimension of product evaluation. Quality cues (attributes) can be of intrinsic nature (product focused), referring to performance, portability, connectivity, colour, taste, smell, feel (Afoakwa et al., 2007; Viaene and Januszewska, 1999) or extrinsic nature (external properties) referring to its price, brand, retailer reputation, COO and regulatory approvals (Abraham and Patro, 2014).

According to Abraham and Patro (2014), extrinsic cues are used as proxies to evaluate such perceptions to intrinsic cues as they cannot be evaluated without using or purchasing the actual product first. However, Verlegh and Steenkamp (1999) refutes this as perceptions can be based on vicarious learning through external factors such as media and marketing. The COO can therefore be referred to as an extrinsic cue as it does not differ from external properties such as price and brand name (Dawar and Parker, 1994; Rezvani et al., 2012). A plethora of studies have demonstrated that such cues act as signals for product quality (Dawar and Parker, 1994).

The COO can be used as quality tool for assessing a products' reliability, safety, durability, sustainability and thus lowering the perceived purchasing risks and is particularly enhanced in purchasing circumstances when there is a dearth of information about the product (Lobb and Mazzocchi, 2007). Individuals will process information that is familiar to them to evaluate and circumvent the unfamiliar attributes (Maheswaran, 1994). For popular global brands such as Apple, Samsung, Microsoft and Mercedes, the COO tends to be less important (Schaefer, 1997) as brand perception overrules the general perception, particularly as most will have experienced products and services or interacted with the brand in some capacity previously and thus will transfer to its overall perception of any product developed by the brand prospectively, thus in some way the brand name is equivalent to their perception of its COO. Despite the COO being referred to as a contributory factor in product evaluation (Papadopoulos et al., 2013, 2017), it is challenging to dissociate brand perceptions from COO perceptions (Profeta *et al*, 2012). It can be suggested that the more information or cues presented to consumers, the more complex and multifactorial the decision-making process

becomes which subsequently evokes a particular action (Samiee et al., 2005). The degree of COO influences varies according to consumer involvement (Teuber, 2010) and risk. However, some researchers (Hong and Wyer, 1989; Li et al., 2009; Liu et al., 2021) suggests that the impact of COO cannot be fully understood through a quality signaling process as it also serves as a symbolic and emotional meaning to consumers (Verlegh and Steenkamp, 1999).

Affective Aspects

The emotional meaning attached to the COO effect resonates with the affective level in that such meanings and associations can stem from direct experiences such as interaction with the country through travel or ancestry or indirect experiences such as education, media, stereotypes and word of mouth (Verlegh and Steenkamp, 1999). These affective feelings of pride, reputation through social status, power, superiority, a specific lifestyle may provoke the feeling of one's involvement in the country's products (Laroche et al., 2005; Papadopoulos et al., 2017). Emotional closeness to a certain COO can be used as an affective moderator variable and is appropriate in connection with the quality perception, willingness to purchase, product experience and is represented through indirect or direct country experience (Harmeling et al., 2015). According to Rashid (2017), the affective level of COO can occur without processing or being cognitive to the available information such as image and is rather facilitated through expression of confidence than a cognitive evaluation. It provokes a 'chicken-and-egg effect' (Abraham and Patro, 2014; Adina et al., 2015; Lee and Lee, 2009) such that despite what level dictates the perception, both can influence each other in various way (Zajonc and Markus, 1982). Thus, whilst cognitive aspects relate to beliefs associated with the geographical location of a product, affective aspects refer to emotions and feelings prompted by the place of origin (Luomala, 2007). These emotions can result in a positive or negative reaction towards foreign countries (Klein and Maybin, 2012; Oberecker and Diamantopoulos, 2011) or attachment (lack of) to the home country (Fischer and Zeugner-Roth, 2017; Josiassen, 2011), thus inflicting a perception of national identity.

Consumers can possess an affective association with a specific country which produces affective emotions that can either be learned through experience or vicarious or observed learning through various mediums. Consequently, brand image is used to state a preference in expressing a certain lifestyle which develops a sense of identity and self-expression – 'the individual's style' (Munteanu and Pagalea, 2014). Furthermore, affective aspects of COO can work in two dimensions in the event that country perceptions are significant such that consumers can evaluate a product being superior because of their attachment to a country but also negative towards its country overall. Obermiller and

Spangenberg (1989) found that Arab-Americans evaluate products from Israel as superior but were negative towards the country itself because it was conceived in Israel thus such aspects are driven by thoughts and feelings as opposed to cognitive aspects of processing information in a skilful manner. Country image can thus represent a sense of expression and self-esteem through the processing of positive emotions such that brand personality aligns with the consumer's personality (Adina et al., 2015).

The affective aspect of COO has an impact on the symbolic value to consumers such that they may hold an emotional attachment to their home country and its subsequent products (Ostberg, 2011). Consumers evaluate a product through affective processing when it is associated with a brand from a favourable country irrespective of the products' actual COO (Rashid, 2017). For self-satisfaction, consumers seek to identify themselves within the brand (Aaker, 1997). Various studies have shown that the brand name predicts consumer product evaluations more accurately than COO (Cordell, 1993; Erickson et al., 1984) as they often formed attachments to the brand itself as opposed to the COO, which taps into the residing emotions through lived experiences. However, these emotions and expressions can inflict an affinity or animosity towards the COO, and despite its dearth in literature, it may be implicitly assumed to mirror one another such that low animosity would suggest high affinity towards a COO and vice versa (Chao et al., 1995; Papadopoulos et al., 2017). Consumer affinity can be generally described as feelings of preference, favourable, sympathy or attachment to a specific country which could act as an important predictor of purchasing behaviours (Oberecker and Diamantopoulos, 2011).

Such affinity feelings are affective-based and could be aimed at culturally proximate countries (Oberecker et al., 2008; Swift, 1999) or 'attractive places' associated with one's social identity (Nes et al., 2014). These feelings may impact the willingness to purchase directly without much involvement of cognitive judgement (Vida and Reardon, 2008). In contrast, animosity refers to the general beliefs about the superiority of one's own country's product (Papadopoulos et al., 2017). Similarly, to affinity, animosity also influences the willingness to purchase directly but without affecting the beliefs about the quality of the country's products (Harmeling et al., 2015, 2017). Consumers are less likely to purchase products from a country that has inflicted a deep-rooted negative perception on its own country causing animosity. For instance, the British boycotting purchasing goods from Germany during World War I and II (Amine et al., 2005). Germany public opinion towards purchasing goods from Jewish owned stores through the effects of the Holocaust (Podoshen, 2009) and the 50-year ban on Japanese products in South Korea after World War II, which has since been lifted as of 2002 (Leong *et al*, 2008).

Such effects on consumer's values through social and personal beliefs can impact consumer purchasing behaviours and their overall perception of brand and COO respectively. However, these deep-rooted social norms may become part of one's reality in regards to a moral or ethical consciousness such that the perceived quality may be positive but the association of its COO with normative mechanisms dampens the effect on its overall country thereby reciprocally affecting purchasing behaviours from that specific COO irrespective of quality.

Normative Aspects

Normative aspects of COO effects refer to one's personal, social, moral or ethical norms regarding the purchase and use of products from a particular country or origin (Verlegh and Steenkamp, 1999; Verlegh and van Ittersum, 2001). Ethnocentrism can be described as "*the view of things in which one's own group is the center of everything, and all others are scaled and rated with reference to it*" (Sumner, 1996) and can demonstrate the association between social and moral norms. Furthermore, consumer ethnocentrism is focused on the economic lens with an emphasis on consumer "*beliefs*" that are central to morality of purchasing foreign-made products (Balabanis and Siamagka, 2017; Chryssochoidis et al., 2007; Orth and Firbasová, 2003) Consumers may boycott products and services from specific geographical regions due to political, economic or ethical concerns such as child labour or human slavery in so-called "*sweatshops*" that violate fair wage, safety laws or enforce long working hours (Rudell, 2006) or may want to purchase only from local communities to boost local economy, "*buying domestic*" to contribute towards a bigger cause (Bartley and Egels-Zanden, 2015; Ostberg, 2011; Phau and Chao, 2008).

Consumers may evoke the intention to purchasing products from developing countries that are made through a fair-trade production system (Hyllegard et al., 2012) to which many well-known companies in HICs now collaborate with such as Starbucks and Nescafe. Examples demonstrating these some of these moral effects are consumers boosting and driving sales of Black-owned businesses during the Black Lives Matter movement, which sought to address systemic problems and needs faced by Black people around the world. Normative pressures e.g., peer pressure or environmental norms and motivation to comply with a particular norm e.g., purchasing from countries that have animosity to one's home or residing nation may impact the overall product evaluation (Erickson et al., 1984; Fishbein and Ajzen, 1975). Furthermore, consumerism dictated by ethical decisions, environmentally friendly, sustainable and fair-trade initiatives, can develop negative sentiments or anti-consumption towards products by other brands who do not meet these values e.g., consumers who adopt

sustainable consumption will adopt an anti-consumption behaviour towards goods that are not sustainable (Garcia-Ruiz and Rodriguez-Lluesma, 2014).

However, these moral values and thus obligations could also spread to specific brands which in turn evokes a general perception that aligns with stereotyping behaviours belonging to specific countries such that many retail consumers globally in 2022, started boycotting sales and spearing the so-called 'cancel culture' of the Shein clothing brand, a Chinese (though headquartered in Singapore) fast fashion retailer, due to consumers receiving items that had placed warning messages within their clothing items such as "*help*" written on the washing instructions label. This fits in within the stereotype that China employs minors, continues to force labour and pay less than minimum wage. Though the stereotype existed prior, consumers tend to compartmentalize their needs to their moral values as people want to pay less for products despite perhaps being subconsciously aware of its reasoning for low prices and possible ethical concerns.

However, an inverse effect can occur as consumers sympathise with struggling communities and purchase their products (Luomala, 2007). These "*buying domestic*" patterns depend on consumers' ethnocentrism and their perceived moral obligation to their own country or region. Normative aspects through boycotting are associated with both cognitive processing and emotional experiences (Luomala, 2007), as consumers may consider the purchasing of domestic goods as the "*right way of conduct*" as purchasing foreign goods may be "*unpatriotic*" (Rashid, 2017) and reduce the success of domestic economy and put local populations at risk of work (Shimp and Sharma, 1987; Wall et al., 1991). Many researchers call for a distinction between country image and normative predispositions, though they can both interact with one another in decision-making (Bartsch et al., 2015; Oberecker et al., 2008) as consumers may perceive products from a specific country as high quality but may still not purchase due to moral reasons (Herche, 1992; Josiassen, 2011; Verlegh and Steenkamp, 1999).

By linking sentiments of affinity or animosity towards specific countries, consumer ethnocentrism and disidentification are normative variables that influence the relationship between COO and consumer purchasing behaviours such that one accepts or rejects products conceived in certain nations dictated by a moral or social consciousness (Adina et al., 2015). There may be other country-related norms that lead to consumers evaluating products through a normative process such as "*Buy American*" could be a normative belief (Erickson et al., 1984). Thus, ethnocentrism is a biased belief system with nationalistic sentiments (Papadopoulos et al., 2013, 2017) and deviates away from internationalism or cultural assimilation (Rawwas et al., 1996). Watson and Wright (2000) showed that consumers from

HICs preferred domestic products than foreign products and this demonstration of behaviour can be generalised in consumer purchasing habits and decisions. Disidentification refers to the dissociation of goods from one's own country and thus implies the infliction of internal country animosity such that there is a negative bias towards locally produced goods to differentiate oneself from the quintessential domestic consumer (Adina et al., 2015). According to Josiassen (2011), disidentification could be significantly linked to current positions on religions, politics, ethnicities, age, interest groups or associated stereotypes. Winit et al (2014) found that ethnocentric consumers are inclined to purchasing goods at a higher cost for domestic brands or locally owned brands compared to foreign-owned brands to a certain extent known as 'price difference acceptability threshold'. Thus, these consumers favour local brands despite the increase in price. These elements mediate customer knowledge, attitude and perception formation, which adds additional context to prospective product evaluations (Brunsø et al., 2004).

2.2.4 Practical Context of the COO Effect

It is particularly important to explore this interpretation in the context of the current climate in which the world faces a global pandemic called the COVID-19. In previous years, the developing world such as Africa and India have faced a global epidemic and have still managed to control its consequences with limited resources. Thus, it would be prudent for the developed world to learn from countries who have a faced a similar challenge. Although the developments from Europe and USA have been well documented and internationally reported, little is known about the developments in Africa regarding limiting the spread and testing of the COVID-19 virus. For example, Senegal-based DiaTropix (*also in collaboration with Pasteur Institute in Dakar*) and UK-based Mologic worked in collaboration to develop the $1 diagnostic test for COVID-19, obtaining test results in just 10-minutes (Adebayo, 2020). This partnership demonstrates that Africa has the capacity to conceive innovations and adds a significant contribution to global health. But despite this positive shift in collaborative learning and partnerships, many consumers are fixated on their preconceived perceptions of high-quality research, products and services which inhibits the acceptance and diffusion of any development from a LMICs.

Kerbouche et al (2012) found that consumers considered products manufactured in China to be cheap, outdated and lacked quality in comparison to HICs. The same type of notion was reported in previous years as Manrai et al (1998) found positive evaluations towards products produced in developed countries in comparison to the negative evaluations for products produced in the developing countries. Contrary to the results found in these studies, the manufacturing of Apple products does not seem to negatively influence the consumer's evaluation of its products. Apple continues to

increase its shares which lead them to become the first trillion-dollar public trading company in the world with the largest market capitalisation in the technology sector in 2018 (Laricchia, 2023). The shift in perceptions or processing of information may have been provoked by changes in the external cues. This is an example of how a “made in” and “designed in” label can influence a consumer’s decision-making when purchasing products from a high notable brand and the distinction between quality cues which refers to the product itself and extrinsic cues which are associated with the externalities such as brand, price and country-of-origin (Adina et al., 2015).

The changes in external cues may have been elicited by the increase in global cultural acceptance and broader perceptual changes. Likewise, it may have been caused by the changes in experiences either personally or by spoken communication within consumer circles e.g., family and friends. However, despite this positive shift and international collaborations, still exists negative perceptions towards products, services, ideas, and knowledge originating in LMICs. Subsequently, this would lead to a negative perpetuation in the diffusion of reverse FIs and bidirectional learning. The information leads to the question whether these concepts contribute towards informed decision-making or are these decisions made significantly on biases based on multidimensional factors which cannot be explored due to insufficient evidence. Or should the implementation of foreign products be enforced within shove policies as a way of achieving the defaulted outcome to save costs for the NHS as consumers are not typically given a choice in the type of equipment being used.

2.3 Application of Theories of Acceptability

2.3.1 What is Acceptability?

Acceptability can be considered as a cognitive, sociological, and psychological construct with a general definition meaning a ‘positive decision to use an innovation’ (Taherdoost and Masrom, 2009). Acceptability is also important to understand as it addresses the needs and expectations of all consumers (Sekhon et al., 2017). User acceptance can be defined as the willingness to adopt an innovation at an individual level (Taherdoost, 2018). After reviewing literature across multiple databases (Medline, Scopus, PsychINFO and Google Scholar) and using forward citations, to my knowledge thus far, acceptability has not been thoroughly explored in the context within frugal and reverse innovation. But despite this, there is much to learn about the acceptability process and its fused dimensions and frameworks implemented within other sectors and other innovation variants, as this information could be translated into the different streams of business (Arbelaez Garces et al., 2016).

2.3.2 Acceptability Factors of FI

According to Tiwari et al (2017), acceptance of FI and its associated societal value may be related to the difference in social contexts between the developed and developing world. In this study, Indian and German students were asked to state their preference in a hypothetical context of purchasing a car to explore the acceptance and preference to frugal cars. These were students all holding a degree in Engineering, with some knowledge of intercultural management and communication but with limited knowledge of FI (Tiwari et al., 2017). These students were asked to imagine having no restrictions to funds thus could afford a high-end luxury car with advanced technology or a frugal car that met the basic needs with better fuel emissions so that the cost of the car was 33% cheaper than the high-end car, but both models met their core needs (Tiwari et al., 2017). They were then prompted to arrange their answers according to the price-point and total cost of ownership (*purchase price + operating costs*) which further elaborated their motivation towards the stated preference (Tiwari et al., 2017).

The study showed that 68% of Indian students preferred the frugal model in comparison to 61% as stated by the German students. Overall, students from developing world (31 out of 40; 78%) had an above-average preference for the frugal model, while students from the developed world (47 out of 71; 66%) were not far behind (Tiwari et al., 2017). The strongest motivation for preference towards the frugal model for both categories of students was "save money (for some other purchase)" in which no Indian student selected rejecting purchasing a status symbol (0%) (Tiwari et al., 2017). In addition to saving money, the preference of German students seems to be influenced by environmental concerns and intentional rejection of status symbols (43%) (Tiwari et al., 2017). The results "*indicated that frugality in India is often motivated by financial considerations that can be easily correlated to cultural dimensions like long-term orientation and restraint"* (Tiwari et al., 2017). Thus, it is likely that the determinant factors of acceptance of FIs vary according to the specific social context and subsequently may affect the developed world and developing world differently. However, as for the factors which dictate the acceptance and adoption of FIs in developed countries like Germany, remains unclear (Tiwari et al., 2017).

An empirical study by Jaakkola and Renko (2007) aimed to investigate which product-related characteristics, physicians (*first-level adopters*) use to evaluate the acceptability of a new pharmaceutical product format. They posited that professional service providers act as 'surrogate adopters' as they decide on the acceptance and adoption of the product aimed at their patients. The authors used a qualitative research approach in part using Roger's Diffusion of Innovation Theory, to

explore which product characteristics physicians would typically use to assess the acceptability of a pharmaceutical product such as new drug (Jaakkola and Renko, 2007). The study incorporated humanism as an approach to explore the reasoning behind the physician's choice of acceptability characteristic.

The researchers interviewed physicians who were asked to evaluate new, innovative medical drug product format which was developed by Research and Development experts. Physician evaluations were therefore based on perceptions rather than experience with using the product (Jaakkola and Renko, 2007). During the interviews, physicians were given a description of the product and shown a prototype of the product under evaluation. They were then promoted to evaluate the product by answering questions that would reflect the advantages and disadvantage. The results showed the need to redefine the existing theory on innovation adoption by firstly adding more distinctive features to the distributed decision-making approach and a refinement to the traditional adoption models (Jaakkola and Renko, 2007). Secondly, the results indicated that innovation characteristics cannot be assessed without considering the adoption context, which in this study was the interactional absence of a pharmaceutical representative and its institutional environment (Jaakkola and Renko, 2007).

According to Aubert and Hamel (2001), an innovation may be more readily adopted by the user, if it is associated with affluential capabilities or properties and thus draws on the social perceptions (*aspirations*) or attributions to culture in relevance to adoption (Lyu et al., 2023). For example, electronic cars are more appealing if one observes public figures of interest driving the same model as a representation of prestige and commodity. Chen et al (2007) proposed that one's behaviour is dictated by their need to behave how others do or think how they should, also referred to as '*social influence*'.

2.4 Acceptability Models (Theory and Application)

There are various different theories and models that explore and analyse user acceptance which can help predict the acceptability of a specific innovation such as Diffusion of Innovation Theory (DOI) (Rogers, 2003), Social Cognitive Theory (SCT) (Bandura, 1986), Theory of Reasoned Action (TRA) (Fishbein, 1967), Theory of Planned Behaviour (TPB) (Fishbein and Ajzen, 1975), Reasoned Action Approach (RAA) (Integrative Model (IM) (Fishbein and Ajzen, 2011), and Theory of Interpersonal Behaviour (TIB) (H. C. Triandis, 1977). These theories have provided pivotal knowledge and principles of modern influential factors on human behaviour and the cognitive processes involved in decision-

making in parallel to acceptability particularly in health technology (Rahimi and Jetter, 2015). The next section will provide a brief review of the current literature exploring some of the most implemented adoption models and theories regarding acceptance of an innovation.

2.4.1 Diffusion of Innovation Theory (DOI)

One of the most popular theoretical conceptualisations of innovation acceptance and adoption behaviour is the Diffusion of Innovation (DOI) theory (X. Zhang et al., 2015). The theory, developed by Everett Rogers in 1962, explores the process of innovation diffusion overtime and investigates the acceptance through different adopter characteristics of an innovation (Rogers, 2003). This model can help explain how an innovation can be accepted and which channels need to be targeted in order to translate the conception of an innovation.

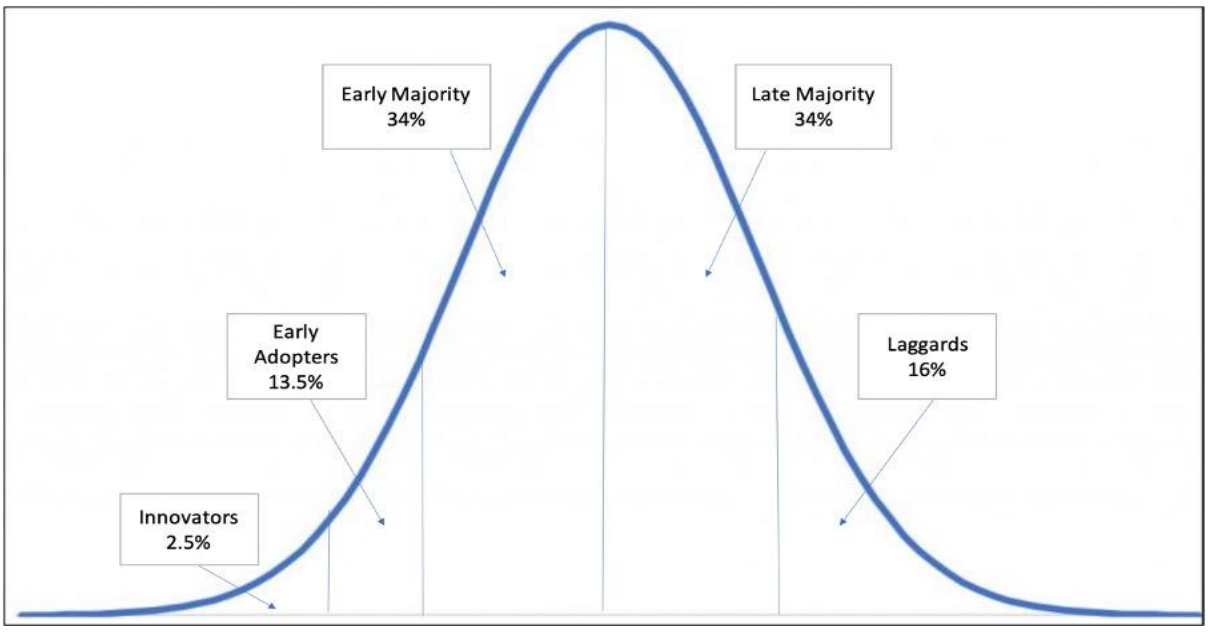
The DOI model is made up of four characteristics: (1) innovation; (2) communication channels; (3) time and (4) social system (Rogers, 2003). Diffusion involves an *innovation* (1) *being communicated via specific channels* (2) *over time* (3) *among the social systems* (4) (Rogers, 2003). Communication channels refers to the vessel through which consumers acquire information about the innovation and its perceived usefulness which involves interpersonal communication (Dearing and Cox, 2018). According to Rogers (2003), the four elements are identifiable in every diffusion study and can be adopted at both the organisation and individual level to assess acceptance with a theoretical foundation on a global scale. This model incorporates adopter characteristics, innovation characteristics, and innovation decision process (Dearing, 2009). Under the innovation decision process, confirmation, knowledge implementation, decision and persuasion go through a series of communication channels among the members of a similar social system over a period of time (Dingfelder and Mandell, 2011).

There are 'five constructs under the characteristics of an innovation process: (1) relative advantage; (2) compatibility; (3) complexity; (4) trialability, and (5) observability, which were proposed as influential factors on innovation acceptance (Dillion and Morris, 1996). The first step, relative advantage refers to the consumers decision-making in pre-assessing whether the innovation is more beneficial than the existing technology prior to the adoption of an innovation (Min et al., 2019). Compatibility refers to whether the innovation is consistent with consumer needs, expectations and values (Lien and Jiang, 2017) thus the more an innovation can integrate such characteristics of compatibility, the greater the chance for its acceptance and adoption. Complexity measures the degree of difficulty to understand and ease of use (Rogers, 2010). Trialability refers to the extent to

which an innovation can be experimented without the need to commit (Dearing, 2009). An innovation that has the ability of allowing potential users to test its service, has greater aptitude for its acceptance and adoption. Observability refers to the extent to which the benefits are tangible to the potential users (Dearing et al., 2006; X. Zhang et al., 2015).

However most notably, the DOI model is known for its five core constructs that sum up the adopter characteristics: '(1) innovators (individuals who have extensive knowledge about the target market *"brand followers"* and are typically first in line to accept and adopt the innovation); (2) early adopters (individuals who allow some time to risk assess and read reviews about the innovation to ensure that it does what it states prior to acceptance and adoption, less riskier than innovators); (3) early majority (when an innovation starts to make great financial profits immediately after the introduction of the innovation, when competition starts to develop similar innovations); (4) late majority (consumers who tend to wait until the 'trial run' or 'hype phase' is over to accept and adopt the innovation, associated with less risk and produces cheaper alternative for consumers due to possible price reductions overtime) and (5) laggards (individuals who do not actively accept nor adopt the innovation but can still experience it in some ways, not the target market, tend to avoid change until their dependent innovation is discontinued leaving them to force acceptance and adoption)' (Rogers, 2003), (See Figure 1).

Figure 1: Diffusion of Innovation (DOI) Theory (Rogers, 2003)



Overall, the DOI model tends to reveal what type of consumers to focus on and at what time through specific communication channels to provide a prediction model of what consumers at a specific time will accept and adopt the innovation (Rogers, 2010; X. Zhang et al., 2015). This would enable a company to save cost by integrating a price model by engaging with the specific target market using escorted advertising during a certain time prone to increase acceptability and lead to its subsequent profit (Rogers, 2003). It also allows companies to address the target market chain according to profit overturn (Rogers, 2010). A review of technology acceptance models and theories by Taherdoost (2018) suggested that the DOI model is more concerned with systematical and logistical characteristics and influences, specifically on an organisational level. The review continues to state that the DOI model does not provide an exploration on human behaviour and yields less power for predicting the outcomes of acceptance and the subsequent adoption of an innovation. Conversely, other models and theories such as SCT, TRA, TIB and TPB, focus on exploring human behaviour and decision-making and thus incorporates preference and perception values, with an overall polarisation at the individual level.

Application of DOI

Moore and Benbasat (1996) study aimed to explore the adoption of an information technology (IT) by the end-user. They developed a hybrid model based on characteristics they found to have the most influence on individual level perception and decision-making regarding IT adoption. These characteristics were derived from the DOI and the Theory of Reasoned Action (TRA) (Moore and Benbasat, 1996). Data was collected from both users and non-users of personal work station (PWS) in seven public and private organisations (Moore and Benbasat, 1996). Data was collected from 540 participants in different organisational levels ranging from "*Executive*", "*Supervisory*", "*Technical*" to "*Clerical*" (Moore and Benbasat, 1996). Variables to assess perception characteristics included, "*Image*", "*Relative Advantage*", "*Compatibility*", "*Ease of Use*", "*Result Demonstrability*", "*Trialability*", "*Visibility*" and "*Computer Avoidance*" and subjective norms at different role levels ranging from "*Peers*", "*Supervisors*", "*Senior Management*" to "*Subordinates"* (Moore and Benbasat, 1996).

The results found that subjective norms and all perceived characteristics seemed to have an influence on one's decision to adopt in both groups of "*adopters"* and *"non-adopters"* (Moore and Benbasat, 1996). Non-adopters reported neutral to slightly negative perceptions on subjective norms e.g., a negative subjective norm meant that there was no expectation to use the PWS by the participant's referent individual. Adopters reported significantly more positive norms (Moore and Benbasat, 1996).

Thus, attitude and subjective norms were shown to influence one's decision to adopt the IT after its trial. Referring to Rogers' DOI constructs, ease of use, relative advantage and compatibility were the most significant determinants on perception (Moore and Benbasat, 1996). Results showed that the adapted hybrid model of interlinking perceptional characteristics was a reliable and effective tool to investigate adoption of an IT application (Moore and Benbasat, 1996).

DOI Summary
• The DOI theory, developed by Everett Rogers in 1962, explores the process of innovation diffusion overtime and investigates the acceptance through different adopter characteristics of an innovation. • The DOI concept is the most applied theory in innovation adoption. • The DOI model is made up of four characteristics: (1) innovation; (2) communication channels; (3) time and (4) social system. • Diffusion involves an *innovation* (1) *being communicated via specific channels* (2) *over time* (3) *among the social systems* (4). • Can be applied at organisation and individual level on a global scale. • There are 'five constructs under the characteristics of an innovation process: (1) relative advantage; (2) compatibility; (3) complexity; (4) trialability, and (5) observability. • Adoption of an innovation does not occur concurrently in a social system but rather is a process of behaviours and preferences over time. • Characteristics of consumers who adopt an innovation early (upon induction) and later (maturation of innovation) differs significantly. • DOI model is known for its five core constructs that sum up the adopter characteristics: (1) innovators, (2) early adopters, (3) early majority, (4) late majority and (5) laggards.

2.4.2 Theory of Reasoned Action (TRA)

The Theory of Reasoned Action (TRA) was initially developed by Martin Fishbein in 1967 and further adapted with Icek Ajzen in 1975 (Ajzen, 2012). TRA has become a leading 'conceptual framework for predicting, explaining and changing human social behaviour' (Ajzen et al., 2007). The purpose that TRA serves is to understand the psychosociological behaviour and its interaction with beliefs and evaluation, attitudes, normative beliefs, and behavioural intentions (*see Figure 2*) with a study on persuasion (Dillard and Pfau, 2002). However, there are various different determinants that influence beliefs such as personal factors (*self-esteem, personality traits,* emotions), demographics (*age, gender, race, ethnicity,* education) and environmental factors (*health conditions, media exposure, interpersonal connections*) (Ajzen and Albarracin, 2007).

TRA uses a mathematical formula to help predict behaviour and intent based on pre-existing perceptions and attitudes to provide a focused behavioural change intervention (Heller et al., 2013). Fishbein and Ajzen posited that one must focus on a particular behaviour and then explore the antecedents that can help predict and explain that particular behaviour thus acquiring the basis for an intervention to change that behaviour (Otieno et al., 2016). The TRA would help elucidate the challenges to accept and adopt different innovations as it provides explanations about perceptions that may be informing one's decision but also provide information on how to modify these attitudes and behaviours towards adoption.

At the core of behavioural analysis lies the intent to perform a particular behaviour (Al-Suqri and Al-Kharusi, 2015). As one ponders their intent, they consider three independent characteristics: (1) beliefs or attitudes, (2) subjective expectations and (3) perceived behavioural control (Sarver, 1983). Belief as defined by the Oxford dictionary means "*any proposition (1) that is accepted as true on the basis of inconclusive evidence. A belief is stronger than a baseless opinion but not as strong as an item of knowledge. More generally, belief is conviction, faith, or confidence in something or someone*" (Oxford Reference, 2023b) resulting in a prepositioned consequence and thus attitudes are derived from beliefs (Ajzen, 2012). For instance, an individual exercises (behaviour) every day because of their belief in that it would avoid weight gain, and thus is a belief about exercising.

Attitude can be defined as "*the way in which a person views and evaluates something or someone. Attitudes determine whether people like or dislike things – and therefore how they behave towards them*" (Oxford Reference, 2023a). For example, exercising every day to avoid weight gain is the attitude towards exercising and thus results in a favourable attitude towards the exercising (behaviour). Intention is defined by "*the state of mind of one who aims to bring about a particular consequence*" (Oxford Reference, 2023c). The subjective norms refer to the probability that an individual, influenced by social pressures, will or will not perform the particular behaviour (Becker and Gibson, 1998). According to Ajzen and Albarracin (2007) perceived behavioural control refers to an individual's capability to perform the particular behaviour. Thus, the more favourable the attitude, subjective norm and the stronger the perceived control towards a particular behaviour, the greater the intent to perform the behaviour (Ajzen, 2012).

As one often has control of their behaviour, the intention is predictive when an opportunity rises to perform the particular behaviour of interest and therefore intent is perceived to be a direct antecedent of behaviour (Ajzen, 1989). The behavioural intent is developed by the evoked belief and its subsequent attitude towards the behaviour and thus elicits the particular behaviour (Rahimi and

Jetter, 2015). The intentions and perceived behavioural control can be used as predictors of actual behaviour as the intention serves as a greater output than the actual behaviour itself (Ajzen and Fishbein, 1980). Thus, each belief results in a certain outcome. As previously mentioned, one's own beliefs can be influenced by the subjective norms (Fishbein and Ajzen, 2011) For example, does an individual's family member want them to exercise rather than being controlled by their own beliefs. One's overall attitude towards performing a particular behaviour is also influenced by the evaluation of the consequences associated with the particular behaviour (Ajzen, 2012). The mathematical formula to explain the attitude towards a behaviour is depicted by:

$$\mathbf{A = \Sigma\, b_i.e_i}$$

Attitude (*A*) refers to the understanding of one's beliefs about the consequences of the behavioural intent (Fishbein and Ajzen, 1975). For example, one's attitude towards exercise refers to their own personal beliefs on the consequences that exercise will give them. The strength in one's belief that the perceived consequence will transpire when performing the particular behaviour of interest is illustrated by (b_i) (Ajzen, 2012). For example, one may have many beliefs about exercise such as it may increase perspiration, its expensive, lose weight, gain muscle and etc., but each one of these beliefs adds a certain strength which will lead to a certain outcome. One also evaluates the particular behaviour and the subjective importance of its consequence (e_i) (Ajzen and Fishbein, 1980) For instance, one may value that the consequence (outcome) of exercising will make them healthier and happier (positive) whereas an outcome of exercising will lead to injury is an outcome one does not value (negative). Thus, multiplying the belief strength (certainty) by the outcome evaluation (favourable or not favourable) and the preference of the consequence will result in the mathematical summation of the attitude towards a particular behaviour (Ajzen, 2012).

Subjective norms (*SN*) follow an analogous logic to the mathematical computation of the attitude formulation (Ajzen, 2012). Subjective norms are the sum of normative beliefs that refer to the behavioural expectations of important individuals such as family, friends, colleagues and healthcare professionals (nb_i) (Becker and Gibson, 1998) According to a study by Jones *et al* (2001), many general practitioners follow specialists' example on using new drugs - *a new product is acceptable if specialists adopt it*. Here, specialist can be referred to as 'gatekeepers' (Blinkenberg et al., 2019; Forrest, 2003). These normative beliefs along with the motivation to comply (mc_i) can influence the subjective norm of a particular behaviour (Ajzen and Fishbein, 1980). The motivation to comply is given a value e.g., how much does someone want me to evoke a particular behaviour (Sarver, 1983). For example, multiplying how much does one *think* their mother (subjective norm) wants them to exercise

(behaviour) multiplied by how much does one *want* to exercise as suggested by their mother results in the summation of subjective norms (Ajzen, 1989). The formula for this process is shown below.

$$\mathbf{SN = \Sigma\ nb_i.mc_i}$$

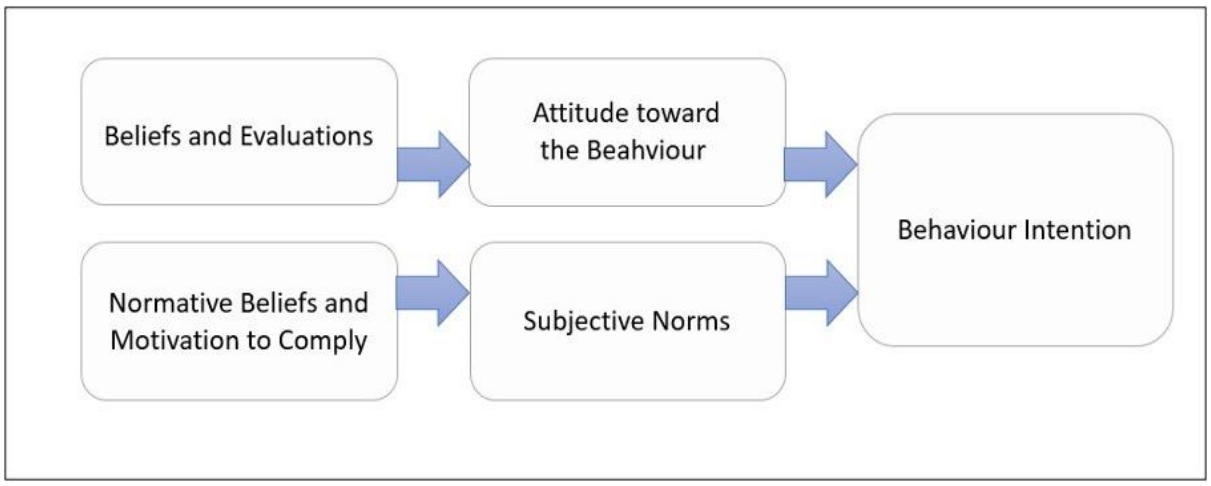
The process mapping of one's attitude towards a belief differs slightly from the subjective norms in that the formula for attitude is calculated for each belief (*referring to one's own personal beliefs, intrapersonal factors*) whereas the formula for subjective norms is calculated for each external driver (*referring to important referent individuals, interpersonal factors)* (Ajzen, 2012). Subjective norms have the capacity to influence one's decision to evoke a particular behaviour. It is also important to elucidate the type of subjective norm (Sarver, 1983). There are two types of norms, injunctive and descriptive in TRA and TPB (Wong, 2019). Injunctive norms refer to one's sense of what others think they should do e.g., health experts want people to isolate during a pandemic, influencing one to stay indoors (Smith-McLallen and Fishbein, 2008). Descriptive norms refer to the belief of what most people actually do and judging by prevalence e.g., an individual observes many people congregating outside and thus influences them to not isolate (Heller et al., 2013). This is important as reliance of one's subjective norm can influence decision-making significantly and thus becomes an important factor to modify and monitor (Ajzen, 2012).

According to Fishbein and Ajzen (1975), attitude should not be referred to as a determinant of one's intention alone but should be viewed as an influence on the general favourability exhibited by one's intentions. For example, two people may have the same attitude towards pregnancy but differ in their intent concerning pregnancy behaviours. One may intend to cease smoking and alcohol and increase their daily exercise in order to maximise chances to become pregnant, but another may choose to limit their alcohol and tobacco intake and eat healthier to increase their chances of becoming pregnant. Thus, the favourability of intent is essentially the same and reflects their attitudes towards pregnancy (behaviour). The formula indicates, to modify one's attitude towards a behaviour, the belief or its evaluation needs to be changed (Rahimi and Jetter, 2015). Those who adopt this theory should explore the beliefs directly associated with the examination of a particular behaviour through interviews with the target population as TRA does not identify the beliefs which influence particular behaviours (Fishbein and Ajzen, 1975).

Overall, the TRA model can be used to conceptualise the process mapping of human behaviour in the decision-making on the adoption of an innovation. TRA can provide answers on whether one's decision to adopt an innovation is dictated by behavioural intention and/or whether that intention is

driven by one's attitude towards the behaviour, influence by subjective norms and/or the perceptions of ease when performing the desired behaviour (Otieno et al., 2016).

Figure 2: Model of Theory of Reasoned Action (TRA) (Rahimi and Jetter, 2015)



Application of TRA

Liker and Sindi (1997) developed and evaluated a user acceptance model for expert systems, based on the TRA, exploring the relationship between beliefs and attitudes towards the adoption of expert systems and intentions to use the system after its induction. The model was then used as a framework for the specification of the user acceptance model (Liker and Sindi, 1997). The model was tested using a cross-sectional study design, and data was collected by self-reported questionnaires from 94 users and non-users from two successful large accounting and auditing companies in the USA (Liker and Sindi, 1997). The questionnaires were sent to the site mangers for self-distribution to employees, as the site managers did not want to reveal the identities of staff members (Liker and Sindi, 1997). The two main outcomes were attitude towards the model and intentions to use the model in the future or continue use for existing users (Otieno et al., 2016). The authors developed a total of seven hypothesis each corresponding to a construct in the TRA model.

Results showed that intention to use the model in the future was significantly correlated with the subjective norms to use the system (Liker and Sindi, 1997). The perceived ease of use was strongly associated with the perceptions of the impact of system use on valued skills and perceived usefulness, which had a linear effect on the attitudes towards the system (Liker and Sindi, 1997). However, an inconsistent finding with the TRA, was that general attitudes towards the system did not predict intentions to use the system (Liker and Sindi, 1997). Overall, the results found conclusive statements to support the use of TRA in this particular context.

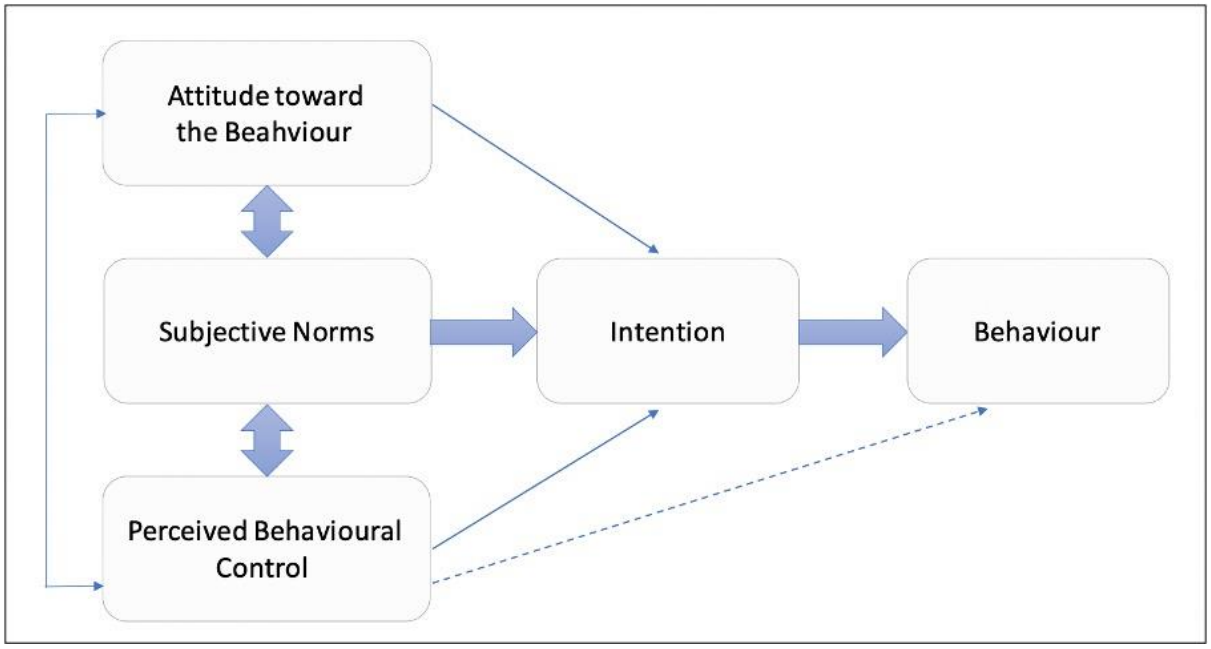
TRA Summary
• TRA was initially developed by Martin Fishbein in 1967 and further adapted with Icek Ajzen in 1975. • TRA is a 'conceptual framework for predicting, explaining and changing human social behaviour'. • TRA aims to understand the psychosociological behaviour and its interaction with beliefs and evaluation, attitudes, normative beliefs and behavioural intentions. • TRA is explicitly concerned with behaviour. • This theory also recognizes that there are situations (or factors) that limit the influence of attitude on behaviour. • Attitudes and norms (or the expectations of other people) are used to predict behavioural intent. • Intent is dictated by three independent characteristics: (1) beliefs or attitudes, (2) subjective expectations and (3) perceived behavioural control. • The theory also integrates normative beliefs along with the motivation to comply which can influence the subjective norm of a particular behaviour. • The motivation to comply refers to how much does someone want me to evoke a particular behaviour. • A mathematical formula is used to predict behaviour and intent based on pre-existing perceptions and attitudes.

2.4.3 Theory of Planned Behaviour (TPB)

Theory of Planned Behaviour (TPB) was developed from the TRA by Icek Ajzen in 1985 to enhance the predictability of human behaviour (Kurland, 1995). The Theory of Planned Behaviour (TBP) is a more modernised extension of TRA with the added components of perceived behavioural control (PBC) over beliefs also referred to as self-efficacy and the power of control factors (*refers to the strength of each controlled belief in inhibiting or enabling a behaviour*) (Madden et al., 1992). PBC refers to the summation of one's perception of the difficultly level of performing the desired behaviour (Ajzen and Madden, 1986). Controlled beliefs refer to hurdles that dictate whether a certain behaviour is evoked (Ajzen, 1991). For example, in order to exercise (behaviour), expensive equipment or a gym membership is needed (controlled beliefs).

Both TRA and TPB models posit that behavioural intent is the strongest determinant of behaviour (Wong, 2019). The time to adopt TBP over TRA is when the behaviour of interest is not voluntary in that it lacks volitional control (Albarracín et al., 2001). For example, if one's intent is to obtain a pilot license in five years, although their intent is there by working towards achieving this goal, they are not in control over whether the behaviour results in the consequence as it also relies on another person e.g., examiner. The process of the TBP is illustrated in Figure 3.

Figure 3: Model of Theory of Planned Behaviour (TPB) (Albarracin et al., 2001)



The mathematical formula to explain the TPB towards evoking a particular behaviour is depicted below (Ajzen, 2012).

$$BI = A + SN + PBC$$

TPB identifies attitude (A), subjective norms (SN) and PBC as predictors of behavioural intent (BI) (Ajzen, 1991). According to Ajzen (2012), the greater the intent to perform the behaviour, the higher the probability of exerting its consequence. Motivational factors such as time, money, availability and skills can significantly influence one's behavioural intention and thus reflects the control over the behaviour (Ajzen, 1985). PBC has a direct influence on the desired behaviour, which is depicted by the formula below (Ajzen, 1989).

$$B = BI + PBC$$

To calculate the effect of PBC on evoking a behaviour of interest, the perceived strength of the control belief (p_i) must be multiplied by the strength of one's belief (c_i), which is depicted by the formula below (Ajzen, 1991).

$$PBC = \Sigma\, p_i.c_i$$

Application of TPB

Albarracín et al (2001) adopted the use of TRA and TPB models to examine behavioural prediction towards condom use. The purpose of the study was to evaluate the success of the theoretical models as predictors of condom use in different studies and investigate the plausibility of the interactions as posited by the models (Albarracín et al., 2001). This study performed a meta-analysis and found a total of 42 articles (published and unpublished) testing the plausibility of either or both models, which were integrated to form 96 data sets involving associations between the key variables of both models (Albarracín et al., 2001). The authors then collated the theoretical relations of interest with statistical modelling similar to those used in traditional studies (Albarracín et al., 2001).

The results indicated that both models were significantly effective in predicting condom use, as consistent with TRA postulations, they found that intention to adopt condom use were derived from attitudes and subjective norms which were factors dictated by the outcome and normative beliefs (Albarracín et al., 2001). Additionally, consistent with TPB postulations, results showed that perceived behavioural control was associated with intention towards condom use and condom use itself, however these findings were not significant (Albarracín et al., 2001). Albarracín et al (2001) stated that the weight of such findings was dependent on the consideration of previous experience or behaviour.

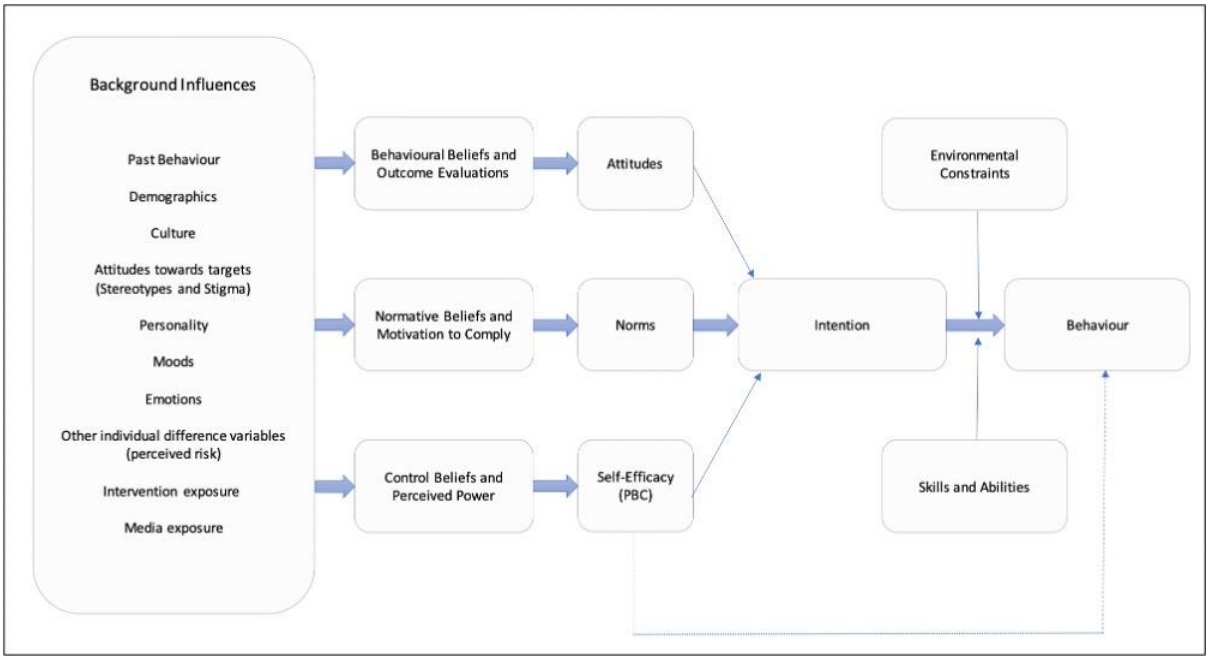
TPB Summary
• TPB was developed from the TRA by Icek Ajzen in 1985 to enhance the predictability of human behaviour. • One of the significant differences between TRA and TPB is the addition of PBC which refers to the collection of one's perception of the difficulty level of performing the desired behaviour. • Behavioural intent is the strongest determinant of behaviour. • The theory was intended to explain all behaviors over which people have the ability to exert self-control. • Like TRA, TPB also uses a mathematical formula to explain one likelihood in evoking a particular behaviour. • TPB states that behavioral achievement depends on both motivation (intention) and ability (behavioral control). • It distinguishes between three types of beliefs: (1) behavioral, (2) normative and (3) control. • The TPB is comprised of six constructs that collectively represent one's actual control over the behavior.

2.4.4 Reasoned Action Approach – Integrative Model (RAA-IM)

The Integrative Model (IM) for behavioural prediction, developed by Martin Fishbein in 2010, involves the most recent formulation of the Reasoned Action Approach (RAA), which incorporates both the TRA and TPB models (Fishbein, 2008). RAA aims to elucidate a 'very small number of variables which represents a large proportion of the variance in the behaviour of interest' (Fishbein, 2009) e.g., acceptance or adoption of an innovation. The variables are not stagnant and thus integrates the ever-changing behavioural intent (Fishbein and Ajzen, 2011). Therefore, such variables are applicable to the behaviours of healthcare professions whose attitudes change as new evidence becomes available. This is also similar to the actions of patients as they become more involved in decision-making particularly in medical advocacy and preventative measures (Rahimi and Jetter, 2015).

The core antecedent of behavioural predictability is one's intention (Fishbein and Ajzen, 2011). Fishbein (2008) explains how developed beliefs, intention and behaviours are "*reasoned*". As one learns and goes through different experiences, they develop beliefs about the world thus they instinctively form attitudes, social norms and perceptions of control which then influences one's intentions and behaviours (Becker and Gibson, 1998). RAA integrates the effects of 'distal variables' also known as background influences on the association between intention and behaviour such as previous behaviour based on experiences, demographics and culture, emotions, environment, and more intrapersonal factors such as skills and abilities (Ajzen et al., 2007) (see Figure 4).

Figure 4: Integrative Model (IM) on the Reasoned Action Approach (RAA) (Becker and Gibson, 1998)



RAA acknowledges that one's beliefs are fundamentally developed by their experience of reality, in which the impact of such influences is observed through subjective norms and emotions on the behaviour of interest (Montano and Kasprzyk, 2015). The background influences such as past experiences, culture, stereotypes, stigma, perceived values, morals, emotions all regulate one's beliefs and how those beliefs are evaluated alongside the interpretation of the subjective norms, adherence and the perceived strength of each factor (Albarracín et al., 2001). It emphasises the perspective of one's beliefs over another which is particularly seen in the work on voting predictability (Fishbein, 2008).

RAA incorporates the value of social contextual learning particularly from the SCT model (Fishbein, 2008). The determinants of intentions and behaviour vary for each individual as it based on one perceived reality (Fishbein and Ajzen, 2011). For example, if one does not action the behaviour of interest (*e.g., acceptance and adoption of a FI)* as expected by others (*e.g., businesses or healthcare professionals*), it can be thought of as the "*wrong*" behaviour as they do not possess the necessary information or attitude towards the desired behaviour.

Fishbein (2008) suggested that many interventions that are designed to alter attitudes or provide relevant information fail, as individuals cannot act on their intentions. This is because the individual has already developed the intent to perform the desired behaviour but are not acting on those intentions, so they possess the 'right' attitude and thus they do not require more information. The hurdle may be that the individual does not possess the skills and abilities or that there are background influences inhibiting them from acting on their intentions such as culture or stereotypes towards frugality (Fishbein, 2008). Therefore, RAA provides a more accurate intervention plan to address those hurdles as opposed to providing more unnecessary information (Montano and Kasprzyk, 2015).

According to Fishbein (2008), the three psychosocial variables which serve as determinants of intention varies according to the behaviour and the population of the studied behaviour. Some behaviours are almost solely influenced attitudinally in one environment but could be normatively influenced in another and thus may be a function of population or cultural consideration (Albarracín et al., 2001). Therefore, it is pivotal to determine whether the intention is under attitudinal, normative, or self-efficacy control in a certain study population, as this could explain the different behavioural antecedents among different demographics and why an intervention may be successful in one population and fail in another (Becker and Gibson, 1998).

Application of RAA-IM

Smith-McLallen and Fishbein (2008) adopted the RAA integrative model to explore the effects of attitude, subjective norms (injunctive and descriptive), and perceived behavioural control as predictors of intent to perform three cancer screening behaviours (mammogram - females, colonoscopy and prostate specific antigen (PSA) test - males) and three healthy lifestyle behaviours (exercising, eating fruits and vegetables, and controlling one's diet to lose weight). Data collection included the completion of online questionnaires comprising of six questions that measured the IM constructs (intentions, attitudes, perceived behavioural control, injunctive norms, and descriptive norms) for each of the behaviours of interest (three cancer screening behaviours and three healthy lifestyle behaviours) (Smith-McLallen and Fishbein, 2008). The sample was derived from a larger survey examining cancer-related information complied by an independent survey research company (Smith-McLallen and Fishbein, 2008).

A total of 1753 participants responded ranging in age from 40 to 70 years old. Results showed that attitudes, normative pressures and perceived control were strong predictors of intention to perform the behaviours of interest (Smith-McLallen and Fishbein, 2008). For male participants, injunctive norms were a significant predictor to engage in prostate and colon cancer screening and for the female participants the same construct served as a strong predictor of intention to engage in getting a mammogram (Smith-McLallen and Fishbein, 2008). However, the study did show a variance in the importance for different behaviours e.g., 'normative pressures' was the strongest determinant of intention to engage in colonoscopy and PSA test but not to engage in lifestyle behaviours with the exception of 'eating fruits and vegetables' (Smith-McLallen and Fishbein, 2008). The findings suggested that an intervention to increase the engagement of cancer screening behaviours should focus on 'normative pressures' but must be rejected as a determinant to increase the engagement to healthy lifestyle behaviours (Smith-McLallen and Fishbein, 2008). According to Rahimi and Jetter (2015) while RAA provides a strong theoretical framework for exploring predictors of the various behavioural intent, the findings from the Smith-McLallen and Fishbein (2008) study suggested that the subjective norms can evade affecting intention and instead directly influence one's behaviour.

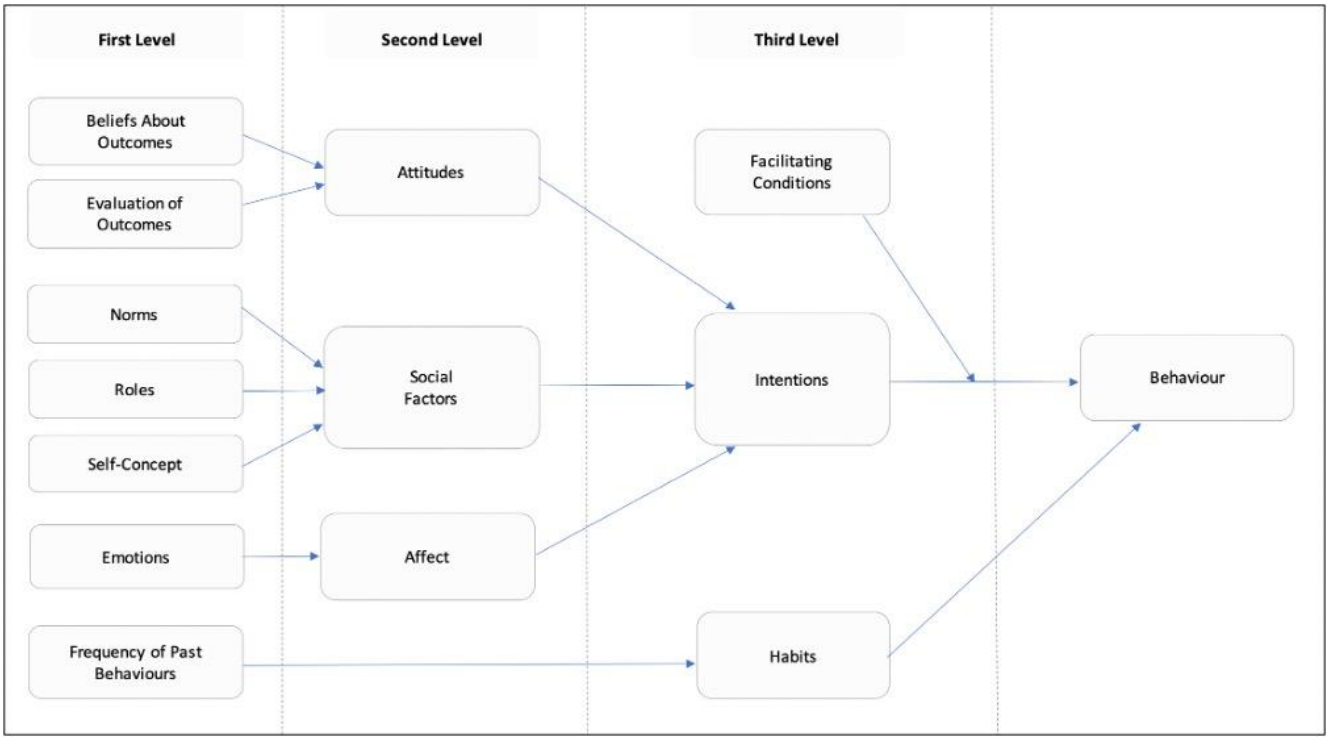
RAA-IM Summary
• The Integrative Model (IM) for behavioural prediction was developed by Martin Fishbein in 2010. • RAA IM is a hybrid model integrating three models, (1) RAA, (2) TRA and (3) TPB. • It aims to understand a limited number of variables which represent a large proportion of the variance in a specific behaviour. • Beliefs, intention, and behaviours are reasoned which are based on experiences and socioeconomic factors and thus influences one's intentions and behaviours. • Intentions are the immediate antecedents of behaviour. • Environmental factors and skills and abilities can moderate the intention-behaviour relationship. • Intentions are a function of attitudes, perceived normative pressure and self-efficacy. • Perceived normative pressure is a function of descriptive and injunctive norms. • Such beliefs are observed through subjective norms and emotions on the behaviour of interest. • RAA incorporates the value of social contextual learning based in the SCT model.

2.4.5 Theory of Interpersonal Behaviour (TIB)

The Theory of Interpersonal Behaviour (TIB) incorporates many of the psychosocial behavioural determinants as observed in the TRA and TPB models (Gagnon et al., 2003). However, the TIB developed by Harry Triandis (1977), acknowledges the complexity in the dimensions of behavioural predictability (Taherdoost, 2018). The aim of TIB is to understand the interaction between the willingness to evoke a particular behaviour and the actual performance of the desired behaviour in which the theory posits that one's behaviour is dictated by the intentions, habits, and the facilitating conditions (Chang et al., 2019).

Here, in this tri-level theory, intention is the driver of social factors, attitude and affect e.g., emotion, which all are believed to improve prediction power (Triandis, 1979). The TIB has been utilised far less than TRA and TPB despite the integration of more complex influential factors (Donovan and Henley, 2010). Triandis (1977), proposed that behaviour is dictated by three determinants: (1) intention (*much like TRA and TPB*); (2) facilitating conditions and (3) habit (Gagnon et al., 2003). The inclusion of personal normative beliefs which is similar to subjective norms includes social norms, morals, values, emotions and self-concept, as well as the beliefs about the consequence of the actual behaviour and its evaluation (Triandis, 1979) (see Figure 5).

Figure 5: Tri-Level Theory of Interpersonal Behaviour (TIB) (Taherdoost, 2018)



The first-level of the TIB model is concerned with the impact of personal characteristics and previous experiences on the attitudes, beliefs and social factors of a specific behaviour (Moody and Siponen, 2013). The second level explains the effect of cognition, affect, social determinants and normative beliefs on the intentions to evoke the behaviour of interest (Triandis, 1982). Lastly, the third level, is concerned with behavioural prediction by assessing the effect of behavioural intentions, past experiences and situational conditions (Mehboob Shaikh and Amin, 2023).

Facilitating factors are positive objective external factors that can influence one's perception of ease of the desired behaviour (Triandis, 1979). For example, one may have established intention to perform a behaviour, however an environmental cue may inhibit them from evoking the behaviour and therefore would have a direct impact on the actual behaviour rather than the intention (Osbourne and Clarke, 2008).

'Habit' refers to the instinctual behaviour which is conditioned routinely overtime (Gagnon et al., 2003) and thus provides ease and comfortability when acting on such habitual behaviours making them easier to evoke. Habits are formed from the *frequency of past behaviours* (Triandis, 1979). Therefore, habitual behaviour influences the emotional component of attitude (*affect*) (Triandis, 1979). As habitual behaviour is uncontrolled and automatic, one does not evaluate the consequences, so the actual behaviour becomes the intent rather than the expected consequences of the behaviour

of interest (Triandis, 1982). Studies implementing TIB have shown a strong influential effect between habits and behaviours and vouched its great ability for behavioural prediction (Amin et al., 2016; Dang Vu and Nielsen, 2022; Issock Issock et al., 2020; Nilsen et al., 2012; Pee et al., 2008; Russell et al., 2017).

'Affect' refers to the emotional capacity evoked by performing a particular behaviour which can either be positive or negative (Hennessy et al., 2010). Triandis (1977) found empirical studies that highlighted the strong interaction between one's affect towards a particular behaviour and their intention to perform that particular behaviour. According to Gagnon et al (2003), affect is 'considered as "*affective perceived consequences of the behaviour*" as opposed to "*perceived consequences*" which refers to the cognitive evaluation of expected perceived consequences of actioning the particular behaviour'. Thus, in this view, 'affect' towards 'perceived consequences' influences one's intent to perform a particular behaviour. This construct is similar to one in Bandura (1986) SCT model, coined 'outcome expectations' which refer to one's perception of specific outcomes associated with evoking a specific behaviour (Gagnon et al., 2003).

Perceived consequences refer to the probability that specific consequences will occur following the induction of a particular behaviour which will either be positive or negative (Pee et al., 2008). However, the association between perceived consequences and behaviour is not entirely strong (Triandis, 1979). As Triandis (1977) explains, when one evokes a particular behaviour attached to a perceived consequence, the actual outcome does not always reflect the expected consequence e.g., when an individual actions a particular behaviour, they may not react to the negative outcome with the same upset as anticipated or vice versa (Triandis, 1982).

Under social factors, perceived social norms are a composite effect of role beliefs and normative beliefs (Ibrahim et al., 2018). Role beliefs reflect what one thinks others in a specified demographic should do, e.g., one thinks a lawyer should dress in a professional manner at work thus building a role stereotype (Palm et al., 2020). These stereotypes are also referred to as "*cognitive structures schema*" by psychologists (Harris et al., 2015). The schema generalises the complexity of one's evaluation of a behaviour by promptly and subconsciously processing incoming stimuli without the need to consider multiple variables influencing its evaluation (Harris et al., 2015). This occurrence could be subjected to external and cognitive cues influencing its decision-making process that could inhibit the acceptance and adoption of an innovation (Harris et al., 2015). Normative beliefs are similar to injunctive norms which refer to one's sense of what others in referent positions think they should do (Wong, 2019). Triandis (1977) posited that social factors and affect have a significant role (*in the form*

of an obligation) in developing intentions towards a certain behaviour (Gagnon et al., 2003). Thus, the external social pressures have the capability to influence one's intention to evoke a particular behaviour.

Self-concept also referred to as self-identity refers to the ideology or reflection of one's self-image (Gagnon et al., 2003) - *how does one regard themselves as*, *what are one's morals and values, how do they describe themselves*, *what are one's intentions, how does one behave or conduct themselves*.

Emotions affect the perceived judgment as opposed to attitudes which affect the rationale judgement (Triandis, 1979). Chang et al (2019), posited that a positive attitude forms a positive behaviour, and a negative attitude may have a negative effect on behaviour.

Application of TIB

Gagnon et al (2003) adopted the TIB model to assess the predictors of physicians' intention to adopt telemedicine in their clinical practice. The authors acknowledge the constraint of acceptance and adoption is inaugurated in its ability for national diffusion (Gagnon et al., 2003). This study adapted the TIB model in reference to minor modifications of the behavioural determinants of intention (Gagnon et al., 2003). The authors hypothesised (*based on previous findings in other studies*) that habit and facilitating conditions were directly associated with intention in comparison to the traditional model to which the two constructs are direct antecedents of behaviour (Gagnon et al., 2003). The study also tested the impact of 'affect' on the interaction between 'habit' and intention' (Gagnon et al., 2003). Open-ended questionnaires comprising of 10 questions was sent to physicians. The questions related to the different constructs of the TIB model e.g., physicians' perception, barriers and facilitating conditions, emotions, favourable or unfavourable utilisation of telemedicine, characteristics of telemedicine, personal values and communication (Gagnon et al., 2003). A content analysis was performed by two researchers to assess the feedback and classify and label themes (Gagnon et al., 2003). 'Confirmatory factor analysis (CFA) was performed to assess the measurement model and structural equation modelling (SEM) was applied to test the theoretical model' (Gagnon et al., 2003).

Results found that 'normative factors' and 'self-identity' were strong predictors of intention to adopt telemedicine (Gagnon et al., 2003). Physicians who perceived affluential characteristics such as value and social responsibilities to telemedicine adoption had a stronger intention to use the tool (Gagnon et al., 2003). Self-identity was shown to have a negative effect in the prediction of intention to adopt telemedicine (Gagnon et al., 2003). Overall, the results indicated that TIB is an effective model to

predict physicians' intention to use telemedicine as it considers the variance distribution (Gagnon et al., 2003). Although, the authors note that the coalescence of the normative construct (social and personal) may inflict concerns in determining the causative factor of intention to perform a behaviour of interest (Gagnon et al., 2003).

TIB Summary
• TIB was developed by Harry Triandis in 1977. • TIB acknowledges the complexity in the dimensions of behavioural predictability. • The purpose of TIB is to help understand the interactions between the willingness to evoke a particular behaviour and the actual performance of the behaviour of interest. • Behaviour is dictated by intentions, habits, emotions and facilitating conditions. • Intention is influenced by social and affective factors as well as by rational deliberations. • TIB is illustrated in a tri-level model showing intention as the driver of social factors, attitude and affect e.g., emotion which all are believed to improve prediction power.

2.4.6 Social Cognitive Theory (SCT)

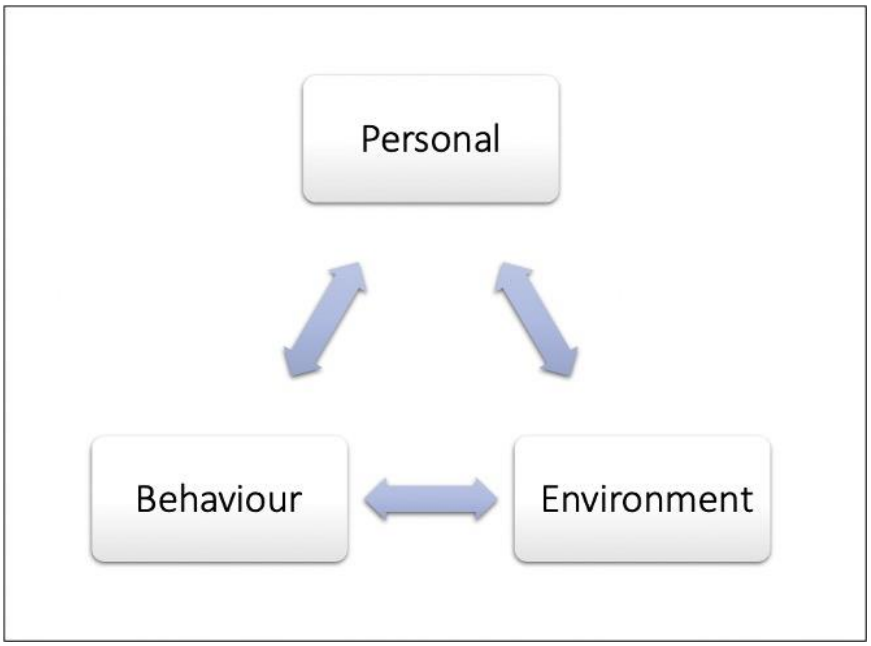
The social cognitive theory is a comprehensive human behavioural model theorised in 1986 by Albert Bandura (Bandura, 1986). SCT stems from the Holt and Chapman Brown (1931) book on Animal Drive and Learning Processes and Dollard and Miller (1941) Social Learning and Imitation Theory and has been applied to many different disciplines (Rahimi and Jetter, 2015). It is often thought that SCT serves as a connection between behaviour and cognitive learning as it integrates the element of attention, competence, memory and motivation (Bandura, 1989a). SCT helps provide an understanding of the interaction involved between the environment and intrapersonal connections and how the two elements can influence interpersonal actions and decision-making (Bandura, 2001b). Bandura believed that an individual's decisions and actions are influenced by the environment and the same social system via observation, imitation, and modelling (Ratten, 2011). The cognitive aspect of the theory relates to the acknowledgement of an idea that intrapersonal thoughts influences an individuals' perception and attitudes according to their environment (Claybourn, 2011).

The theory posits that human behaviour is influenced by the multidimensional and bidirectional triadic model which is made of three variables which all have an effect on each other: (1) personal; (2) environment and (3) behaviour (Bandura, 1989b; Bandura, 1986) (see Figure 6). It merges an individual' sociological and psychological mapping to fully understand the process and regulation of action and decision planning which in turn evokes the response to acceptance and adoption of an innovation (Bandura, 2001a). Like many psychological theories e.g., the antecedents of SCT have advanced over the years as it was previously believed that decisions and actions occur unconsciously

and were parallel with the intrapersonal forces such as one's own beliefs, values, impulses, motivations and needs (Bandura, 2004). However, as behavioural studies have been researched further, external factors such as the environment and interpersonal factors were uncovered to be pivotal stimuli as they were shown to influence behavioural changes and its subsequent consequences (Bargh et al., 2012; Schunk, 1989).

In essence, an individual behaves a certain way and/or develops a perception subsequently evokes an action, based on their interaction with personal factors, environment, and the observation of others (Conner and Norman, 2015). Although each component is present, they do not necessarily exert the same influence on each other (Bandura, 1991b), whereby one element would dictate actions more so than others due to the social context of the situation, different behaviours, intrapersonal thoughts and thus the influence on behaviour and action will vary overtime (Bandura, 1989b). Additionally, the determinants do not occur simultaneously as it takes time for variables to develop and activate an influence and thus an action (Wood and Bandura, 1989). For example, if a student was offered a place at university, the student decided to accept the offer over an another (behaviour) solely based on their interest in the subject (personal) rather than the close geographical location to their home (environment). Thus, the component exerting the most significant influence on behaviour is personal factor (Claybourn, 2011).

Figure 6: Model of Social Cognitive Theory (SCT) (Claybourn, 2011)



Individuals tend to choose something from a range of options to suit their acquired preference and capability (Bandura, 1991a). As the preferences and actions do not remain stagnant, the reciprocal factors that fall within the determinants continuously adapt to the context and provides a conceptual play on acceptance and adoption of an innovation at any point in time (Bandura, 2001b). The advantage of SCT is that it illustrates the interplay of personal, environmental and behavioural factors and maps the psychology of social factors and its association with cognition and behaviour which lead to the inspiration behind the TPB theory (Rahimi and Jetter, 2015).

Bandura (1991b) posited that the behaviour of an individual is self-regulated and fortified towards evoking a goal or response through a process he called triadic reciprocal causation model or reciprocal determinism (TRD) (Ryan, 2019). This causation model involves four steps; (1) fortuity; (2) modelling and observational learning; (3) efficacy and (4) moral disengagement (Bargh et al., 2012).

Fortuity is the inevitable influence but not undetermined as they are activated in the causal channels in the same way as pre-determined influences (Bandura, 2004). The reciprocal influence of intrapersonal behaviours and social factors is what activates the fortuitous influences (Bandura, 2002b). Modelling and observational learning is a general development of cognitive competency (Bandura, 1986). It involves how an individual may respond to observing the actions of others and determining whether to act in the same or different manner (Wood and Bandura, 1989). This involves the cognitive mechanisms and social learning determinants of cognition, whereby "lead by example" fits the variable, but only if that example fits the position of context (Bandura, 2001a, 2001b). Bandura (1986) posited that social learning occurs by observing the behaviours and consequential actions of others. Much of the behavioural patterns and the impact it has on the environment is acquired through modelling via verbal or illustrations.

Bandura (1989a) also states that an individual's ability to be influenced by behaviours and actions of others is dependent on retention of the action in such one must be able to remember the action observed. In parallel to remembrance, attentional processes dictate an individual's observation and the extraction of information and therefore the individual shows an interest to observe or fortuity influence (Heydari et al., 2014). However, the theory notes that people do not always apply what is learnt and observed and thus the influence does not make a conscious immediate impact but may subconsciously affect the decisions (Bandura, 1991b).

According to Rahimi and Jetter (2015), self-efficacy is the most important component of SCT. Self-efficacy refers to the competency and confidence of ones' own ability to perform a behaviour (Schunk, 1989). Self-efficacy is a key indicator of how an individual behaves, conducts themselves and tackle

challenges and it provides an outlook on own's own capabilities and attitudes towards a task (Bandura, 1991b). This indicator interconnects with observational learning in that social learning involves an individual typically finding relevance or relatability to the model (Ajzen and Albarracin, 2007). For example, if an individual observes a task being accomplished by a person who they can relate to, they find the motivation and confidence to feel competent to achieve the same task (Prussia and Kinicki, 1996). Self-efficacy is a pivotal component to assess as it can help predict the acceptance and adoption of an innovation (Bandura., 1986). The construct of self-efficacy has been assessed in various fields ranging from health promoting research (Bandura, 2004), technology adoption (Pourrazavi et al., 2014; Ratten, 2015) to health technology adoption (Fox and Connolly, 2018; Wu et al., 2021) and used to understand behavioural prediction with the intention to alter behaviour towards the desired outcome (Ajzen and Albarracin, 2007; Lent et al., 2015; Lowry et al., 2017; Petosa et al., 2003).

Moral decision-making channels through the self-regulatory process in that moral reasoning is developed whether that be moral or immoral (Bandura, 1991b). These moral decisions can be thought of as standards in which individuals evaluate their own and other's behaviours through self-regulation. By adherence to one's own morals results in a positive effect whereas disobeying the moral standing can result in an undesirable outcome e.g., rejection and guilt (Bandura, 1991a). Thus, individuals are motivated to conduct themselves according to their own moral standards which is driven by moral awareness. Factors which negatively affect moral decision-making, is referred to as moral disengagement (Moore, 2015; Whitaker and Godwin, 2013). This component prevents negative outcomes caused by cognitively re-evaluating a behaviour that would typically be known to disobey one's moral standards thus becoming acceptable and supporting of morality (Bandura, 2002a). However, this is particularly challenging as one's morality may differ in the different social settings (Bandura, 1991a).

The interrelationship between behaviour and the environment results in 'reinforcements' (Nabi and Clark, 2008). The consequences of one's behaviour has a direct effect on adherence or cessation of that behaviour (Corcoran, 1991). For example, if an individual observes another person adopting an innovation and sees the benefits it provides, this will motivate them to adopt the innovation themselves. Once adopted, if the individual starts to experience benefits early on, then they are more likely to adhere to continue use (post-adoption phase) (Rahimi and Jetter, 2015).

Application of SCT

Agarwal et al (2013) conducted a multi-level study to evaluate the determinant factors involved in the acceptance of Public Health Records (PHR) provided by the employer in the context of patient user acceptance. The study adopted SCT to theorise and examine the behavioural influences of early adopters of PHRs to increase the speed of its adoption (Agarwal et al., 2013). The PHR tool involved patients submitting and managing health information which integrated patient medical records with an access to educational materials and provided secure patient-provider messaging (Agarwal et al., 2013). Data was collected through the use of questionnaires (n=238 participants) during the first three months since the induction of the PHR tool (Agarwal et al., 2013). Analysis included the effect of individual factors (patient activation and provider satisfaction) under two environmental contexts (technology and organisation) as both were believed to have an influence on patient intentions to use a PHR among early adopters of the technology (Agarwal et al., 2013).

Results showed that employer satisfaction, environmental factors, interactions between patient activation and tool value potential were significantly associated with behavioural intentions to accept and adopt the PHR tool (Agarwal et al., 2013). Higher intentions to adopt PHR was correlated with those who were more satisfied with their provider and high perceived value associated with PHR properties such as health care process management features, increased the intention to adopt and thus communication tactics was highlighted as an influential factor (Agarwal et al., 2013). The results highlighted important determinants which could influence one's intention to accept and adopt a new innovation but also the implications for the management of PHR implementations (Agarwal et al., 2013).

SCT Summary
• SCT is a human behavioural model theorised by Albert Bandura in 1986. • SCT describes the influence of individual's experiences, the actions of others, environmental factors on individual health behaviours. • The theory helps understand the interaction involved between the environment and intrapersonal connections and how the two elements can influence interpersonal actions and decision-making. • Human behaviour is influenced by the multidimensional and TRD model, which is made of three variables, (1) personal; (2) environment and (3) behaviour, which all have an effect on each other. • Behaviours are self-regulated towards evoking an action through a process Bandura called triadic reciprocal causation model or reciprocal determinism (TRD) • The TRD model involves four steps; (1) fortuity; (2) modelling and observational learning; (3) efficacy and (4) moral disengagement. • Self-efficacy is the most important component of SCT. • Self-efficacy is a key indicator of behaviour and provides an outlook on own's own capabilities and attitudes towards a task.

2.5 Key Acceptability Model

It could be argued that the first challenge to implementation or adoption of FI is the ideology of acceptance. For instance, in order to support adopters in the implementation and subsequent spread or diffusion of any innovation, it is the willingness to first accept the idea because it cannot be successful through compulsion and nor is success dictated by mandating policy as evidence from this research has reported. To explore the acceptance, we believe that applying a theoretical framework presents a systematic approach to understanding the events or experiences of an individual and how such factors can provoke specific behavioural trends, which are embedded in an individual's psychological process mapping or decision-making traits. The application of a social theory can help explain or predict such actions or behaviours by illustrating the relationships between certain sociopsychological variables. The theory can identify where certain perspectives and perceptions are developed as they are referred to as "*intervening processes between observable stimuli and responses in real world situations*" (Godin et al., 2008).

2.5.1 Using SCT to Explore Acceptability of FI

The SCT can help explain the dynamics of health behaviours, including the processes involved in changing them, and factors that influence such behaviours such as acceptance and/or perceptions including physical environments. The SCT has been found to guide the search for reasoning – why do individuals engage or not engage in certain health behaviours and identifies indicators which should be monitored and measured during evaluation. The SCT can be thought of as a pluralism of explanatory and change theory because it not only describes the reasons why a problem or challenge exists but also guides the development of health innovations by identifying concepts that can be translated into strategies (U.S. Department of Health and Human Services, 2018). Though research has shown that individual decisions are often integral to adoption of a health-related behaviour, rigorous evidence about the cognitive mechanisms underlying behaviours is imperative to understand perceptions and behavioural change towards accepting FI mainly targeting the service users e.g., healthcare professionals and recipients such as patients (Godin et al., 2008).

2.5.2 Core Principles of the SCT

As outlined in section 2.4.2, the principle of the SCT is a reciprocal interaction between the individual, behaviour and environment. SCT examines the unique social aspects of an individual and how the individual acquires knowledge and maintains their behaviour whilst also considering the social

environment in which the individual exhibits behaviour (Bargh et al., 2012). The model also factors the individual's past experiences, which influence reinforcements, expectations and expectancies (Prussia and Kinicki, 1996). In combination, all of these components can determine if an individual will elicit a specific behaviour or behavioural change and its justification (Bandura, 1991a). In essence, an action is elicited by a behaviour or perception which is dictated by personal factors, environment and/or observations of others (Bandura, 1989a). Individual cognitions are referred to as processes intercepting between observable stimuli and responses in real-life (Godin et al., 2008).

Though all components are present concurrently, the impact of each can be transient (Bandura, 2001b). The components do not necessarily exert the same influence on each other, and each one can have a varying impact on decision-making over time (Bandura, 1986). Therefore, SCT considers the late-stage decisional change because something that may affect an individual's behaviour at one time may not be replicated at a later stage despite the situation being the same, which is particularly important when exploring the effects of a global emergency on acceptability (Bandura, 2001a). SCT can uncover the process mapping of decision-making, which allows those exploring behavioural change or behaviour analysis to intercept or assess the factors that influence a certain behaviour or action.

2.5.3 Why Choose SCT to Explore Acceptability?

As previously discussed, there are a plethora of acceptability models and theories, however it is the mere components and its mechanisms of interaction and the context to which they are applied that enables the SCT to be appropriate for this study. Unlike many acceptability models, the SCT intends to understand how individuals engage in intentional behaviour. Therefore, SCT is one of the very few acceptability models that can be used in healthcare which not only focuses on how certain behaviours are evoked but also explores the likelihood of that certain behaviour being maintained, which subsequently leads to a conscious and intended action (Dewar et al., 2012; Glanz et al., 2002). Whilst many studies have explored the potential determinants involved in healthcare behaviours and decision-making and a few studies assessing the impact of such influential factors, no studies have examined the derivatives, mediators, and maintenance of such behaviours. To explore the acceptability of FI in the NHS, it is important to incorporate those underpinnings that seeks to not only initiate acceptance but to support the maintenance of this behaviour by adaptation in order to increase its diffusion and adoption overtime, which is aligned with the objectives reported in the NHS Long Term Plan.

2.5.4 SCT in Exploring Healthcare Behaviours

There has been relatively scant evidence and attention given to applying SCTs investigating healthcare behaviours as opposed to evaluating interventions based on the SCT. This lack of attention contributes towards our limited knowledge of understanding factors that may influence an individual's decision-making process within healthcare but also how certain healthcare behaviours are maintained and altered overtime. Though the global pandemic accelerated the need for reciprocal international health partnerships in the context of shared learning particularly gaining knowledge from those in the developing world, there remains a difficult challenge and a paucity in the number of innovative solutions developed in LMICs adopted in HICs like the UK (Issa et al., 2021). Previous research has shown that this may be attributed towards cognitive bias and a country of origin effect that influences perception of FIs but also bidirectional learning from LMICs (Skopec et al., 2022). The successful development and adoption of innovative solutions in LMICs perceive them to be 'equal innovators' rather than "*passive recipients of expertise*" (Issa et al., 2021). It therefore highlights a need for theoretical research to better inform the design and development of innovative solutions to alter healthcare behaviours of both staff and patients (Grimshaw et al., 2002).

Based on the information gathered on exploring acceptability and the different notions of risk to acceptance, it can be argued that acceptance is a prerequisite to adoption. Though there are numerous theoretical perspectives that can be used to explore the determinants of healthcare behaviours, the majority of clinical practice adoption decisions are dictated by individual professional decisions such as their knowledge, routines or attitudes (Grol and Wensing, 2004). Thus, many look to explore such behaviours from the perspective of healthcare professionals which are typically seen as 'gatekeepers' to decisional changes. But in the era of patient medical advocacy and the 'self-driven healthcare' movement, individuals are encouraged to become more engaged in their own health and wellbeing management as opposed to 'passive receivers' of healthcare.

Though there have been studies that have explored both perspectives individually within application to healthcare (excluding medical technology and apps for mobile phones), the disconnect among these studies highlights the fractures of decisional transition and translation among the two target groups. In such a climate, determinants of adoption of an innovation have yet to be explored in the context of both healthcare professionals and patients or patient representatives as part of one study to which this study aims to explore in the context of FI in healthcare. Consequently, this exploration would help better understand the individual mechanisms of the adoption of new behaviours, how each one is initiated and how they are maintained overtime from a sociopsychological theoretical

perspective (Michie, 2005). Adoption is a complex process and understanding this may provide insights for the development of strategies that incorporate influencing factors to ultimately increase the acceptability of FI and its subsequent diffusion worldwide. Evidence has suggested that healthcare interventions facilitated by an appropriate theoretical approach is more effective in changing behaviour than using non-theoretical approaches (Abdi et al., 2015; Hardeman et al., 2005; Michie et al., 2008; Plotnikoff et al., 2014).

2.5.5 Application of SCT in Healthcare

To better understand the mechanisms and application of the SCT and how the theory can help investigate the acceptability of FI specifically in the NHS, we will explore previous research that has applied the SCT in a real-life healthcare setting, though none were focused on acceptance of healthcare innovation and NHS.

SCT in Adolescent Eating Behaviours

Dewar et al (2012) aimed to develop a questionnaire based on the SCT constructs and investigate the reliability and validity of these constructs related to adolescent healthy eating behaviours in New Zealand. After qualitatively assessing psychometric properties of each construct, the authors developed a questionnaire based on the constructs of the SCT which were referred to as scales and were unidimensional i.e., self-efficacy, intentions (goals), situation (perceived environment), social support, behavioural strategies, outcomes, expectations (perceived benefits), and expectancies (impact or value of benefits) (Dewar et al., 2012). Similarly, to the existence of numerous definitions of FI, the authors acknowledged though there are many definitions of "*healthy eating*", the one chosen is derived from high-quality and available evidence for key nutrition behaviours related to ill-health (Dewar et al., 2012).

The questionnaire was peer-reviewed by experts in nutrition, SCT and/or scale development for further refinement and to assess the content validity to which they were asked to: (1) consider the content validity of each scale (how well did the scales relate to the theoretical conceptualisation of the construct being measured), (2) consider the suitability of the language used to respond to the respective items, (3) item comprehension (were the items understandable) and (4) consider the burden of response (Dewar et al., 2012). This questionnaire was then piloted on a focus group of adolescents that matched the intended target population of the study for further review and refinement of scales (Dewar et al., 2012). During this pilot, a recorded semi-structured interview

approach was adopted in which prompts were used to examine the individual's thought process in the delivery of their response, interpretation of items, instructions, and response options (Dewar et al., 2012). The questionnaire was then amended based on the feedback from the focus group and returned to the experts for further review prior to its administration to the study sample (Dewar et al., 2012). The individual items included in the questionnaire were rated using different Likert-type scales and item reliability was assessed using different quantitative models (Dewar et al., 2012). The study found that the questionnaire based on the SCT constructs had acceptable factorial validity in which all items showed at least acceptable internal consistency reliability and strong rank order repeatability (Dewar et al., 2012).

Further to its excellent content validity and reliability, the factorial validity was reported to be strong due to its specificity to certain behaviours (Dewar et al., 2012). Though the measures used in this study allows others to assess a specific dietary behaviour or intake, it is not effective in examining multiple aspects of a specific behaviour and thus the approach used in this study represents a generalist method to assessing dietary behaviours (Dewar et al., 2012). The authors recommended that the SCT can be adopted for changing health behaviours (Dewar et al., 2012). Many studies have adopted the SCT in the development of healthcare interventions and found it to be effective in assessing and changing behaviours related to adherence to physical exercise and weight control to tackle obesity (Dennis et al., 2012; Hallam and Petosa, 2004; Jang and Yoo, 2012; Najimi and Ghaffari, 2013).

SCT in Technology and Weight Control

In 2014, a randomised controlled trial (RCT) was conducted by Abdi et al (2015) to evaluate the effect of an intervention based on new communication technologies and the SCT on weight control in Iran. The individual constructs of the SCT were evaluated through the administration of a 'researcher-made' questionnaire that was developed based on the most recent valid and reliable studies on the SCT (Abdi et al., 2015). The SCT constructs pertaining to physical activity and nutrition were evaluated using the adapted Dewar et al (2012) and Dishman et al (2010) questionnaires (Abdi et al., 2015). The questionnaire was translated from English to Arabic by a panel of researchers who were also asked to evaluate the face validity, clarity, readability and relevance (Abdi et al., 2015). The questionnaire was reviewed twice by 20 employees with a week interval in which the reliability coefficients were reported to be 94% (Abdi et al., 2015).

Similar to the previous Dewar et al (2012) study, the questionnaire involved seven scales: (1) self-efficacy, (2) intention, (3) situation, (4) social support, (5) behavioural strategy, (6) outcome expectations and (7) outcome expectancies (Abdi et al., 2015). The adapted lifestyle program is based on the principles of the SCT which involves 10 lessons that provide participants with information on the two interested behaviours, nutrition and physical activity (Abdi et al., 2015). The study involved a clear representation the SCT constructs, many of the participants were obese or overweight that consumed unhealthy foods (personal construct), at the organisation and home with no supportive environment (environmental construct) and their behaviours should be changed (behavioural construct) through the adoption of the interventions, the SCT and modals – 'provides information on nutrition, physical activity, healthy cooking and exercise skills (behavioural capability)' (Abdi et al., 2015).

The expectations principle of the SCT was represented through lessons on eating a healthy diet and exercising and how both can benefit the participants (Abdi et al., 2015). Self-efficacy was represented through communication between health advisors and the participants by creating incremental goals (Abdi et al., 2015). Observation learning was reflected through the presence of "respected members" posing as role models (Abdi et al., 2015). Reinforcements was represented by incentives given to participants who were taught to reward themselves (Abdi et al., 2015). Participants were randomly assigned to one of three groups: (1) telephone-assisted group, (2) web-assisted group and (3) control group (Abdi et al., 2015). Whilst participants in all three groups received general brochures about lifestyle and weight, the control group did not receive the lifestyle program (Abdi et al., 2015). The lifestyle intervention resulted in a weight loss of 1.92kg in the telephone-assisted group and 1.08kg in the web-assisted group to which a significant difference was reported in weight loss among the groups according to time (p=0.03) (Abdi et al., 2015). The outcome expectancies and self-efficacy constructs were both reported to have statistically significant findings (Abdi et al., 2015).

However, the study did highlight challenges in evaluating the SCT constructs in that it required numerous questions which would exhaust the participants and deemed the questionnaire unacceptable (Abdi et al., 2015). Another challenge associated with the evaluation of the SCT constructs was that the questionnaire was based on self-reporting and thus increased the likelihood of social desirable bias (Abdi et al., 2015). The authors suggested that educated individuals are more likely to engage in improving their health than others and that is difficult to involve disadvantaged individuals in health promoting interventions (Abdi et al., 2015). Overall, the results found in this study

corroborated previous findings showing the SCT is effective in developing and applying interventions in real-life setting within the healthcare context (Abdi et al., 2015).

SCT in Depression of Female Students

Moeini et al (2019) conducted a cross-sectional study to investigate the prevalence of mild to moderate depression among female High School students in the Hamadan, Iran. The study aimed to examine the effectiveness of the Dorehye Amozeshie Dokhtaran (DAD) course, an online-based education program (Moeini et al., 2019). The DAD course was divided into two phases (Moeini et al., 2019). In the first phase, a qualitative study was conducted on 45 female students (Moeini et al., 2019). The study involved conducting two interviews and a focused group discussion depression improvement website application (Moeini et al., 2019). Their response from these discussions indicated a need to a depression improvement website application (Moeini et al., 2019). The second phase involved the development of a preliminary website which was based on the data collected from the first phase (Moeini et al., 2019).

The DAD program provided an online cognitive-behavioural therapy to manage mild and moderate depression (Moeini et al., 2019). Each user had distinct and confidential login credentials (Moeini et al., 2019). The DAD program was based on the SCT constructs, as it explains reciprocal behaviours to which an individuals' behaviour, personal and environmental factors interact and mediate one another (Moeini et al., 2019). The intervention involves various modules such as the "*introduction and assessment, awareness-raising, positive psychology, problem-solving, thoughts and feelings, relaxation, physical exercise and lifestyle modifications*" (Moeini et al., 2019). Each module included a multimedia illustration in which participants were asked to identify inconducive beliefs and received training to help manage them and turn them into more positive reasonable thoughts (Moeini et al., 2019). Students were encouraged to engage in physical enjoyable activity and were asked to complete a daily mood assessment form (Moeini et al., 2019). These forms were used to help understand the relationship between mood and favourable activities (Moeini et al., 2019). The intervention also included additional information about the effects of adequate nutrition on depression, anxiety, sleep improvements and assertive skills learning (Moeini et al., 2019). Continuous online support from a psychiatrist was available using a secure online messaging system, which included eight 30-minute sessions (Moeini et al., 2019). Students were assigned homework at the (Moeini et al., 2019).

Depression and SCT constructs were assessed using the questionnaires which was provided at baseline, 12-week point, and 24-week point after the intervention (Moeini et al., 2019). Depression was measured using the validated Centre for Epidemiologic Studies Depression Scale (CES-D), which includes 20 items evaluating the occurrence of symptoms in the past seven days (Moeini et al., 2019). These items were rated using a 4-point Likert scale giving a total score ranging from 0 (low level of depression) to 60 (higher level of depression) (Moeini et al., 2019). Social support was assessed using the Farsi version of the Perceived Social Support Scale-Revised (PSSS-R) (Moeini et al., 2019). The scale included 12 items which were rated using a 5-point Likert scale, ranging from 4 to 20 (Moeini et al., 2019). Higher scores indicated high-perceived social support (Moeini et al., 2019). Self-efficacy was assessed using the Farsi version of the Sherer's general self-efficacy questionnaire (Moeini et al., 2019). The questionnaire included 12 items and were rated using a 5-point scale (Moeini et al., 2019). Outcome expectations was assessed using the Outcome Expectation Scale for depression (Moeini et al., 2019). The scale involved seven items e.g., "*I feel insufficiency if I look for depression treatment*", which were rated using a 5-option Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) (Moeini et al., 2019).

Self-regulation was assessed using the Self-Regulation Scale for depression (Moeini et al., 2019). The scale consisted of seven-items e.g., "*I feel worthless if I look for treatment of depression*" which were selected from a study of the self-regulation model of depression (Moeini et al., 2019). Satisfaction with the website and self-reported website usage was assessed using items in the questionnaire to measure frequency of usage, usefulness, preferences and overall website satisfaction (Moeini et al., 2019). Repeated ANOVA tests were used to assess changes in depression scores and SCT constructs from baseline to 24-weeks (Moeini et al., 2019). ANCOVA test was performed to identify any differences between mean scores of depression and SCT constructs in both the intervention and control groups (Moeini et al., 2019). Multiple linear regression analysis was used to examine the association between variations in the SCT constructs and depression scores (Moeini et al., 2019).

Results showed that a total of 128 students (out of 243) were randomly recruited and assigned to one of two groups, intervention and control group (Moeini et al., 2019). Each group consisted of 64 students (Moeini et al., 2019). A statistically significant finding was revealed between the prevalence of depression and the type of school, family income, residing in the suburbs and field of study ($p<0.001$) (Moeini et al., 2019). There were no reported changes in the majority of the SCT constructs, with the exception of two, self-regulation and social support (Moeini et al., 2019). In the intervention group, an intention-to-treat (ITT) analysis found a statistically significant increase in the self-regulation

and social support constructs from baseline to follow-up (24-week point) ($p<0.05$) (Moeini et al., 2019). A similar finding of a statistically significant increase was reported from baseline to the 12-week point ($p<0.05$) compared to the control group (Moeini et al., 2019). A multiple linear regression analysis revealed no statistically significant association between changes in the SCT constructs (self-efficacy, goal setting and outcome) and depression scores (Moeini et al., 2019). This study was the first to investigate the use of an online-based therapeutic approach to improve the prevalence of depression based on the SCT constructs (Moeini et al., 2019). The statistically significant findings in the prevalence of depression associated with the type of school, family income, residing in the suburbs and field of study ($p<0.001$) have been found to be embedded within the constructs, though this was not reflected nor explored in association with the SCT (Moeini et al., 2019).

SCT in e-Health Technology

Online Health Communities (OHC) have become an important method or source for individuals to conduct health-related activities such as booking appointments, attending appointments and access to medical records (Zhou and Fan, 2019). E-health literacy refers to an individuals' ability to use online-related resources to achieve better health outcomes (Zhou and Fan, 2019). Promoting e-literacy can also provide support to individuals to better utilise the health information available online (Zhou and Fan, 2019). E-health literacy has been used as a personal health outcome which is derived from both personal determinants (behaviours and cognitive factors) and social and environmental determinants of health (Zhou and Fan, 2019). However, only a few studies have investigated the effect of personal, social and environmental determinants on patient e-health literacy in OHCs (Zhou and Fan, 2019). As the health outcome is influenced by personal and social systems, SCT was suitably applied to explore factors influencing patient e-health literacy in OHCs (Zhou and Fan, 2019).

Based on previous studies, the "*patient health knowledge seeking*" domain was referred to as the behavioural factor and the "*social interaction ties*" was referred to as a social environmental factor (Zhou and Fan, 2019). The authors developed three hypotheses, (1) "*patient health knowledge seeking behaviours in OHCs positively influence their e-health literacy*", (2) "*social interaction ties as an OHC social environmental factor positively influence patient e-health literacy*" and (3) "*social interaction ties positively moderate the effect of health knowledge seeking behaviour on patient e-health literacy*" (Zhou and Fan, 2019).

Zhou and Fan (2019) adopted three scales to assess three different constructs, health information seeking, social interaction ties and e-health literacy (Zhou and Fan, 2019). The scales were selected based on previous studies and adapted to this study's OHC context (Zhou and Fan, 2019). The 'health knowledge seeking' construct was assessed using three items, social integration was assessed using four items and e-health literacy was assessed using eight items (Zhou and Fan, 2019). All items were rated using a 5-point Likert scale ranging from 1 (totally disagree) to 5 (totally agree) (Zhou and Fan, 2019).

The authors developed an online questionnaire which consisted of the three SCT constructs and demographic factors (Zhou and Fan, 2019). The distribution of the questionnaire link was supported by the community administrators, and involved four communities (Zhou and Fan, 2019). Participation was voluntarily and anonymous (Zhou and Fan, 2019). An incentive of 50 popular textbooks, focused on health preservation, was randomly provided to participants after the completion of the study (Zhou and Fan, 2019). Each book was valued at approximately $4.30 or 30¥ (Chinese Yuan) (Zhou and Fan, 2019). The authors used a sophisticated algorithm that only those who were OHC users could complete the questionnaire and only one IP address could be used to complete one questionnaire to avoid repeated data questionnaire (Zhou and Fan, 2019). The participants' concentration was also assessed in that if they failed to acknowledge a reverse question, the sample will be referred to as invalid (Zhou and Fan, 2019). Data collection was conducted over two-months (Zhou and Fan, 2019).

A total of 409 participants were familiar with using an OHC service but 76 participants were excluded due to the failure in recognising the reverse questions which resulted in a final sample of 333 valid responses (Zhou and Fan, 2019). Majority of the participants were female (n = 221; 66.4%), with the highest number of participants (n = 86; 25.8%) aged between 16 to 25 years and 82 participants (24.6%) were aged between 26 to 35 years (Zhou and Fan, 2019). Participants' level of education ranged from High School and below (n = 80; 24%), College (n =73; 21.9%), Bachelor (n = 110; 33%) to Masters and above (n = 70; 21%) (Zhou and Fan, 2019). Many participants had at least 3 to 4 years of prior internet experience (n = 132; 39.6%), preceded by those who had more than five years of prior internet experience (n = 133; 39.9%) (Zhou and Fan, 2019).

Regression analysis was able to validate the three hypotheses (Zhou and Fan, 2019). Two SCT constructs, 'health knowledge seeking' and 'social interaction ties' in OHCs were found to have a positive influence on patient's e-health literacy (Zhou and Fan, 2019). Social interaction ties were referred to as an environmental item and was found to have a positive effect on health knowledge

seeking on patient e-health literacy (Zhou and Fan, 2019). The stronger the social interaction ties, the higher the effect on health knowledge seeking behaviour and vice versa when the variable is weaker (Zhou and Fan, 2019). Thus, social interaction ties positively mediate the effect of health knowledge seeking on patient e-health literacy (Zhou and Fan, 2019).

The study was able to identify two SCT constructs (one behavioural and one social environmental) to develop a model for patient e-literacy based on the SCT and prior studies on e-health literacy (Zhou and Fan, 2019). The findings from this study were able to contribute towards the literature exploring the impact of OHCs on personal health outcomes by identifying the mechanism of OHC use and its effect on patient e-health literacy (Zhou and Fan, 2019). The findings also provided an exploration on the interaction of SCT constructs, behavioural factors, and social environmental factors and how they influence patient e-health literacy in OHCs (Zhou and Fan, 2019). Zhou and Fan (2019) were able to elucidate the direct relationship and effect of a social environmental factor on e-health literacy specifically in OHCs.

However, this study also had three notable limitations (Zhou and Fan, 2019). The first limitation was that the 'health knowledge seeking' construct was assessed as one singular construct thus the effect of individual behavioural frequencies was not explored (Zhou and Fan, 2019). The second reported limitation was that 'health knowledge' was congregated into one construct, consequently forgoing the assessment of individual types of health knowledge as each different health knowledge item may cause a different effect on e-health literacy (Zhou and Fan, 2019). Lastly, the third limitation was the lack information exploring the factors influencing OHC participation behaviours, as the factor of time may be an implication between participation and e-health literacy (Zhou and Fan, 2019).

SCT in Addiction Therapies

Addiction has increased in recent decades and consequently had led to a serious problem in social and psychological health issues (Heydari et al., 2014). Iran was reported to have the highest rate in drug use across the world with 2.8% (Heydari et al., 2014). The premise of addiction therapies and treatment is to promote an individual's acceptance of addiction as a chronic disease and improve the lifestyle to increase the adherence to addiction quitting behaviours (Heydari et al., 2014). Recurrence of addiction is identified as a serious concern in which it is used as an indicator to evaluate healthcare systems and its functions (Heydari et al., 2014). According to a previous study, Iran has a recurrence rate relating to just one month post detoxification treatment (Heydari et al., 2014). As SCT provides a

reciprocal direction of impact among three constructs, its applicability to intervention strategies promoted its adoption in the study (Heydari et al., 2014). Heydari et al (2014) conducted an experimental study to examine the effect of SCT constructs on addiction quitting individuals referred to an addiction quitting clinic in Iran.

This study involved a before-after two group design, recruiting individuals with a confirmed diagnosis of an addiction from the Imam Reza Hospital clinic in Mashhad, Iran (Heydari et al., 2014). Eligibility criteria included a formal diagnosis of an addiction by a physician, the duration of the addiction must be less than 10 years, no drug dependency other than opium and no chronic and psychiatric disease (Heydari et al., 2014). Participants were randomly assigned to an equal sample of an intervention and control group (n = 30 in each group) (Heydari et al., 2014). Participants were then asked to complete the 16-item self-efficacy questionnaire before and after the intervention (Heydari et al., 2014). All items focused on assessing problem-solving, decision-making, self-protection and communication (Heydari et al., 2014). The intervention group received a treatment based on Bandura's SCT model whereas the control group received conventional treatment (Heydari et al., 2014).

The validity and reliability of the questionnaire was verified by two previous studies and through face and content validity (Heydari et al., 2014). Data collection took place over the course of seven-months (Heydari et al., 2014). The intervention group were provided with 60–90-minute sessions of SCT-focused treatment, which consisted of four steps (Heydari et al., 2014).

The first step also referred to as 'information', involved an educational need assessment followed by presentation providing information on addition process, complications, and treatment (Heydari et al., 2014). The second step, 'inspiring vulnerability' involved assigning participants into groups of six to eight to discuss changing attitudes (Heydari et al., 2014). Education, self-regulatory skills and required risk elimination aided in the conversion of 'knowledge of health risk' factors to 'preventative behaviours' (Heydari et al., 2014). The third step, 'enhancement of social self-efficacy' involved four sessions (Heydari et al., 2014). In the first session, participants were trained on problem solving-skills, in which the applicability of these skills in actual problems experienced by the participants were discussed in their assigned groups (Heydari et al., 2014). Researcher supervision was present when the participants tried to apply the skills to their actual situations (Heydari et al., 2014). The second session involved discussions about decision-making skills (Heydari et al., 2014). The third session consisted of the application of self-projection skills (Heydari et al., 2014).

The final and fourth session involved a review of the previous skills and scenarios and the training of communication skills (Heydari et al., 2014). The fourth step, 'social support' included two sessions, the first session included discussions about family support and the types of support during the quitting period with the participant's referent individual present in the discussion (Heydari et al., 2014). The second session involved the discussion about the self-governing group in which the current members were invited to present their group and activities and invited the participants to join their meeting (Heydari et al., 2014). The last session consisted of a summary review of the information provided and presented during the eight sessions and were assisted for future referrals (Heydari et al., 2014). In the post-intervention step (after), participants were followed up for a month and conducted weekly morphine tests (Heydari et al., 2014). The intervention was then reset and completed after for post-testing (Heydari et al., 2014). During this post-test, self-efficacy questionnaires used on addiction-quitting participants was analysed to examine the effect of the presented educational course (Heydari et al., 2014).

The study did not provide any information on demographics and found no statistically significant findings between the two groups whilst controlling for numerous variables such as age, gender, educational level, occupation and many more (Heydari et al., 2014). The results did however reveal that the possibility of experiencing addiction quitting behaviours was higher in the intervention group (90%) compared to those in the control group (73.3%) (Heydari et al., 2014). A statistically significant difference in the rate of a successful addiction quitting intervention (based on SCT) was found between the two groups ($p<0.05$) (Heydari et al., 2014). Similarly, another statistically significant finding in the recurrence was revealed between the intervention/test and control group (Heydari et al., 2014). Four participants (14.8%) in the test group had recurrence compared to nine (40.9%) in the control group (Heydari et al., 2014). A statistical difference in the mean self-efficacy scores before and after the intervention was reported between the two groups (test vs control) using paired *t*-test ($t = -5.89$ vs $t = -1.634$; $p<0.05$) (Heydari et al., 2014). Overall, this study showed that the SCT model could be successfully applied when examining the effects of an educational intervention to improve adherence to addiction quitting behaviours (Heydari et al., 2014). The findings from this study corroborated previous evidence regarding the preference to non-pharmaceutical interventions and detox treatments to experience continuous, long-term and effective quitting behaviours (Heydari et al., 2014). However, the authors also did not report any limitations to their study.

Chapter 3: Methodology

This chapter describes the methodological approach adopted to understand perceptions of FI from NHS staff and patient representatives. The setting of the data collection sites is briefly outlined, alongside the study population, eligibility criteria, process of data collection, data analysis, epistemological and ontological position, and reflexivity.

3.1 Conceptualisation of Risk

Risk is ubiquitous and supports the existence of various definitions as it's a term that means different things to different individuals (Adams, 2002). It is often linked to an insidious and negative connotation which corroborates its vague conceptualisation (Heckmann et al., 2015). However, some may argue that the term also refers to a positive connotation e.g., providing an opportunity (Aven, 2012; Gluckman, 2016). Much like FI, though there is no gold standard definition of risk, when it's used in everyday language, the term is frequently used and easily understood (Heckmann, 2016). A collective description and general synthesis of the term could include 'an undesired consequence from an action, activity or event causing a potential or serious implication such as injury or death' (Serrano-Gomez and Munoz-Hernandez, 2019). Risk can also be simplified as the product of two components, (1) the probability of the harm and (2) the magnitude of the harm (Resnik, 2005). Nonetheless, in different professional fields such as medicine, business, politics and organisations, the consensus of risk would differ significantly, e.g., in business, the connotation of risk would be focused on financial loss rather than death and injury in a medical profession (Kemshall and Wilkinson, 2011). Thus, some definitions are based on probabilities, expected values, uncertainty and objectives (Šotić and Rajić, 2015). Furthermore, to add to its polysemous nature, there is a plethora of the different types of risks such as legal risk, perceived risks, social risk, psychological risk, financial or economic risk and can be further categorised into evaluation stages such as risk analysis, risk identification, risk assessment and risk management (Belas et al., 2018; Resnik, 2005).

Each decision and action are susceptible to uncertainty in which incorrect assessments and misjudgements may led to unforeseen consequences, thus risks need to be continuously monitored and managed (Heckmann, 2016). It may be extremely challenging and difficult to assess risks associated with any action, decision or project due to uncertain nature and thus as the number of uncertainties increase, so does the level of importance assigned to each risk (Adams, 2002; Heckmann, 2016). Due to its uncertain nature, risk is frequently estimated to near reality and is rarely confined to

accuracy as each new experience or past experiences can only reflect limited risk identification and mitigation which is largely based on probability (Flage et al., 2014; Hoffman and Hammonds, 1994; van Asselt, 2000). Thus, to assess risk, a Fuzzy Set Theory approach is often adopted as it translates 'ambiguous, subjective and imprecise linguistic data and quantifies it for decision-making' (Bon-Gang, 2018). According to Zadeh (1978) fuzzy set approaches are one of the most appropriate and reliable tools to use when assessing subjective data such as human knowledge and behaviour as human decisions are based on possibilities rather than probabilities in nature and thus stems from the ideology posed in the 'theory of possibility' and not 'probability theory' (Yucel et al., 2012; Zeng et al., 2007).

The fuzzy set theory categorises data using simplistic language such as low risk, high probability, or moderate impact (Serrano-Gomez and Munoz-Hernandez, 2019). Risk analysis in healthcare involves consideration of various sources of risk in the effort to distinguish minor acceptable clinical risks from the unacceptable major risks and to provide data to assist the subsequent evaluation and management of risks (Pascarella et al., 2021). When evaluating the acceptability, adoption and sustainability of an innovation, the fuzzy set theoretical approach assumes an appropriate mechanism to assess the impact of individual risks. Before discussing the associated risks of specific FIs, it is important to acknowledge and understand the various assessment tools used.

In the UK, under the regulation of the health and safety law, entails a preventative, risk assessment approach. Such processes for assessing and regulating health technology, medical devices and drugs may have an impact on how FI is being introduced into the UK. Regulatory bodies such as MHRA, FDA and Health Canada will have a particular view on what counts as acceptable evidence of risk. This perspective may deter some innovators and seek other markets due to the stringent and expensive requirements as seen with the Aurolab who acquired a European CE accreditation for its intraocular lens but did not seek competition in the US market as it would require approval by the FDA (Barlow, 2017). This may be as such requirements could imply that evidence is only considered from reputable sources and institutions. Though risk is contextual, many processes in HICs often follow similar formats to one another as opposed to those in LMICs which are less regulated (Barlow, 2017). It is important to also consider how risk is conceptualised particularly in the realm of specific LMICs through the COO effect and frugality lens.

Typically risk assessment involves risk identification (what could cause an effect, whether it be positive or negative?), what is the likelihood of the risks occurring? and what is the severity or impact of the

consequence on the objective? Action needs to be taken to eliminate the hazard, or if this is not possible, control the risk (Khunti et al., 2021). Furthermore, in healthcare, all risks cannot be predicted or anticipated particularly when the specific risks have never occurred or been unreported. Therefore, it is not possible to accurately predict the consequences and likelihood of a risk (Pascarella et al., 2021). However, a risk assessment provides an appropriate reflection and understanding of comparisons between alternatives and allows individuals to make informed choices based on existing information and acknowledging uncertainties. Nonetheless, estimated risk or risk perception can be used to evaluate the risks of specific frugal innovations based on published data and evidence.

3.2 Risk Assessment Models

The heterogeneity of defining risk adds to the challenge of understanding the underlying concepts including uncertainty. Furthermore, there are many risk assessment techniques currently used in a variety of disciplines to which each is chosen due to the objective in question such as Event Tree Analysis (ETA), Fault Tree Analysis (FTA), Monte Carlo Analysis (MCA), Healthcare Failure Mode and Effect Analysis (HFMEA), Programme Evaluation and Review Technique (PERT), Hazard and Operability (HAZOP), Systematic Human Error Reduction and Prediction Approach (SHERPA), Root Cause Analysis (RCA) and perhaps the most commonly used Failure Mode and Effects Analysis (FMEA) (Faiella et al., 2018; Gul and Ak, 2018; Liu et al., 2018; Rah et al., 2016; Yucel et al., 2012).

ETA is used to assess risk based on the probability of an event's success and failure and therefore is not applicable as it assesses risk based on a top-down approach (Win et al., 2004). Similarly, the FTA tool assess the root cause of an event failure and is a retrospective risk assessment and thus is not applicable for predictive risk (Bonnabry, 2005; Yucel et al., 2012). Though, the MCA tool uses a simulation algorithm to randomly select a value for competing variables to estimate the impact of risk to the objective, the tool requires imputation of three estimates and only provides the overall probability of all risk factors rather than individual risk and thus is not appropriate for use in this project (Harrison et al., 2010). HFMEA involves a multidisciplinary team to identify high-risk healthcare processes and potential failures that can occur within the process activities and thus is time-consuming, subjective, expensive and requires illustration and thus is not appropriate in this project (DeRosier et al., 2002; Faiella et al., 2018).

PERT assess tasks in a systematic manner and identifies the probability of project completion time which is not the objective of this project and therefore not applicable (Gogoi and Hazarika, 2017; Habibi et al., 2018; Sackey and Kim, 2019). HAZOP identifies potentially hazardous circumstance that

may affect personnel (people), the environment, equipment as well as operability of the process to function as designed and focuses on the deviations from design intent and requires some level of expertise (Baybutt, 2015) and is therefore not applicable.

On the other hand, SHERPA assesses individual tasks to understand the types of human error involved in the occurrence of risk and though it is exhaustive, SHERPA requires interviewing the operator working on the task to seek possible mitigation and is thus not applicable (Hughes et al., 2015; Imtiaz et al., 2014). RCA uses a top-down approach to understand the causative factors involved in the occurrence of avoidable adverse events and therefore it is not applicable for this study (Charles et al., 2016; Hagley et al., 2019; Martin-Delgado et al., 2020; Peerally et al., 2016). FMEA analyses manufactured products and processes by qualitatively identifying possible failure modes and effects prior to its occurrence (Liu et al., 2018; Rah et al., 2016; Yucel et al., 2012). Though FMEA along with the aforementioned tools are effective and sophisticated for a rigorous risk assessment, high quality data is a prerequisite (Winch, 2010). Regrettably, such data is difficult to obtain or has yet to be published in FI. Risk analysis is a subjective process to which there is no objective criterion against examining the validity of the methods (Rah et al., 2016). Therefore, the selection of FIs to explore in this project will be based on four congruent components of a generic and simplistic risk assessment, (1) risk identification or detectability, (2) likelihood or frequency, (3) consequence or impact of the risk and (4) time or duration of impeding risk (Adams, 2002; Aven, 2012; Gluckman, 2016; Joint Australian New Zealand International Standard, 2009; Resnik, 2005; Royer, 2000; Yucel et al., 2012; Zeng et al., 2007).

3.3 Components of Risk Assessment

Risk can be measured by assessing three questions, (1) what can go wrong? (2) how likely is it? (3) what are the consequences? The quantitative definition of Kaplan and Garrick (1981) defines risk as a set of triplets, represented by the following equation:

$$\text{Risk} = \{(s_i, p_i, x_i)\}$$

s_i represents the specific risk, p_i is the probability of that risk occurring and x_i is the consequence of the risk e.g., degree of injury (Campbell, 2005; Kaplan and Garrick, 1981; Šotić and Rajić, 2015). Thus, risk is often expressed as the probability multiplied by consequence, however Kaplan and Garrick (1981) acknowledges the inconsistencies with this formulation and proposed that risk is probability

and consequence. Nonetheless, a risk assessment with the same components using a qualitative approach is compatible and appropriate for selecting the types of FIs to explore and thus will focus on the previous four components.

Identifying Risks

Whilst some risks are apparent, others require judgement and thorough consciousness to which can be identified through human behaviour and values (Adams, 2002; Gluckman, 2016). Though risks can stem from epistemic values, the knowledge must be derived from non-epistemic sources to provide judgement based on science and human value (Aven, 2016). In the UK, organisations have a responsibility to conduct a risk analysis of a proposed system, process, or equipment to understand the possible outcomes of certain risks in order to help minimise and mitigate the impact (Dludhlu et al., 2017; Khunti et al., 2021). Risk identification (Ri) involves the exploration of all potential risks that may occur within a process and opportunities which may affect the organisation whether positive or negative and forms the basis for a risk assessment and provides an understanding of the areas in which is exposed to risk (Renault et al., 2016; Zou et al., 2007). Ri deals with potential threats to not only minimise injury and prevent catastrophic events but also to translate risks into opportunities which can lead to effective implementation of an innovation and end-user safety (Tchankova, 2002; Winch, 2003). Ri is an iterative process as new risks become known and existing ones may evolve as the project progresses through its life cycle (PMI, 2013). One of the most frequently used approaches to risk identification is the top-down technique, where the process is analysed from an overall point of view (Bajaj et al., 1997; Wang et al., 2004). Furthermore, brainstorming, previous history, interviews, questionnaires and workshops are frequently used methods to research the types of risks involved in a specified project or event (Tang et al., 2007).

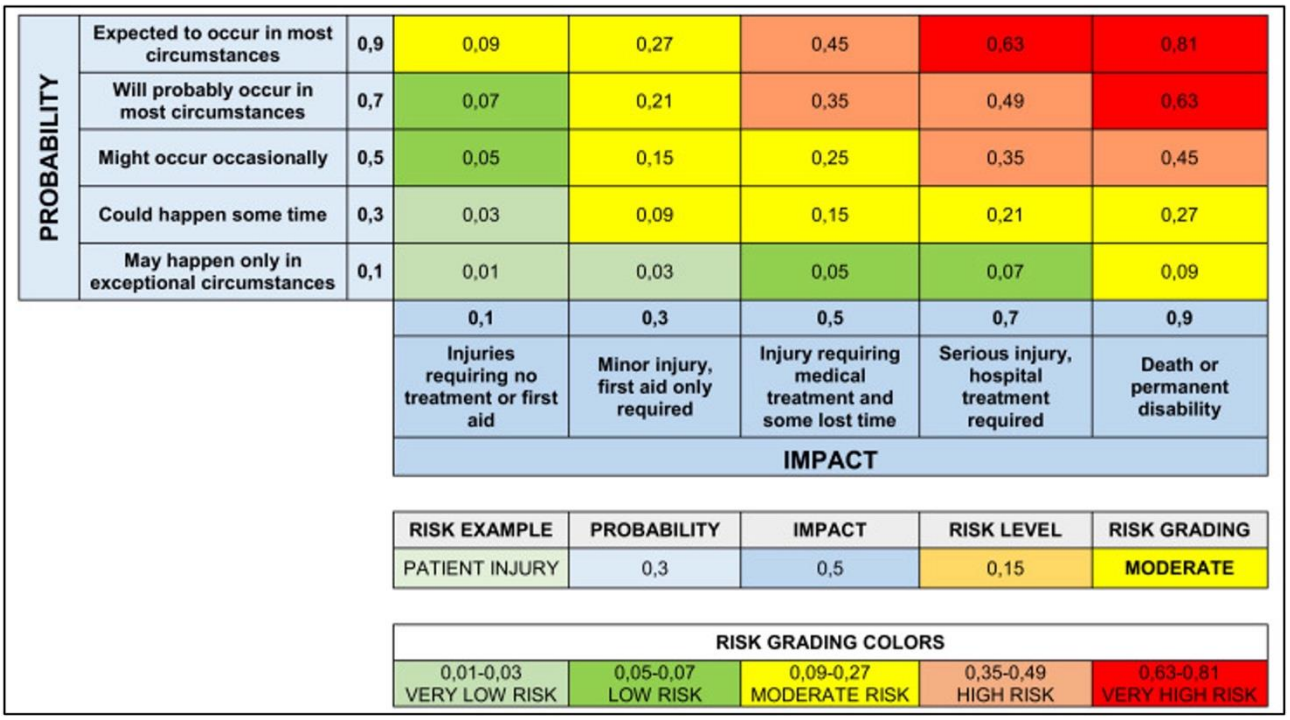
Likelihood

In risk management, likelihood refers to the probability or chance of something occurring and is often described using general qualitative standardised terms such as ‘extremely remote’, ‘very unlikely’, ‘certain’, ‘moderate’ or quantitatively, derived from a mathematical formula, frequency or probability over a given time period (Joint Australian New Zealand International Standard, 2009). Once risk identification is completed as the first step, then next step involves assessing the likelihood (probability) of the risk occurring (Rah et al., 2016). If a statistical model is used, the likelihood measures the relative frequency of a risk, which is typically assessed from historical data to produce

an estimated judgement of the underlying likelihood (Gluckman, 2016). The aforementioned methods used in risk identification can be used in assessing likelihood, in the case where historical data is unavailable or incomplete and thus behavioural models, simulations and judgements are often used to produce an estimate of likelihood (Tang et al., 2007). According to Gluckman (2016), these terms reflect the predicted frequency of occurrence or calculated probability. Information about the likelihood of a risk is particularly relevant to healthcare and those choosing between alternatives (FI) need to understand the likelihood of both negative outcomes (risks) and the positive outcomes (benefits) associated with the available options to make informed decisions (Zeng et al., 2007; Zou et al., 2007).

Two questions can be used to assess likelihood, (1) how likely is the risk to occur? and (2) how frequently has this occurred? (Alam, 2016). A rating scale can then be established e.g., the assessment of likelihood of a risk occurring is assigned with a numerical value, see Figure 7.

Figure 7: A Quantitative Guide to Likelihood Scoring*



PROBABILITY							
	Expected to occur in most circumstances	0,9	0,09	0,27	0,45	0,63	0,81
	Will probably occur in most circumstances	0,7	0,07	0,21	0,35	0,49	0,63
	Might occur occasionally	0,5	0,05	0,15	0,25	0,35	0,45
	Could happen some time	0,3	0,03	0,09	0,15	0,21	0,27
	May happen only in exceptional circumstances	0,1	0,01	0,03	0,05	0,07	0,09
			0,1	0,3	0,5	0,7	0,9
			Injuries requiring no treatment or first aid	Minor injury, first aid only required	Injury requiring medical treatment and some lost time	Serious injury, hospital treatment required	Death or permanent disability
			IMPACT				

RISK EXAMPLE	PROBABILITY	IMPACT	RISK LEVEL	RISK GRADING
PATIENT INJURY	0,3	0,5	0,15	MODERATE

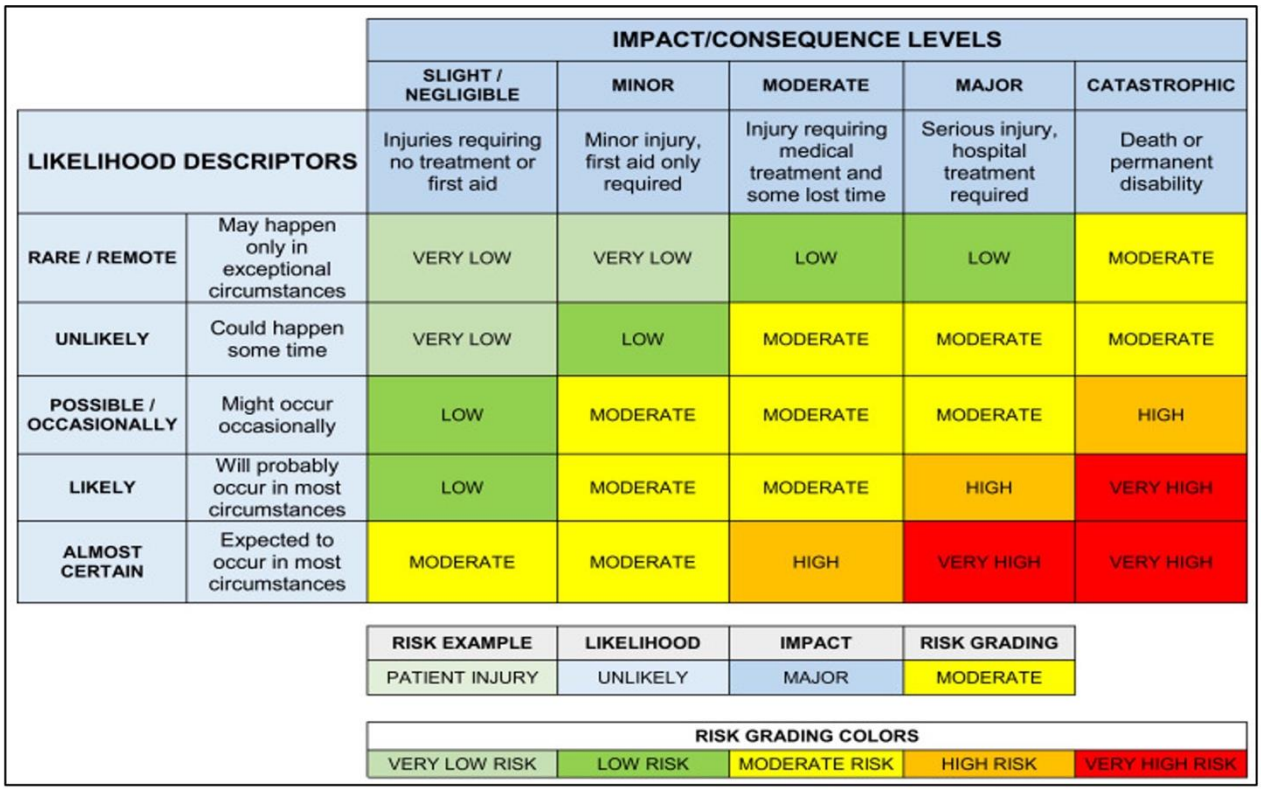
RISK GRADING COLORS				
0,01-0,03 VERY LOW RISK	0,05-0,07 LOW RISK	0,09-0,27 MODERATE RISK	0,35-0,49 HIGH RISK	0,63-0,81 VERY HIGH RISK

*Extracted from Pascarella et al (2021)

Though, likelihood is essentially a numerical concept, verbal terms are used because they are easier and more natural to understand (Brun and Teigen, 1988; Kong et al., 1986). The value of likelihood of a specific risk is given by description using a pre-defined rating scale, see Figure 8 (EU Commission

Staff Working Paper, 2010). Although, verbal terms or qualitative grading implies in inaccurate determination of risk, it is appropriate for single probabilities that are vague or uncertain (Erev and Cohen, 1990; Resnik, 2005). Verbal terms are viewed as more practical because they do not indicate more than a generalised consensus and hence is a more preferred choice of grading for information providers (Burkell, 2004).

Figure 8: A Qualitative Guide to Likelihood Scoring*



		IMPACT/CONSEQUENCE LEVELS				
		SLIGHT / NEGLIGIBLE	MINOR	MODERATE	MAJOR	CATASTROPHIC
LIKELIHOOD DESCRIPTORS		Injuries requiring no treatment or first aid	Minor injury, first aid only required	Injury requiring medical treatment and some lost time	Serious injury, hospital treatment required	Death or permanent disability
RARE / REMOTE	May happen only in exceptional circumstances	VERY LOW	VERY LOW	LOW	LOW	MODERATE
UNLIKELY	Could happen some time	VERY LOW	LOW	MODERATE	MODERATE	MODERATE
POSSIBLE / OCCASIONALLY	Might occur occasionally	LOW	MODERATE	MODERATE	MODERATE	HIGH
LIKELY	Will probably occur in most circumstances	LOW	MODERATE	MODERATE	HIGH	VERY HIGH
ALMOST CERTAIN	Expected to occur in most circumstances	MODERATE	MODERATE	HIGH	VERY HIGH	VERY HIGH

RISK EXAMPLE	LIKELIHOOD	IMPACT	RISK GRADING
PATIENT INJURY	UNLIKELY	MAJOR	MODERATE

RISK GRADING COLORS				
VERY LOW RISK	LOW RISK	MODERATE RISK	HIGH RISK	VERY HIGH RISK

*Extracted from Pascarella et al (2021)

Consequence

Consequence in risk assessment or management is referred to as the degree of severity of an action from a specific risk whether it be positive or negative (Faiella et al., 2018; Rah et al., 2016). It is important to note that consequence is distinct from impact and threat (Pascarella et al., 2021). For example, threat is the potential for harm, impact or severity is a forceful effect (anticipated outcome of the risk), whereas consequence is the result of an effect (Carroll, 2014). Consequence represents the effect of the risk to the workplace, workforce, and individuals (Alam, 2016). Consequence can be rated using a five-point scale: (1) insignificant/negligible, (2) minor, (3) moderate, (4) major and (5) catastrophic negative (Rah et al., 2016). It is important to note that consequence is distinct from impact and threat (Pascarella et al., 2021). It is important to establish a standardisation to grading so

that it can be used to compare risks against each other and develop an appropriate risk management plan (Pascarella et al., 2021). It can be expressed in terms of tangible and intangible impacts (Joint Australian New Zealand International Standard, 2009; Royer, 2000). Consequences can be expressed in terms of economic, environmental, or social criteria, see Table 1 (Alam, 2016; Gluckman, 2016; Rah et al., 2016).

Table 3: Classification of Consequences*

Classification	Consequence	Score
Negligible/ Insignificant	No impact or some local, general response required, but no specialised response. No injuries, little damage, low financial damage	1
Minor	Some local, specialised response, and surveillance and monitoring from regional authorities. First aid treatment, minor building damage. No injuries	2
Moderate	Significant local, specialised response, and multi- regional general response, and notification from national authorities. Medical treatment, moderate building damage. No permanent injury	3
Major	Multi-functional, multi-regional specialised response and mobilisation from national authorities and notification from international authorities. Extensive injuries (not permanent), high level of building/infrastructure damage	4
Extreme	Multi-functional, national and international, specialised response. Deaths, severe sequelae, large-scale structural damage and infrastructure failure	5

*Extracted from Alam (2016), Gluckman (2016), Rah et al (2016)

Each consequence category has been associated with a specific meaning and an example to represent its severity e.g., if the risk causes death or large-scale structural damage or complete infrastructure failure than the risk is catastrophic with the score of 5. The categorisation is to help users navigate through risk identification and interpretation by providing examples to reflect the degree of severity and to communicate more efficiently and effectively (Pascarella et al., 2021). We acknowledged that risk plays a significant role in developing perceptions, particularly when the risk is high to evoke a specific action i.e., acceptance and thus sough to conduct a risk assessment on six examples of FI to identify which ones to present to our participants that vary in invasiveness and subsequent risk. We conducted a risk assessment of specific FIs based on published data and evidence which included Sayeba's method, Arbutus Drill Cover System (ADCS), Mosquito Net Mesh (MNM), Aravind Eye Care System, Kangaroo Care, Family Health Strategy's Community Health Workers Programme (see Appendix 2). We conducted a risk assessment on an individual risk and organisational level following the red, amber, green (RAG) rating scale applying the aforementioned components of risk e.g.,

likelihood and consequence. Our risk assessment resulted in the selection of three examples that varied in risk overall, (1) ADCS, (2) Sayeba's Method, and (3) MNM based on the variation of invasiveness and risk on both an individual and organisational level.

Among the most basic characteristics of humans such as subjectivity and affect, are emotions, opinions, and the language they use to express them. According to Martin and White (2005), affect or the manifestation of emotional states can be classified into two categories. The first is the utterance of judgement towards something or someone and the second is the classification of appreciation or aesthetic opinion often led by social norms and environmental factors. These categorisations (affect, judgement, and appreciation) together form the basis of sentiment analysis. Though the way in which opinions are formulated and expressed, through behavioural exertions, are imperative to its understanding, the linguistics used to portray the intended perceptions and processing is also significantly important. The linguistics used are closely related to the foundation of sentiment analysis. There are various other assessments within the study of linguistics that explore and examine how everyday language is used to convey emotions, evaluation, and subjectivity such as affect (Batson and Yoder, 2012) subjectivity and perception (Banfield, 1982; Traugott, 2010; Traugott, 1995) and modality (Bybee and Fleischman, 1995).

Conversation analysis identifies the basic elements of everyday language and examines what was said, why it was said and how it was said through speaking in turn, adjacency pair and the sequential implicativeness (Sacks et al., 1974). How we correlate emotions and opinions to certain linguistics such as particular words, syntactic patterns, frequency, and occurrence (Biber and Finegan,1989; Stein, 1995)and how we can use them to categorise linguistic expressions according to the intended opinion and perception can be conveyed through the use of sentiment analysis which is inclusive of all aforementioned techniques and aspects. *'Sentiment*' is the expression of subjectivity, which is typically assigned as a positive, neutral, or negative polarity and is project as a score (Peng et al., 2018; G. Wang et al., 2014; Xia et al., 2015). However, these classifications are not restricted to the three polarities but can also be quantified using a 5-point scale: strongly disagree, disagree, neutral, agree or strongly agree (Prabowo and Thelwall, 2009). This is distinct from Emotion Analysis, though both are used interchangeably, and its classification system e.g., anger, fear, happy, surprise, shocked and etc, as it examines the psychological state or mood (Nandwani and Verma, 2021). Thus, emotion analysis involves the complex understanding of responses through lived experiences and is an objective and precise technique as opposed to sentiment analysis, which focuses on the polarity and generalisability of responses as a categorical outcome e.g., positive, and is therefore significantly more subjective (Nagamanjula and Pethalakshmi, 2020; Singh et al., 2021).

Another method to consider for rigour is sentiment analysis (SA), a popular field in Natural Language Processing (NLP). SA is a form of opinion mining which is an automated, systematic computational assessment of opinions, feelings, attitudes and emotions towards a particular topic, question, or item (Devika et al., 2016). Some would argue that SA and opinion mining are assessed differently such that whilst SA identifies sentiments expressed in text then analyses it, opinion mining extract first and then analyses opinions about a product or person (Tsytsarau and Palpanas, 2012). SA involves an intellectual process of quantification with a categorical outcome measure that is combined with an expressive behaviour e.g., 98% of the sample were positive (Onyenwe et al., 2020). The evolution of healthcare innovations, access to more information and knowledge has steered a significant amount of informed unique reviews. However, these reviews only become interpretative and project a particular outcome once data mining has been completed. We can see this type of opinion mining on review sites detailing the lived experiences of restaurants, hotels, cars, medical procedures, healthcare professionals and etc (Hussein, 2018) that often dictate one's decision-making process (Chalothom and Ellman, 2015; Matthew et al., 2015). According to Online Reviews in 2013, 90% of consumers depended on reviews to make decisions and accept the use of a service or purchase an item (Ling et al., 2014). There has been an increase in the use of SA due to its significance in the decision-making capacity and changing the needs of people (Devika et al., 2016).

The analysis of sentiments is divided into many layers: document level (Yessenalina et al., 2010), sentence level (Farra et al., 2010; Meena and Prabhakar, 2007; Shirsat et al., 2019), aspect level (V. K. Singh et al., 2013) and word level (R. Chen et al., 2019), however the document, sentence and aspect levels are the most used processes (Medhat et al., 2014). At the document level, the sentiment is identified from the entire document or record, which then categorises an opinion and provides a positive or negative sentiment (Joshi and Itkat, 2014). Within the document level, we must consider the association between words or terms and phrases and the entire context of semantic information to accurately understand the structure of sentiments (Liu, 2020). At the sentence level, a sentiment is assessed at each sentence which includes subjectivity classification which determines objectives sentences expressing factual information from subjective sentences that express opinion-based reviews (Montoyo et al., 2012; Wilson et al., 2009).

Whilst document and sentence levels (e.g., documents, paragraphs, sentences, or phrases) do not provide information on what exactly people favoured and disfavoured, the aspect level, provides detail within opinions as it aims to categorise sentiments according to specific aspects of an item, person, or service in question and thus evaluates the opinion itself (He, 2012). It is possible to gain

different opinions for different aspects on the same topic e.g., "*the quality of the food is very good, but it is overpriced*". Here, the 'quality' and 'cost' are two different aspects as the quality of the food is explicitly mentioned whereas cost is an implicit aspect using a dependent term to reference the cost as "*overpriced*". Aspect level SA is challenging as its difficult to determine implicit opinions (Nandwani and Verma, 2021). Thus, irrespective of the level chosen, SA detects the contextual polarity of text (Ye et al., 2009). Perhaps the most important acknowledgement of SA is that it requires training the system to perform and code sentiments with the highest quality and accuracy (B. Agarwal et al., 2015). SA requires several stages including data collection, pre-processing through classification, language detection, feature extraction, developing SA modelling, polarity detection and model assessment (see Figure 9) (Medhat et al., 2014; Nandwani and Verma, 2021; Wankhade et al., 2022).

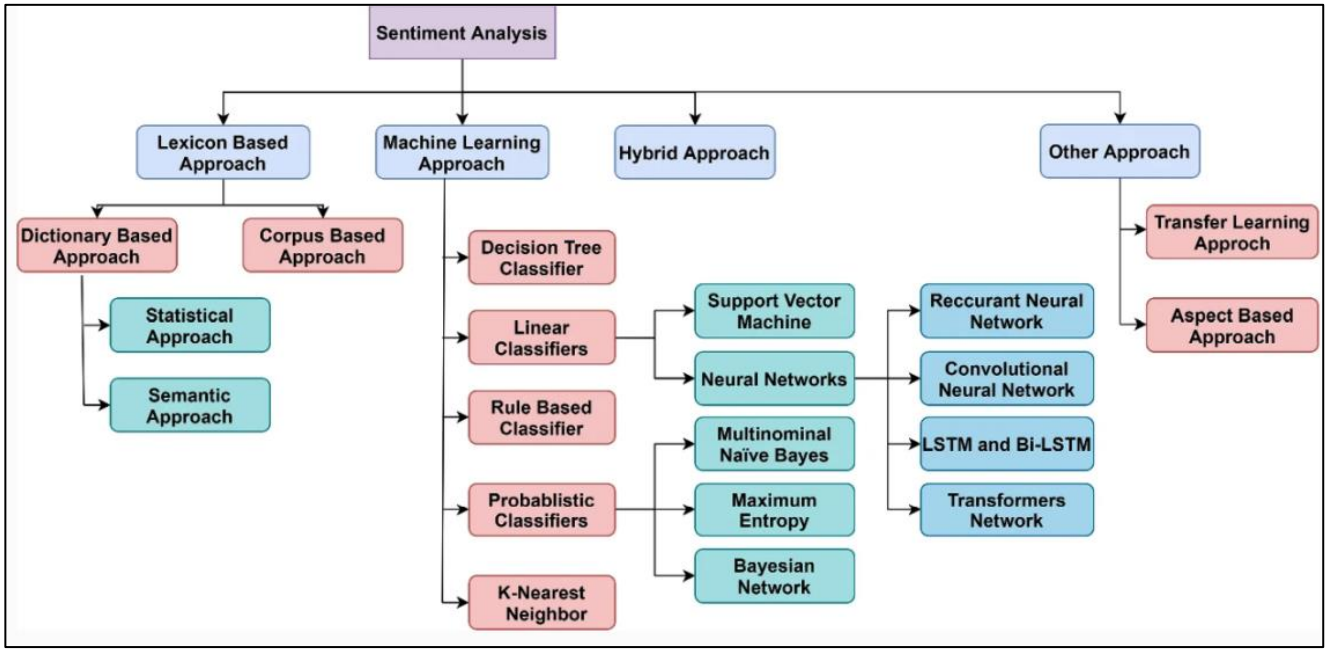
Figure 9: Stages of Sentiment Analysis



3.4 Sentiment Analysis Techniques

Though SA can be conducted using different approaches pertaining to a specific outcome measure, e.g., emotion, narrative, frequency and etc, there are three strategies that typically exist including: 1) machine learning approach (including deep learning approach), 2) rule-based approach and 3) lexicon-based approach, which can be used to classify and analyse sentiments (see Figure 10). In this section, we will look at the advantages and disadvantages of each approach (see Table 4) and conclude our chosen approach.

Figure 10: Different Approaches and Stages of Sentiment Analysis



The machine learning technique uses a computational algorithm that is dictated by a trained data set to accurately assign data into specific polarity categories e.g., words corresponding to a specific sentiment classification e.g., positive (Gamon, 2004). This technique is often a supervised classification which means the processing of sentiments is determined by labelled datasets (Asghar et al., 2019). Another example of a supervised classification is regression which uses an algorithm to understand the association between dependent and independent variables (Bakker et al., 2014). The dataset is typically sectioned into two parts, 1) training and 2) testing (Ye et al., 2009). The training section involves training the algorithm with specific inputs that correspond to particular outputs which could work with prospective unknown data (Lan et al., 2009). The testing portion of this technique involves the use of the trained algorithm to determine its accuracy and success (Joshi and Itkat, 2014).

3.4.1 Deep Learning Approach

The deep learning approach or deep neural network involves the intricate and multilayer brain networks of perceptions that do not require traditional manual feature processing (Birjali et al., 2021). It is dictated by the human brain which contains numerous neurons to build a network (Day and Lee, 2016). This approach has been shown to outperform the conventional methods in SA as it provides a deep understanding and incorporates efficient methods through strategy (Habimana et al., 2020). Within this approach lies several networks such as Convolutional Neural Networks, Recurrent Neural Network, and Recursive Neural Network (Ouyang et al., 2015). Several researchers have conducted sentiment classification by applying neural networks (Kalchbrenner et al., 2014; Kim, 2014; Mesnil et al., 2014; Mikolov et al., 2013; Mishev et al., 2020; Tai et al., 2015). These networks can be very effective in vector representation, sentence construction, feature modelling, word representation estimation, sentence classification and text generation (Zhang et al., 2016). According to (Deng et al., 2013), deep learning involves a relationship between 'software engineering, improved learning procedures and accessibility of computing power and training data' (Ain et al., 2017). Some examples of machine learning techniques includes: support vector machine, random forest, decision trees, naïve bayes method, maximum entropy classifier, multilingual sentiment analysis and feature driven sentiment analysis (Liu, 2012; Pang and Lee, 2008; Yessenalina et al., 2010).

3.4.2 Rule-Based Approach

Rule-based approach involves the analysis of text without the requirement of training or machine learning algorithms (Dwivedi et al., 2019). This often simpler and more interpretable method compared to machine learning, determines the sentiments by defining a set of rules or patterns (Wankhade et al., 2022). The set of rules are typically based on specific keywords, sentences, paragraphs, phrases, and other linguistic features (Piryani et al., 2017). These rules are then used to interpret sentiment polarity as positive, neutral, or negative (Vashishtha and Susan, 2019). This approach is dependent on predefined rules as opposed to a statistical or machine learning technique (Zahoor and Rohilla, 2020). It is particularly useful when there is limited availability of a large, labelled dataset needed to train and test the system or to focus on specific languages (Mehta and Pandya, 2020). Consequently, as the rules are predefined and modified by the user, the rule-based approach provides another layer of control and transparency (Asghar et al., 2017). Techniques within the rule-based approach includes regular expressions, pattern matching, phrase matching and keyword matching – all of which are indicative of a particular sentiment (Berka, 2020). For example, this could involve the number of occurrences of positive keywords or more complex approach which uses regular

expressions in everyday language to encapsulate the context, negation and other nuances that affect sentiments (Liaqat et al., 2022). A limitation of rule-based approach is the use of predefined rules as it may confine the capturing of complexities and subtleties of sentiments and thus may not consider the full context and nuances of language (Hussein, 2018). Subsequently, its effectiveness and accuracy depend on the quality and encapsulation of the rules being used and the specific characteristics of the text being analysed (Gómez-Rodríguez et al., 2019).

3.4.3 Lexicon-Based Approach

The lexicon-based approach involves the application of keywords and phrases that are associated with different emotions or attitudes (Turney, 2002). These are then labelled in everyday conversations or texts to detect sentiments (Al-Thubaity et al., 2018). Lexicons datasets are typically referred to as valence dictionary and do not involve the sophistication of training a model to follow a specific algorithm (Cero et al., 2024). Here, the text can analyse the overall sentiment in real time, calculate sentiment scores based on the dataset chosen, which are language dependent (Hota et al., 2021). These dictionaries can be developed manually by the user (V. Singh et al., 2018; Tong, 2001), automatically, by applying "seed words" to expand the list of words in a corpus (Turney and Littman, 2003) or semi-automatically, using predefined and organised sentiment values from resources such as Hu and Liu Opinion Lexicon, General Inquirer, Multi-Perspective Question Answering (MPQA) Subjectivity Lexicon, Semantic Orientation Calculator (SO-CAL) Lexicon Version, SenticNet, WordNet, SentiWordNet and VADER (Moussa et al., 2020; Neviarouskaya et al., 2011). Typically, lexicon-based research uses adjectives and synonyms to detect semantic orientation and thus its polarity, e.g., positive, negative, or neutral – a value is sometimes used to represent the strength or intensity of the sentiment (Taboada et al., 2011).

To determine the overall sentiment of an interview or document, an algorithm or formula is required to aggregate the sentiment values of individual keywords (Khoo and Johnkhan, 2018). Previous research has shown that the lexicon-based approach provides good and accurate results when applied to different corpuses (Öhman, 2021). It can be applied to various levels of SA such as aspect level, document level and sentence level as seed sets determine domain-specific sentiment associated keywords from a corpus (Taboada, 2016). However, similar to the aforementioned approaches, this technique also shares some limitations e.g., lexicons are polysemantic, *words that have multiple meanings and senses*, and can differ according to contexts. Furthermore, though some keywords may not have a predefined sentiment polarity, they may be used to imply a sentiment in particular contexts (Öhman, 2021).

Table 4: Comparison of Different Sentiment Analysis Approaches

Approaches	Classification	Advantages	Disadvantages
Lexicon-Based Approach	Unsupervised learning	• Easily accessible via publicly available resources • Less expensive • Does not require advanced algorithms • Less time-consuming • Does not require training data	• Requires a reliable and powerful lexical resources as the approach is based on tagging and rules • Domain-dependent and strict assigning of sentiments
Rule-Based Approach	Supervised & Unsupervised learning	• High performance accuracy • Does not require a large amount of data • Robust and adaptable • Highly interpretability	• Complex, numerous and overlapping rules • Fixated language (outdated language) • Prone to errors as it cannot mediate natural language • Extensive precision and human supervision are needed
Machine Learning (ML) Approach	Supervised & Unsupervised learning	• Lexical resource is not necessary • High accuracy classification • Provides real-time results and temporal trends • Mediates data-driven decision-making • Can detect sarcasm, irony, and negation	• Requires extensive training • Requires a large dataset • Requires a sophisticated algorithm • Expensive • Not easily accessible
Hybrid Approach (Lexicon-ML)	Supervised & Unsupervised learning	• Provides statistical and knowledge based polarity detection • Highly accurate via ML and stable via lexicon-based approach	• Limited words included in the lexical resource • Focuses more on ML disciplines which reduces stability • Extensive training and supervised rules • Expensive • Not easily accessible • Time-consuming

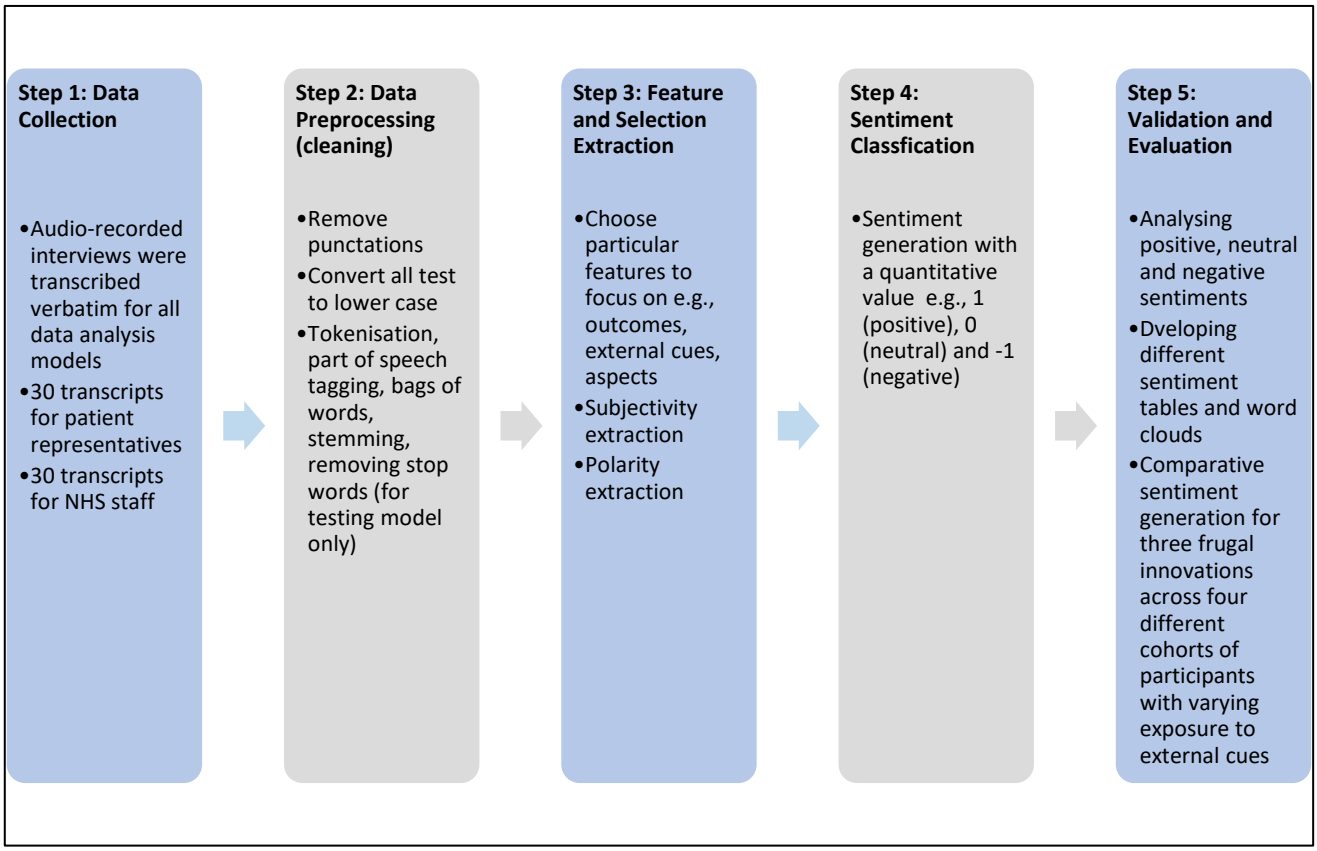
3.5 Sentiment Analysis Methods

For SA, we used the same transcriptions that were completed during the transcribing of the audio-recorded interviews for consistency, efficiency and accuracy. We performed a SA on every response to each individual question using NLP. After considering the three aforementioned approaches to SA, we concluded that a lexicon-based approach was the most appropriate for this study as we look to analyse the sentiment orientation, human behaviour and linguistics used whilst unsupervised to corroborate the dimensions of CA. For the resolution to missing data, if a response to any question was not available, then it was considered as missing data, and missing data is not imputed, though this did not occur. The average sentiment value was derived for each participant which forms the baseline data for further analysis. We applied the SenticNet, *incorporates changes in tones and context during common conversations and 'common-sense' knowledge*, and SentiWordNet, *opinion mining and assigns three sentiment scores to individual synset of WordNet e.g., positive, neutral, negative, or objective*, lexicon datasets due to its wide applicability of lexical resources and its polysemantic approach to avoid bias or subjective opinions.

These lexicon datasets both provide a level of consistency with everyday common language whilst encapsulating numerous contextual factors used to define each keyword. Whilst the healthcare sector is seeing an increase in SA techniques and applications, there are still several issues associated with its application and evaluation such as 'sarcasm, irony, and language-specific challenges' (Wankhade et al., 2022). Furthermore, keywords and languages e.g., "*slang*" have a different meaning due to various socio-economic backgrounds and place of residence and/or upbringing and thus the translation orientation differs depending on the context and domain in which they are employed.

Our SA method consisted of six steps: 1) data collection, 2) data pre-processing, 3) feature and selection extraction, 5) sentiment classification and 6) validation and evaluation (see Figure 11).

Figure 11: Stages of Our Sentiment Analysis



3.6 Chosen Examples of FI for Presentation

This project evaluated the perceptions of three FIs (1) Arbutus Surgical Drill Cover System (Orthopaedic), (2) Mosquito Net Mesh for hernia repair (General Surgery) and (3) Sayeba's Method for postpartum haemorrhage (Obstetrics and Gynaecology). These innovations were chosen from a more exhaustive list as they varied in risk and invasiveness to present a variable perception to FI. However, what may be rated as high risk by the research team, may not be the same for participants. Thus, by separating the participants into Groups where frugality and COO serve as exposures, we could explore the impact of both cues and whether this exacerbates risk perceptions to subsequently cause a decision to accept or reject the FI.

Arbutus Drill Cover System

Disability and premature mortality pose a significant burden in the UK (Prime et al., 2018). Musculoskeletal conditions affect joints, bones and muscles and are the leading cause to disability worldwide, with low back pain being the leading cause of disability globally (World Health Organization, 2021). Such conditions accounts for more than 25% of surgical interventions within the

NHS (Briggs, 2012). Some of the most essential tools required in orthopaedic surgery include a surgical drill and saw (Prime et al., 2018). As the ageing population increases globally, there will be an increase in the demand for orthopaedic care (Badley et al., 2013; Briggs, 2012; Etzioni et al., 2003; van den Bogaart et al., 2020). Thus, orthopaedic surgical tools are highly required which within the NHS are substantially expensive costing between £20,000 and £30,000 (Prime et al., 2018). Such challenging costs have provoked orthopaedic surgeons in LMICs to adopt slow hand drills or unsterile hardware drills (Prime et al., 2018). The consequences of using such equipment could lead to severe infection, disfigurement and loss of life (Lehoux and Silva, 2019; Prime et al., 2018). The high costs are attributed to the highly sophisticated encasing that allows autoclaving (Prime et al., 2018). However, a reverse innovation called the Arbutus Drill Cover System (ADCS), developed by Arbutus Medical Incorporated reduces costs without compromising safety and performance (Lehoux and Silva, 2019; Prime et al., 2018). The innovation ideology and target market in East Africa was characterised by need and less stringent regulatory processes but the design, engineering, manufacturing, quality system, strategic and operational control were based in Canada (Prime et al., 2018).

The ADCS uses a simple, sterilisable, washable and reusable cover that wraps around a household power or hardware drill, converting it into a surgical grade drill (Prime et al., 2018).The cover consists of a robust, double-layered surgical grade material that attaches to the drill's components through a waterproof chuck adapter interface which results in a completely sealed barrier between the non-sterile drill inside the covering and the outside sterile surgical area (Prime et al., 2018). The autoclaving can last up to 75 times and only requires 30 minutes of steam autoclave at 121°C using gravity displacement to become fully sterile thus the turnaround available operating room time for surgeries is much shorter than sterilising traditional current equipment (Prime et al., 2018). The Drill Cover is adapted for hardware and current surgical drills therefore reducing the need to purchase more clinical drills as it also increases the lifespan and reduces wear and tear from harsh autoclaving (Prime et al., 2018). Thus, whilst there is potential for cost saving using the cover with the hardware drill, the cover alone can result in financial benefits.

Mosquito Net-Mesh

Inguinal hernia (IH) repair is one of the most performed surgical interventions worldwide with more than 20 million people undergoing the surgery each year (Ahmad et al., 2019; Naveen and Srinath, 2014; Skopec et al., 2021). In the UK, IH repair has been reported to be 10 per 100,000 people (Abbott et al., 2017; Jenkins and O'Dwyer, 2008). IH can be defined as 'a mass formed by a protrusion of

abdominal visceral organs into the inguinal canal located in the triangular area between the lower abdominal wall and the thigh' (Zhao et al., 2021). IH can be treated via open and laparoscopic surgery, both require the insertion of a surgical mesh (Skopec et al., 2019). However, the UK National Institute for Clinical Excellence (NICE) recommends laparoscopic surgery for the repair of IH due to the decreased incidence of long-term pain and quicker rehabilitation time (NICE, 2004). Laparoscopic hernia repair is safer than the Bassini technique in terms of pain, use of analgesic drugs, resumption of activities, and recurrence (Dirksen et al., 2003).

The traditional surgical repair for an IH involved one developed by Edoardo Bassini in the 19th century, which is still considered the 'gold standard' approach, despite its high reoccurrence rate of about 15% in general practice (Oribabor et al., 2015). In Ghana, hernias are common, and some estimates suggest a 10-fold increase in prevalence compared to Europe (Dalton, 2010). Due to an inadequate healthcare system and socioeconomical barriers that may lead to nutritional deficiencies, majority of the hernias go untreated (Dalton, 2010). In Africa, IH was neglected as a public health priority due to resources focusing on malaria, HIV and tuberculosis (Kingsnorth et al., 2009). Although most hernias in Africa are significantly large and is thus suitable for the tension-free mesh repair, meshes are either not available or affordable for most patients in LMICs (Freudenberg et al., 2006). More recently, there has been an increase in the acknowledgment of surgical needs in Africa, which involves a cost-effective alternative to undertake hernia repair under local anaesthesia using mosquito netting as mesh (Beard et al., 2013; Clarke et al., 2009; Cotton et al., 2014; Kiss et al., 2012; Ozgediz et al., 2008; Sharma and Cotton, 2021).

Sterilized mosquito net mesh (MNM) was developed by Dr Ravindranath Tongaonkar and colleagues in India as a low-cost alternative to the synthetic commercial mesh (Ahmad et al., 2019; Kiss et al., 2012). The mosquito-net cloth, made from copolymer of polyethylene and polypropylene, is manufactured in Bangalore and was found to be 3700 times cheaper than the polypropylene mesh per meter and can be sterilised by autoclaving (Tongaonkar et al., 2003). However, since then MNM was reported to be 20,000 times cheaper than commercial mesh (Stephenson and Kingsnorth, 2011). As the mosquito-net cloth belongs to the same cloth category as the polypropylene, it possesses the same properties, strength and inertness required of a suitable biomaterial and is not soaked in pesticides (Tongaonkar et al., 2003). The method of inserting the MNM was similar to that described by Lichtenstein with some modifications (Tongaonkar et al., 2003). A clinical trial conducted between 1996 to 2002, examined the results of 359 patients across four hospitals in India who received IH repair surgery using sterilised MNM (Tongaonkar et al., 2003). Follow-up results ranging from one

month to five years, found only one recurrence (0.27%) and minor infection caused by stitch abscesses in 4.7% of patients, which resolved without any cases of rejection.

Sayeba's Method

Postpartum haemorrhage (PPH) remains the leading cause of maternal mortality and morbidity worldwide (Hayman, 2002), accounting for 25% of maternal deaths worldwide (World Health Organization, 2012) and is the second leading cause of maternal deaths in the UK (Chandraharan and Krishna, 2017; Say et al., 2014). PPH is also the most common cause of obstetric-related intensive care admissions (al Wattar et al., 2017). Although most of these deaths occur in developing countries or LICs, approximately 150,000 per year, several publications have noted an increasing trend in the incidence of PPH over time in high-income countries (HICs) (Cameron et al., 2006; Ford et al., 2007; Joseph et al., 2007; Knight et al., 2009). As the incidence of PPH continues to increase significantly and with its idiopathic aetiology, maternal mortality remains a growing concern (Bell et al., 2020; United Nations, 2016).

Approximately 80% of all primary PPH cases are caused by uterine atony (poor uterine tone) (Chandraharan and Krishna, 2017). The World Health Organization (WHO) recommends the use of intrauterine balloon tamponade (IBT) as secondary treatment for PPH if women do not respond to uterotonics, or not available, shortages of essential medical supplies, or absence of skilled surgical team (World Health Organization, 2012). Despite its 80-100% successful outcome rate, these commercially available devices are prohibitively high cost (Mishra et al., 2016; Ranathunga, 2014). Thus, LICs rely on frugal adaptations to provide an effective and appropriate management of PPH such as the 'condom balloon tamponade' or 'condom catheter uterine tamponade' (Mishra et al., 2016; Ranathunga, 2014).

The non-surgical condom balloon tamponade was developed by an obstetrician, Dr Sayeba Akhter, from Bangladesh to improvise with low-cost resources to help treat the increasing incidence of PPH in LICs (Mishra et al., 2016; Ranathunga, 2014). The approach involves the fitting of a latex condom onto a rubber catheter which is inserted into the uterus and inflated with 250-300ml of isotonic saline until the bleeding is controlled (Akhter et al., 2003). The balloon was kept in situ by using sterile sutures and padding the vaginal cavity with roller gauzes (Akhter et al., 2003). The balloon would then apply pressure to the uterine walls to prevent haemorrhaging whilst awaiting surgical intervention (DeJonckheere and Vaughn, 2019). The condom catheter would be kept for 24-48 hours (Georgiou,

2009) and then gradually deflated over 10-15 minutes, then removed (Akhter et al., 2003). However, in cases with severe bleeding, the catheter would be removed much later (Akhter et al., 2003). This technique for PPH treatment became known as the 'Sayeba's Method of PPH control' (Akhter et al., 2003).

3.7 Study Design

This study involved a qualitative cross-sectional design, as we did not require any follow-up. It's important to note, that the study did not focus on measuring the differences in responses but rather to identify themes within responses. As this is a straightforward study which involves providing a presentation and conducting interviews with participants, we collected data from a large pool of subjects and compared differences between groups at a single point in time. Consequently, this approach provided a less time-consuming and inexpensive approach compared to other types of research such as RCT. The results from our recent literature review (Hindocha et al., 2021) subsequently informed the study design and recruitment process of this study. To explore the perceptions of FI, we investigated the impact of the term 'frugality' or 'frugal' and the COO effect on decision-making such as acceptability.

3.8 Factorial Design

Our study involved the separation of participants into four Groups (A, B, C and D). Group A received a presentation introducing the selected FIs involving the term 'frugal' and providing information about its COO. Group B presentations involved the term frugal only whilst Group C presentations involved information about its COO only. Group D received a presentation without mentioning the terms frugal and COO. To avoid bias, the participant information sheet (PIS) will involve a general title without using the term frugal to ensure the validity and integrity of responses to external cues and thus will state "*exploring the acceptability of healthcare innovation within the NHS*". Each participant was randomly allocated to each Group. Though there were no methodological processes to randomisation, we were conscious of the diversity among participants in each Group e.g., if there were more than four White British participants in one Group, then we would randomly reallocate one or two of them to a different Group for equal diversity across the four Groups. This is important as it can ensure a variable response among individual Groups.

Table 5: Allocation of Presentation Groups for Patient Representatives

		Group A (7-8 participants)	Group B (7-8 participants)	Group C (7-8 participants)	Group D (7-8 participants)
Innovations 1, 2 & 3	**Frugal**	✓	✓		
Innovations 1, 2 & 3	**COO**	✓		✓	

A total of 30 participants were involved, with seven to eight participants separated into each Group, see Table 4. This approach was used as patient representatives do not need to have any current need to the innovations presented or its alternatives currently being used in the NHS. This is because their perspectives and perceptions can still be explored regardless of their current need towards the use of the innovation.

However, for NHS staff, due to their medical speciality, job role and experience, had to be directly or indirectly involved in the area of the presented innovation e.g., Orthopaedic, Musculoskeletal, General Surgery and Obstetrics and Gynaecology, see Table 5.

Table 6: Allocation of Presentation Groups for NHS Staff

Group A (Frugal and COO Effect)	Group B (Frugal)	Group C (COO Effect)	Group D (No Frugal and No COO Effect)
Innovation 1 (2-3 participants)	**Innovation 1** (2-3 participants)	**Innovation 1** (2-3 participants)	**Innovation 1** (2-3 participants)
Innovation 2 (2-3 participants)	**Innovation 2** (2-3 participants)	**Innovation 2** (2-3 participants)	**Innovation 2** (2-3 participants)
Innovation 3 (2-3 participants)	**Innovation 3** (2-3 participants)	**Innovation 3** (2-3 participants)	**Innovation 3** (2-3 participants)

3.9 Setting

Our study sites included five teaching hospitals in the Imperial College Healthcare NHS Trust: (1) Hammersmith Hospital, (2) Queen Charlotte's & Chelsea Hospital, (3) St Mary's Hospital, (4) Western Eye Hospital and (5) Charing Cross Hospital. Each hospital has a wide array of specialist departments ranging from ophthalmology, trauma, general surgery to neonatal care. These hospitals offer the specialist treatments corresponding to the selected FIs and thus makes it an appropriate study setting for recruitment. These sites were also chosen due to the locality of each site (*Northwest London*), the demographic portfolio and workforce composition. Each hospital employs and treats a diverse set of

ethnicity and ages. Patient representatives were offered an option to attend any one of the participating sites to be interviewed. However, due the issues arising from the COVID-19 pandemic with some people exercising social distancing, or accessibility issues and for convenience matters, all participants were provided with an opportunity to participate via virtual conference calling via Microsoft Teams.

3.10 Study Population

We aimed to recruit 30 patient representatives and 30 NHS staff members for this study. Corroborated by previous studies, we believed that this number of recruited participants would provide sufficient in-depth analysis of certain issues, sources and different perspectives and perceptions about the acceptability of FI. We used an opportunistic sampling strategy to recruit participants with the objective of maximising diversity of perspectives. As mentioned, in section 3.6, patient representatives do not need to possess a need for the FI presented nor have any current related health conditions to the FI, e.g., musculoskeletal condition for ADCS, as their perspectives and perceptions can still be explored. However, our recruitment strategy for NHS staff was more focused as they were potential users of the presented innovations (*FIs will not be physically used in this study*).

3.11 Eligibility Criteria

3.11.1 Patient Representatives

The inclusion criteria involved individuals aged 18 years or over and spoke fluent English. Exclusion criteria included those under 18 years old, inability or refused to provide consent and could not communicate in English.

3.11.2 NHS Staff

The inclusion criteria involved currently employed by the NHS, aged 18 years, or over, directly, or indirectly involved in the area of one of the three FIs presented e.g., healthcare professionals, nurses, ward managers, surgeons, consultants, registrars, procurement staff and midwives and could provide informed consent and spoke fluent English. The exclusion criteria included those under the age of 18 years who could not communicate in English with an inability or refusal to provide consent.

A screening log, which includes names of all individuals contacted, screened, eligible and excluded will be recorded.

3.12 Recruitment Strategy and Consent Procedures

3.12.1 Patient Representatives

Recruitment of patient representatives involved referrals from our internal Imperial College London (ICL) National Institute for Health Research (NIHR) Applied Research Collaboration (ARC) Northwest London (NWL), Patient and Public Involvement and Engagement (PPIE) group. The ARC NWL Innovation and Evaluation (I&E) theme at ICL had partnered with the George Institute to help mainstream FIs into the NHS, through which workshops will be held in the Academic Health Science Network (AHSN). The research team utilised professional networks within the AHSN to promote the study and recruit eligible participants. The study poster advertising the project and a participant information sheet (PIS) were sent to all attendees and referred individuals. The research team also spread awareness about the study through advertising on Twitter, which included the study poster.

Potential participants who were interested in enrolling were encouraged to email CNH regarding their interest and address further questions. A follow-up "nudge email" was sent to all unresponsive individuals as a reminder. All responsive individuals were screened against the eligibility criteria and only those who were eligible received a PIS and consent form and those who did not, were sent an email clarifying why they could not enrol onto the study. All eligible individuals were sent a consent form via email to which they could sign electronically and email back to the lead researcher for approval.

3.12.2 NHS Staff

NHS staff were recruited from some of the five teaching hospitals in the Imperial College Healthcare NHS Trust as mentioned in section 3.7. However, the study's advertisement strategy and professional networks led to the recruitment of staff from different NHS trusts. NHS staff were recruited using purposive sampling within the context of the FI presented e.g.., those that worked in the orthopaedic department were chosen to review the Arbutus Drill Cover System. NHS staff were selected based on their role within their team as well as their level of knowledge and specific expertise i.e., orthopaedic surgeons.

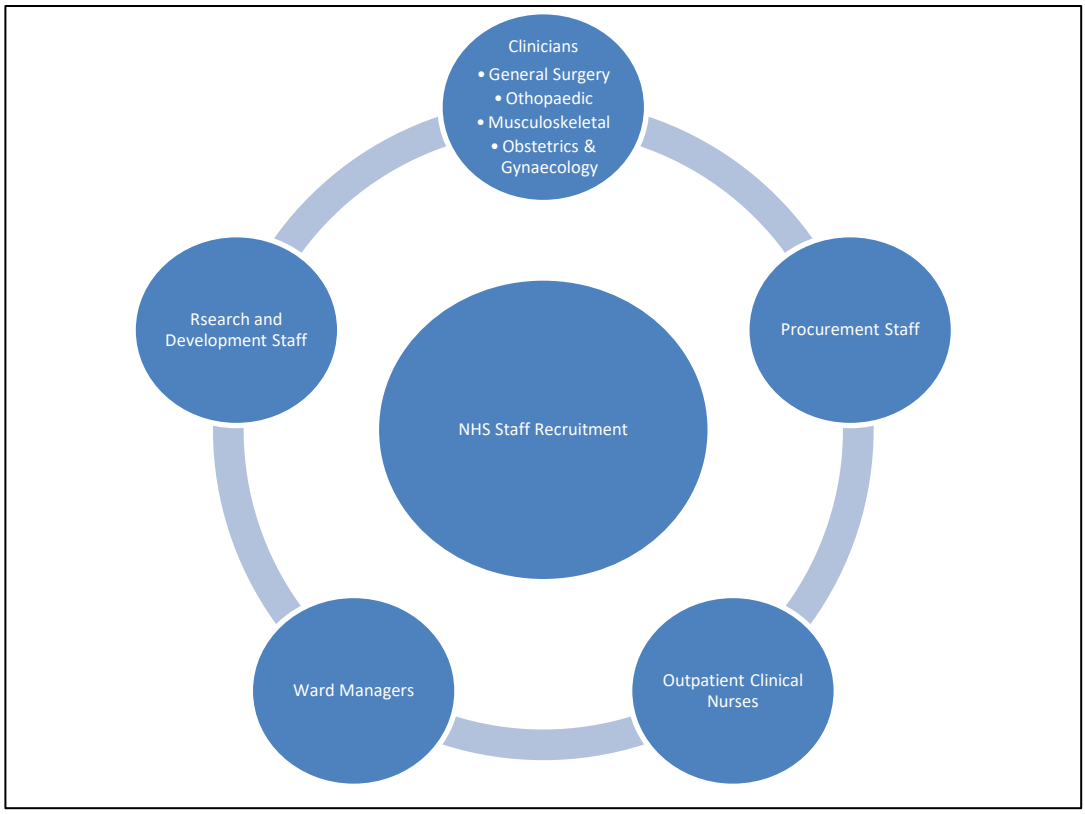
This study's recruitment strategy involved voluntary participation without any recourse or implication on the staff's employment status. Recruitment followed a similar format to the recruitment of patient representatives, whereby once ethical approval is obtained, the research team leveraged internal and external networks within Imperial College Healthcare NHS Trust, Chelsea and Westminster Hospital, the AHSN and the NHS Confederation to promote this study and invite NHS staff to participate. All interested individuals were encouraged to share, spread awareness, and disseminate information about this study using their distribution lists. Additionally, the research team also leveraged an opportunity with the George Institute to identify specific clinicians that may be related to the FIs of interest. The research team also spread awareness about the study to staff members through advertising on Twitter, which included the study poster.

The research team utilised professional networks to send out an invite to be contacted. Those who were happy to be contacted liaised with the lead researcher for more information. However, it should be noted that no contact whether via email, in-person, or telephone with the potential participants about the study was made prior to ethical approval. The aforementioned contact included only the option to be contacted, where no information about the study was provided.

Once potential participants were identified, the lead researcher provided information to all individuals and distributed PIS forms via email. These individuals were encouraged to email CNH regarding their interest and to address further questions. A follow-up "nudge email" was sent by CNH to all unresponsive individuals as a reminder. All responsive individuals were screened against the eligibility criteria and only those who are eligible received a consent form and those who did not, were sent an email clarifying why they could not enrol onto the study. All interested individuals were sent a PIS and consent form via email to which they could sign electronically and email back to the lead researcher for approval.

Based on previous studies and information about NHS Procurement, Research and Development (R&D), protocols and workplace infrastructure, the range of eligible participant suitability, though not limited to, is illustrated in Figure 9.

Figure 12: Potential Recruitment of NHS Staff



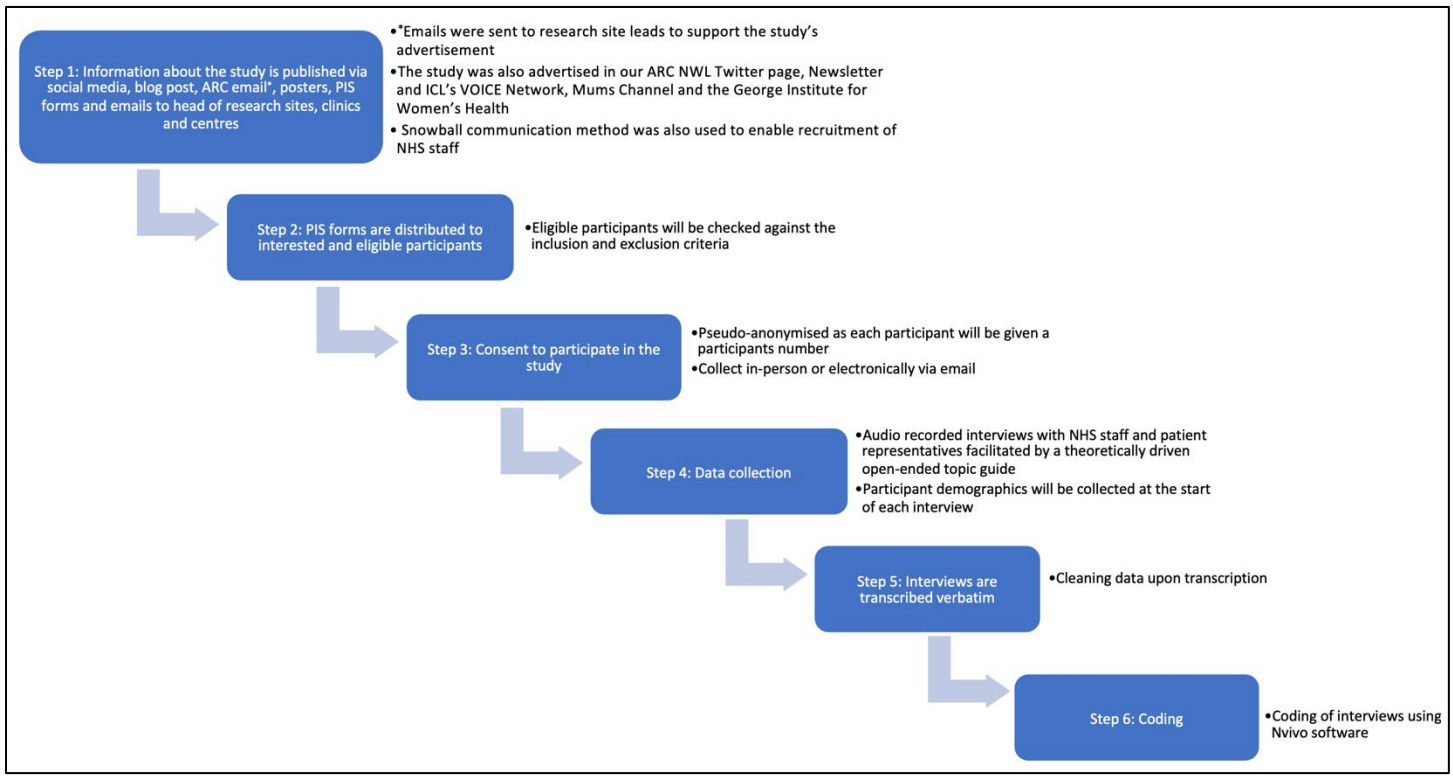
3.13 Data Collection

Semi-structured open-ended interviews were conducted with NHS staff and patient representatives to gain an in-depth understanding of their perceptions and perspectives to the presented innovations. Semi-structured interviews are typically used in qualitative research and are the most frequently used qualitative data source in health service research (DeJonckheere and Vaughn, 2019). A semi-structured approach allowed us as researchers to include questions that are guided by previous research and focused on the aim of this study. This approach was coupled with open-ended interview questions as it enabled participants to review and provide their opinions freely, without feeling constrained to a specified response. Furthermore, we wanted to prevent bias responses and thus leaving questions to be open-ended allowed participants to express their thoughts without facilitating their response to a certain way. It also allowed us to have a flexible approach to which we could ask further questions using prompts and follow-up questions.

Figure 10 demonstrates the overview of the study process from advertising the study to coding the data collected. Once an eligible participant showed interest in participating, they were sent a PIS

outlining the study and important information regarding their participation and data controls (see Appendix 3 [NHS staff] and Appendix 4 [patient representatives]) and a consent form requesting their signature of approval (see Appendix 5 [NHS staff] and Appendix 6 [patient representatives]). Within data collection, interviews were then scheduled with the participant (Figure 11) and then transcribed verbatim by the lead researcher and coded using the NVivo software 14.23.0.

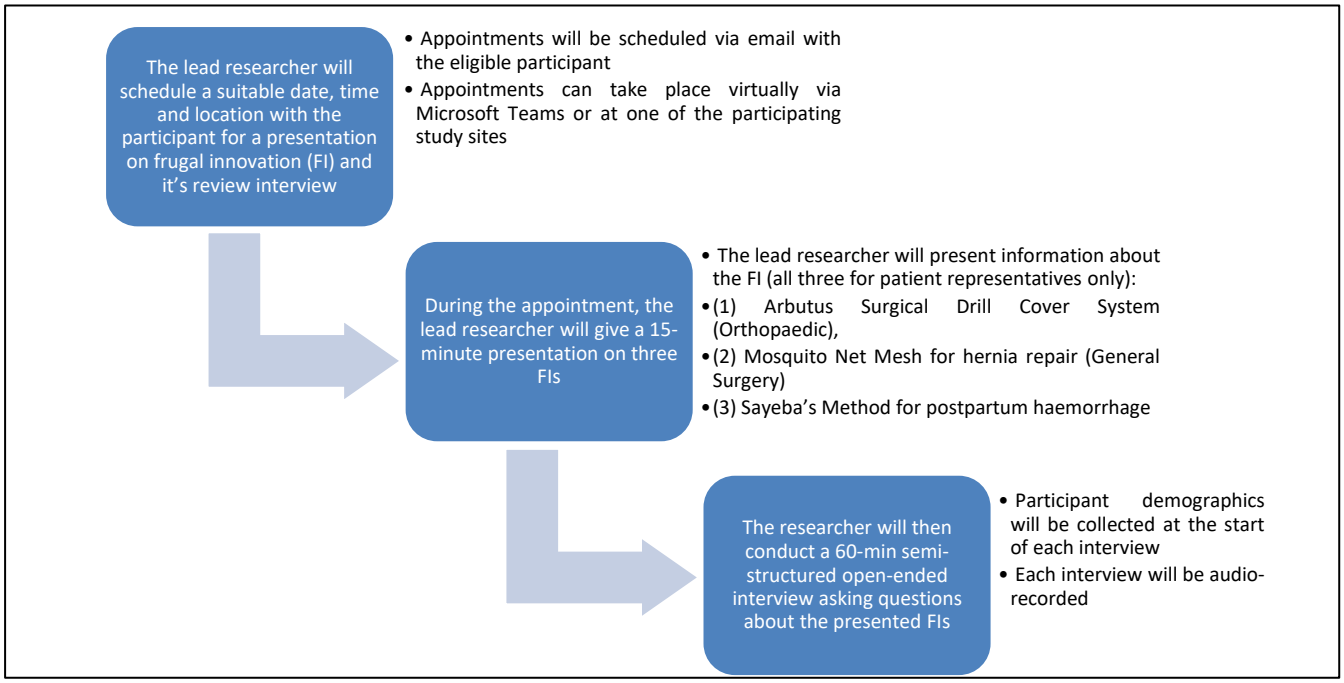
Figure 13: Brief Schema of the Study Process



Participants were required to attend a 15-minute presentation on the three FIs. As mentioned in Section 3.6, the allocation of the presentation will differ for both the patient representatives and NHS staff. The lead researcher arranged a presentation and interview slot with the participant at a time and place convenient to them (see Figure 11). Each participant was required to take part in a single one-to-one 60-minute interview directly following the 15-min presentation. The process of their participation was reminded to them before the commencement of the presentation. There were no follow-ups. The lead researcher used a semi-structured interview topic guide known as a case report form (CRF) to help facilitate the discussion (see Appendix 7 and Appendix 8). Interviews explored the perceptions and perspectives of three FIs, through linguistics and behaviours of acceptability.

Interview questions were informed by the relevant literature and co-designed by the research team and our PPIE group.

Figure 14: Brief Scheme of Data Collection



3.14 Ethics Approval

The ethical approval for this research project was a straight-forward process as it did not include the physical use of any innovation. The project followed the regulatory process mandated by ICL and the Health Research Authority (HRA). The project also followed ICL's confidentiality procedure for storing sensitive data obtained during the study. The ethics approval can be seen in the appendices (Appendix 9).

3.15 Analysis of Qualitative Interviews: SCT, COO Effect, TA, CA and SA

The audio-recorded interviews were transcribed verbatim. The inclusion of the SCT model helped direct the narrative synthesis and analysis by coding responses obtained during data collection. The core constructs of SCT were used to provide themes for coding. By using the SCT, it helped identify emerging themes in an inductive manner. The application of SCT in this research study followed a similar process to empirical studies using SCT in a healthcare setting. Quotations were extracted and

assessed to explore and support the different themes and perceptions of FI and whether the result from this study corroborated or challenged findings from previous studies.

An analytical pluralism, *combination of more than one qualitative analytical approach*, will be adopted as it incorporates a multifaceted understanding of a complex research area, involving more than one hypothesis which includes a multilevel response. This approach has 'shown that it is capable of producing many, intricate, and diverse understandings of a particular phenomenon' (Braun and Clarke, 2006). This approach integrates the combination of Thematic Analysis (TA) and Conversation Analysis (CA). TA uses minimal order to structure sentences, providing a rich description by identifying, analysing and highlighting 'themes' within the data (Braun and Clarke, 2006). This method provides information on when an utterance starts and finishes within a sequence of talk (Braun and Clarke, 2006). Similarly, CA can link the structure of the conversation, context and the action elicited in a temporal and reflexive approach (Goodwin and Heritage, 1990).

Analysis of conversations involves the extraction of sentences and utterances which in turn evokes a form of action within specific contexts and attention (Goodwin and Heritage, 1990). Typically, CA is used in naturally occurring conversations ('talk-in interaction') because it gives a realistic and specific account of human socialisation due to the language used in everyday conversations. This type of analysis provides an imperative when decoding and coding everyday language and understanding how perceptions can be developed and how preferences can be communicated with its true intention. In addition to the analytical pluralism approach, the COO effect will be incorporated in the data analysis to serve as a theoretical framework.

Using a retrodictive approach which combines a deductive and inductive approach (Meyer and Lunnay, 2013; Mukumbang, 2021), data was analysed in five phases (phases one to three involved the deductive analysis and phases four and five involved inductive analysis) which were separated accordingly to the deductive and inductive approach (see Appendix 10: data coding tree). Phase one involved the analysis of raw data e.g., interviews as transcribed. Phase two explored and generated initial codes or themes using TA and CA. These themes or codes were then reviewed and given a definition for transparency and interpretation forming the third phase. The fourth phase involved the review of these aforementioned themes and then applied to the SCT. Lastly, phase five included the extractions of themes or codes that were streamlined according to the SCT constructs.

Coupled with the SCT, thematic analysis (TA) was used for identifying, analysing, organising, describing, and reporting themes found within the data collected. TA is particularly useful for examining the perspectives of different participants whilst highlighting similarities and differences and generating unanticipated insights (Nowell et al., 2017). TA uses minimal order to structure sentences and provides a rich description (Braun and Clarke, 2006). This method provides information on when an utterance starts and finishes within a sequence of talk (Braun and Clarke, 2006). Typically, TA is used in naturally occurring conversations ('talk-in interaction') because it gives a realistic and specific account of human socialisation due to the language used in everyday conversations. This type of analysis provides an imperative when coding everyday language and understanding how perceptions can be developed and how preferences can be communicated with its true intention. In addition to the SCT and TA approach, the lead researcher also explored the impact of the COO effect on the interpretation of findings. Previous research has shown that the COO effect is highly prioritised over more generalist characteristics such as brand name, brand experience and socialism. The COO effect has many overlapping interpretations with the environmental criterion of the SCT. Therefore, by using both frameworks, we examined whether the COO impacts decision-making in regard to acceptability of FI.

We carried SA on each individual Group (A-D), Groups A and D, Groups C and D and all four Groups together. In total, SA at the aspect-level was conducted on 30 interview transcripts of patient representatives and 30 interview transcripts of NHS staff. We processed the responses within these transcripts to formulate a stemming tree which provided an essential baseline for sentiment calculation. Each baseline keyword was classified as a positive or negative using a custom and pre-processed hybrid library. This was to ensure that sentiments could be consistent and considered in classification and polarity for further evaluation and comparison. To further analyse the performance of the lexicon datasets and pre-processing (stemming and tagging), as well as the sentiment classification approach, recall and precision were applied to the original transcripts and results (see Chapter 7: Synthesis Chapter). There were no missing data to record as each keyword or feature was analysed and assigned a sentiment score in subjectivity and polarity. A negative sentiment score refers to a negative response and likewise, a positive score demonstrates a positive response. A score of 0 indicates a neutral response or mixed feedback, where the score reflects positive and negative sentiments.

We applied the SenticNet and SentiWordNet lexicon datasets and processed it using the R package of Quantitative Discourse Analysis Package (qdap), which automates the assessment of quantitative

discourse analysis of transcripts including frequencies, words, sentences, phrases, turns of talks, syllables, and other assorted tasks, well equipped and effective to corroborate and communicate the analysis in conjunction with CA. The lexicon-based approach was considered due to the small size of the dataset, which is less sensitive to the quantity and quality of the data being imputed. In this case, we did not adopt the hybrid approach, as the aim of this analysis did not require the application of a machine-learning approach involving a well-trained algorithm and supervised learning. Furthermore, the size of our dataset could manage an unsupervised model. As sentiments are classified according to subjectivity and polarity, both positive and negative words are calculated and normalised to baseline, particularly during the pre-processing and consequently holds the calculation output to provide a sentiment score as an answer. As adjectives, adverbs and verbs holds significant wight in expressing an opinion or perception, it will drive the other features or tokens of their response. For example, "*I like the design of the arbutus cover*". In this sentence, the word "*like*" is an adjective and expresses a positive sentiment about the FI but the "*design*" feature was isolated. This demonstrates that the participant may not think positively about the FI as a whole but rather a feature of its innovativeness. On the other hand, some positive keywords have been pre-processed as having a double meaning relating the dialect used within responses.

As we have a total of 60 transcripts, an estimate is applied to derive an average sentiment across the Groups being analysed. However, this estimate corresponds to the individual contextual categorisation e.g., a positive score of 1 will indicate acceptance and favourability and likewise a negative score of -1 will indicate rejection and unfavorability towards the FI and a neutral score of 0 will indicate neither rejection or acceptance and neither favourable nor unfavourable. For transparency and objectivity, text mining operations such as removing stop words, was not completed in this case. Whilst the removal of stop words is common as they have 'little value' for NLP, they can still be used to provide emphasis and context to attitudes. Lexical resources can be created manually, or be imported through widely available resources and corpuses. The chosen resource can then determine the polarity score of a given document based on the individual sentiment indicators which are identified in the lexicon (Vyas and Uma, 2018). In this study, we have used this polarised lexicon approach to which the word (w) is assigned with the aforementioned values. The polarity of the document at the aspect level 'A = (w_1, w_2, w_3, w_4, w_5, w_6, w_7, w_8, w_9, w_{10})' is calculated based on detecting occurrences and the narrative of the sentimental words from the lexical resource (l). Pos(itive)(l, a), neu(tral)(l,a) and neg(ative)(l,a) are the positive, neutral and negative words from the "l" that occur in document at the aspect level (Augustyniak et al, 2016). The total (sum) is calculated

as sum(l,d) = pos(l,a)-neu(l,a)-neg(l,a) to which the sentiment orientation (s_1(a) of the dataset at the aspect level (a) is indicated as follows:

$$S_1(a)=1 \text{ if } sum(l,a)>0=0 \text{ if } sum(l,a)=0=-1 \text{ if } sum(l,a)<0$$

We have organised the level of results according to the four cohorts (A-D) and analytical Groups (trends between those in Groups A and D; trends between invasiveness of innovations and trends between responses from patient representatives and NHS staff). Results of sentiment scores according to each cohort and Group are illustrated in an ambient RAG system with key indications. In Figure 4, we demonstrate how specific keywords, features and 'aspects' provoke or dictate a reaction of polarity. For instance, when discussing Sayeba's Method in Group C, the COO elicits a negative transitional reaction from a neutral to a negative response which is further exacerbated when discussing risk. Whilst we highlighted specific aspects of each Group, in the relevant sections, SA provided a detection of subtle nuances that typically with qualitative analysis would have been considered at the first instance instead of the moving tones. This would corroborate the analysis found with the CA such that a statement which was initially using positive keywords, had a contradictory sarcastic meaning, which was highlighted by the SA, CA and behavioural analysis through facial expressions and body language.

3.16 Epistemological and Ontological Position

Auerswald (1987) defined epistemology as "*a set of imminent rules used in thought by large groups of people to define reality…the study or theory of the nature and grounds of knowledge*". Crotty (2003) described it as a "*way of understanding and explaining how we know what we know*" as it seeks to provide a philosophical grounding for choosing what kind of knowledge (intuitive, authoritarian, logical, and empirical) (Fuller, 2002; K. Weber et al., 2014) is possible and the methods, we can adopt to ensure its adequacy and legitimacy (Maynard and Purvis, 1994). Keeney (1983) disagreed in that epistemology represents the general premises underlying action and cognition. Similarly, Weber (1964) suggested that social action should be interpreted at the level of individual actions by adopting Verstehen as a methodological strategy to provide a different type of knowledge (Ejnavarzala, 2019). With this we tried to understand the contexts and actions of lifestyles lived by people to comprehend and align them with the discourses they develop overtime (James and Busher, 2009) but in a momentary point using semi-structured open-ended interviews (method) at times in naturally occurring conversations. This was coupled with the application of CA and thematic analysis which

helped form the interpretations of more subjective concepts of facial expressions, linguistics, and structural sentence formation.

Whilst our study used an organised method of combining deductive and inductive, *retroductive arguments* (Meyer and Lunnay, 2013; Mukumbang, 2021), it involved a factorial design and suggest some level of hypothesis testing due to the anticipated response to external cues. We examined our conjectures that participants will have a negative perception of innovations when exposed to both external cues (Group A). However, on the other hand, the analytical strategy did not allow for quantitative corroboration of thought and thus we sought to surface these themes around people's responses to the FI in different Groups.

This is an exploratory study seeking to examine the perceptions of people with diverse backgrounds (not standardised) exposed to specific markers e.g., external cues in a relativist approach as it opens the forum to possible meanings and actions through the facilitation of the SCT model, not entirely subjective nor objective. Here, we studied the various forms of reality, descriptions, and experiences from a specified population, which by definition takes a social constructivist position (Merriam, 2009). The decision to apply the SCT as reasons for this study's ontology was based on the paradigm that can guide such interpretations based on the beliefs about the nature of reality and humanity in a social context. For instance, we wanted to capture decisions based on every day and past experiences that have shaped such perceptions about things that directly relate to the innovation examples and indirectly through the medical speciality related to the innovation examples, with a particular focus on frugality and COO. Whilst we aimed to infiltrate behaviours that are commonly founded on past experiences, our positionality differed from the postmodern/post-structural approach which seeks to dissect previous "truths" and rationales, as our study was the first to our knowledge, exploring such perceptions in the NHS setting and thus there are no existing "truths" but rather assumptions based on temporal trends of FI uptake in HICs particularly those conceived in LMICs.

Constructivism enables the interpretation with a subjective lens and thus refutes the objectivist perception of human knowledge (Crotty, 2003). In this context, it is where interpretations e.g., meanings are constructed not discovered and this falls part of the everchanging societal values and rules of the real world versus the actual world which tends to overlap (T. Kuipers, 2001). We chose to understand responses from participants through the lens of an acceptability model, *SCT*, to know what it means to understand and value perceptions in a non-subjective and non-objective manner as interpretations of concepts were rather reflexive (Bryman, 2004).

It is important to note that though we took a position of social constructivist in the realm of relativity, it differs for subjectivism because there is no evidence of structuralism and post-modernistic thinking, though the SCT model can provide this, we did not obtain such a conclusion due to the study design and its limitations, e.g., cross-sectional study. Interpretations may have emerged from innovations presented or experience with an incumbent alternative or its characteristics such as the COO and the participant and was not imposed on the innovation by the participant which was grounded in the application of the SCT model. Perhaps if we were able to engage with participants longitudinally, we could explore and understand meaning in actions through hermeneutics, phenomenology, and symbolic interactionalism (Schwandt, 2001). This narrative would suggest a realist approach as it involved the objective view to investigate the real world that seeks to understand how mechanisms and context influence an action which evokes a particular action based on factual evidence (Robson, 2002). However, this is difficult to conduct in our study as it was not based on assumptions nor factual evidence of specific behaviours of acceptance of FI. Furthermore, it is difficult to ascertain the accuracy of social reality and how it can be assessed (Wikgren, 2005).

3.17 Reflexivity

In this section, I provide a self-reflection as the lead researcher, the subjectivities, and a description of the reflexive position I chose, how the data collected has been interpreted with consideration to the bias positionalities and the decisions that were made regarding study design, methodology, data analysis, interpretation, discussions, and conclusions (Jamieson et al., 2023). During this study, I was one of a neutral presenter, interviewer, and assessor of responses to which prior to the commencement of each presentation and interview, the neutral position was explicitly stated allowing participants to freely provide their perspectives without encouraging a particular view of pro-FI or anti-FI. I acknowledged that the different roles played in this study may have subconsciously influenced our research process based on past experiences, background research, assumptions, and interpretations of responses. Though to my best efforts to remain impartial and cognisant of using appropriate tools to help understand perceptions were made, there is some acknowledgement towards the influence of the study aims. Furthermore, there is explicit recognition in the current views of FI such that though I appreciate the trajectory and temporal trends of FI across the world and its advantages, it is not consider compactible in different sectors and countries, thus expressing a neutral standpoint in this research. This influenced the design of the study, methodological practices, and data analytical strategies to reflect an unbiased and neutral perspective.

Whilst it is difficult to remain objective in qualitative research, particularly when exploring and interpreting views and opinions and acknowledging that "*it is not possible for qualitative researchers to be totally objective, because total objectivity is not humanly possible*" (Ahern, 1999), I mitigated the influence of subjectivity in the form of bracketing, *providing validity to the data collection and analytical methods, creating a view free from researcher influence* (Ahern, 1999), by incorporating an analytical framework e.g., SCT, to consolidate and interpret the findings to limit bias interpretations. I made a conscious effort to obtain a diverse set of responses that could represent different lifestyles, genders, ages, ethnicities, employment, and academic backgrounds. This decision was made due to the background research obtained and diverse perspectives of FI in HICs and LMICs, particularly within decolonisation. Additionally, the differences in perceptions from NHS staff and patient representatives may differ significantly due to the environment that the interview is taking place. I acknowledged that true reflections and perceptions may not be provided due to the environment, social norms and being around other people as this may constrict perhaps controversial views towards the FI being presented. Furthermore, the questions posed to all participants were piloted with an NHS staff member who did not participate in this study and a patient representative to ensure validity and suitability.

Reflexivity involves the critical thinking and understanding that evokes the consideration of "why" and "how" of research by assessing the product of "*utility, ethics, and value of what, whom, and how we study*" (Jamieson et al., 2023; Willig, 2013). Reflexivity is both a personal (researcher) and theoretical (epistemological and ontological position) influence on research processes such that it provides an understanding and acknowledgment of the person behind the research, biases, and theoretical positioning as shown in the research process and its findings (Willig, 2013). Our ethical position is one that allows participants to freely discuss their perceptions of the FIs being presented in a capacity that is suitable and comfortable to them. Ethical and confidentiality regulations are explained to all participants to which they consent to as participation is not compulsory. We also appreciate that though at times, responses may be catered to 'please the interviewer' as incentives were provided to patient representatives for their participation. This would be noted and challenged further using prompts and further exploration to avoid 'interviewer bias'.

To endorse the accuracy of transcription, coding and interpretations, interviews were recorded with the permission of every participant. I kept reflexive notes during each interview to note and corroborate the interpretations of body language, facial expressions, and disturbances during the interview e.g., colleagues or participant in the same room as the participant during the interview and the type of place the participant was in whilst conducting the interview. Our ethical standpoint also

enabled participants to pause, stop the interview at any given time without providing a reason and not to be recorded whilst still being able to participate. With this approach of audio-recording, we note that this may change the expressions and perceptions of participants in forms of pressure such that they may refrain from expressing potentially controversial views. Consistent support from the research team (MH, GA, and JB) involved challenging me with the relevance and importance of the research question in addition to challenging and addressing interpretations and trends from the data collected and ensuring a position of explicitly.

Participant Descriptive Results

This section outlines the demographics collected during the interview with all participants in this study. These characteristics (see Table 6) are important as it allows us to interpret the understanding and value of influences, particularly through lived experiences and how cultural and environmental factors can form perceptions and facilitate behavioural changes. Our sample found a relevant ethnic diverse pool of participants who varied in age, marital status, education and employment history and an almost equal sample of genders for comparative analysis.

Table 7: Demographics of Participants

	Patient Representatives (n=30)	NHS Staff (n=30)
Mean age, years (range)	53 (19-87)	43.5 (20-67)
Gender		
Female, n (%)	18 (60)	10 (30.3)
Male, n (%)	12 (40)	20 (66.7)
Ethnicity		
White, n (%)	15 (50)	17 (56.7)
Mixed, n (%)	1 (3.3)	2 (6.7)
Asian/Asian British, n (%)	6 (20)	8 (26.7)
Black, n (%)	8 (26.7)	3 (10)
Other, n (%)	0 (0)	0 (0)
Marital status		
Married, n (%)	18 (60)	18 (60)
Divorced, n (%)	2 (6.7)	4 (13.3)
Widowed, n (%)	1 (3.3)	0 (0)
Single, n (%)	3 (10)	3 (10)
Rather not say, n (%)	1 (3.3)	0 (0)
Other, n (%)	5 (16.7)	5 (16.7)
Highest level of education completed		
Higher degree, n (%)	16 (53.3)	30 (100)
A-level, n (%)	5 (16.7)	0 (0)
NVQ, n (%)	0 (0)	0 (0)
GCSE, n (%)	3 (10)	0 (0)
Other, n (%)	6 (20)	0 (0)
Mean years in education, (range)	8.5 (5-12)	24.5 (14-35)
Currently employed		
Yes, n (%)	18 (60)	-
No, n (%)	12 (40)	-
Job role, (n)	Carer, (1) Retail manager, (1) Retail assistant, (1) Cleaner, (1) Administrator, (1) Teacher and Tutor, (1) Apprentice, (1) Mechanic, (1) PPIE Representative (2)	- - - - - - - - -

	Pharmacist, (1)	-
Staff role		
Clinicians, n (%)	-	3 (10)
Surgeons, n (%)	-	19 (63.3)
General nurse, n (%)	-	3 (10)
Scrub nurse, n (%)	-	2 (6.7)
Clinical lead, n (%)	-	1 (3.3)
Other, n (%)	-	2 (6.7)
Length of employment		
Less than a year, n (%)	-	2 (6.7)
1-5 years, n (%)	-	6 (20)
6-10 years, n (%)	-	11 (36.7)
More than 10 years, n (%)	-	11 (36.7)

Chapter 4: Results for Sayeba's Method

This chapter examines the qualitative responses pertaining to the perceptions of Sayeba's method for PPH treatment. During the collation of these results, participants were presented with information about Sayeba's method to which all were encouraged to take notes during the presentation and note any questions they may want to discuss during the interview section of their participation. Interviews followed directly after the commencement of the presentation. The content of the presentation varied accordingly to our factorial design of four Groups, whereby each Group were presented with either or both external cues (Groups A-C) or none at all (Group D). The analysis considers how patient representatives and NHS staff respond to the FI, though staff were only provided information about Sayeba's method as opposed to patient representatives that could compare this FI with the others e.g., ADCS and MNM. Furthermore, the analysis of responses was grouped by six overarching themes of important components affecting perceptions e.g., **risk** (grouped with expectation and invasiveness as it was a prospective interpretation and measure), **design** (colour, ruggedisation, porosity, material, and weight), **cost**, **useability**, **clinical effectiveness** (clinical evidence, success rate, failures, complications and side effects) and **shared decision-making**. Grouping of themes are mentioned where some themes included a combination of the overarching themes. Throughout some of these themes, vignettes were used to elicit responses i.e., exploring expectations, risk, and invasiveness. The chapter is divided according to the four Groups, merging both Groups B and C together, and further spliced by responses from patient representatives and NHS staff.

4.1 Group A (Frugal and COO)

Participants in Group A were presented with information involving the term 'frugal' and providing information about its COO.

4.1.1 Patient Representatives

4.1.1.1 Risk

All patient representatives provided a description of risk involving Sayeba's method. The element of risk in Sayeba's method was associated with safety, death, infection, outcome, toxicity, complication, clotting, removal of product, haemorrhage, likelihood, side effects and reoccurrence.

The majority of risk perceptions on Sayeba's method focused on negative connotations whilst reflecting on hypothetical scenarios. These risk perceptions were more critical of the innovation

despite many participants describing the innovation using positive connotations, *"this method just screams risky to me, because again I would put it down to the country it's made in, I just don't like it when smaller countries with no reputation for these kinds of things, makes it and we just have to use it cause its cheaper!*"

4.1.1.2 Design

The design of Sayeba's method posted a diverse and contradictory view with descriptions including, "*simple*", "*boring*", "*cheap*", "*cool*", "*mediocre*", "*flimsy*", "*fragile*", "*ordinary*", "*sensitive*", "*clever*", "*less side effects*", "*more natural*", "*faster*", "*non-invasive*", "*cost efficient*", "*familiar*", "*cold*", "*exposed*", "*reliable*", "*sustainable*", "*plain*", "*painful*", "*scary*", "*scatty*", "*triggering*", "*uncomfortable*", "*discomfort*", "*low-cost*", "*attainable*" and "*average*". Whilst some participants focused on the functionality and external components in relation to design, others concentrated on the outcomes through the lens of its design in which discussions were more emotionally based particularly if the innovation attracted its target service users e.g., females.

None of these discussions were facilitated or solicited further by the interviewer to confirm what or how this impacted their perceptions as participants naturally expressed this during their discussions. These participants were therefore treated as having a strong entitlement to the information. It was a natural digression to discuss risk and its suitability which was led by their thoughts on the design. The design and mechanisms of Sayeba's method was important and influential to their overall perception of the innovation and whether they would accept it in their care.

4.1.1.3 Cost

Some participants focused on the cost of the innovation singularly which was also deemed the most important element. These participants were vocal and descriptive when discussing cost which was also associated with the design of Sayeba's method. Cost was found to be directly associated with the design of the innovation which ultimately shaped the overall perception. These participants focused on cost more so when the COO was elicited as both were discussed in conjunction to each other and often responses were conflated with its design. Furthermore, topic initial elicitors had to be provided to all participants to ensure that the discussions around cost was inclusive of many attributes and not solely on the actual cost of materials such as condoms, i.e., cost of training, labour, bed, materials, accreditation, importation, and regulatory approvals. A deliberate rejection of status in respect to the COO and the source of materials was reported in some participants *"I think the cost saving sounds*

great but if you're saving a pound here or there […], that's not gonna make a dent in the NHS pockets, this is why it's not always gonna be great when your exporting stuff from poorer countries like Bangladesh, cause then you even gotta look at the quality and I'm sure it's not gonna be like ours or America I'm sure."

In contrast however most participants were more concerned about the mechanism, outcomes, safety, risk, and expectations. Although cost was synonymous with various adjectives such as "*cost efficient*", "*cheaper*", "*affordable*" and "*low-cost*", proxies (partners e.g., husband) to service recipients (females) prioritised cost over outcomes as opposed to females.

4.1.1.4 Useability

Useability refers to the mechanism or functionality of the innovation. There were varying perceptions about the useability throughout the discussions. Initially participants favoured the idea of training other clinical staff to increase productivity and efficiency of procedures but when discussed more, the same participants showed some hesitancy and concern. Though this is a form of holistic injunction (Noblit and Engel, 1999), *a 'tell-all' whereby discussions show the complete patterns of 'back and forth' decisions by focusing on a particular context at the time of the discussion and then when a new one is introduced the initial may have changed and so on*.

Most participants discussed recommendations for improvement in the context of its functionality and training. Some participants were circumlocutory which aided to the vagueness of their responses. Though topic initial elicitors were evoked by the interviewer, the responses remained vague. Though there was some reluctancy due to the limited information available and presented, particularly about the pain associated with the use of the innovation and its application, most participants still felt that Sayeba's method was a good innovation that could serve its purpose and prevent haemorrhaging. However, a few responses were insouciant and seemed disinterested in the application of Sayeba's method, which could be attributed to the proxy narrative. The addition of training others who are not doctors elicited a varied response including some favouring the idea whilst showed reluctancy.

4.1.1.5 Clinical Effectiveness

The majority of participants mentioned elements of clinical effectiveness in parts of their responses. For clarity, clinical effectiveness refers to the degree to which the innovation is successful in producing a desired or intended result in the "real world" and is associated with the notion of external validity,

in that it refers to service users (Gartlehner et al., 2006). Predominant factors associated with clinical effectiveness were safety, clinical evidence, side effects, likelihood of success, prevalence of PPH, incidence of recurring rates of PPH through different birthing methods, safety of environment, complications, and risk.

Complications and clinical evidence were important factors to consider when accepting Sayeba's method by proxy or shared decision between the participant and their partner. Complications and the limited clinical evidence demonstrating its success further compromised the perception of Sayeba's method which would dissuade partners from using Sayeba's method by proxy. Topic initial elicitors such as questions pertaining to its safety and clinical data were used to enquire further and obtain depth for an inclusive discussion. The participants talked about FI and Bangladesh and how it strongly and negatively facilitated their perception about its clinical effectiveness. The participants explicitly, in various degrees, abstractly stated that reliable information on complications, safety, side effects and success rate could not exist because it was a cheap innovation made by a poorer and smaller country with no regulations in place to uphold any health standards.

4.1.1.6 Shared Decision-Making

Shared and proxy decision-making (patients and between clinical staff/ partners) was captured among numerous responses relating to different themes.

Shared decision-making varied across genders and was involved across many other themes: risk, design, COO, useability, and clinical effectiveness. In each response relating to the acceptability of Sayeba's method in their care, most participants would include the assumed perception of their clinicians and partners to form their actual decision, "*I know what I'm gonna be like and not listen to anything and let the doctor do whatever needs to be done to stop the bleeding. I mean I expect my husband to listen for me and tell me really quickly what to do if I had to decide*."

Participants were asked if they would feel confident in making informed decisions about their healthcare with an inclusivity to Sayeba's method. Most proxy participants felt that they had an influence in the decision-making process because they could evaluate and assess the options without an emotional anchor compared to their partners who were the target service users. Furthermore, some participants made decisions based on their assessment of the assumed body language of clinical staff.

4.1.2 NHS Staff

4.1.2.1 Risk

Risk and quality were the most important aspects when considering the use of all medical innovations regardless of its COO and reference to frugality. There was considerable overlap with the quality and clinical effectiveness. Risk was judged and discussed using technical language and concrete factors such as "*efficacy*", "*balloon failure*", "*complication rates*", "*pre-pregnancy obesity rates*", "*rates of caesarean delivery*", "*balloon expulsion rates*", "*initial blood loss volume*", "*admission rates*" and "*coagulopathy*". Expectations was directly linked to negative risk perceptions because of the lack of clinical evidence. These responses were based on a prospective risk analysis and outcome. There were high expectations towards clinical evidence that was needed to thoroughly assess risk in which responses involved a degree of scepticism, "*until I have more information, it will be a highly risky method because I cannot assess something when I don't have all the facts on but can realistically imagine the level of risk would be high…*".

Though most participants dissociated risks from the COO, it was somewhat related to the COO for one participant. This participant associated innovations developed in LICs with poor rigorous longitudinal evidence. Generally, staff participants validated reasoning for their risk perception based on the lack of probability evidence. This response was tentative as the participant did not include any corroborative evidence to substantiate their perceptions such past experiences, social context, personal behaviours, and views. At the end of the response, the narrative shifted the burden from the developers to the climate of the COO in relation to legalities, regulatory processes and resources, "*…I don't typically value scientific data from a low-income country especially when it is to do with medical innovation…you have to think about the level of standards being vastly different from the UK…it's a frugal innovation I see it all come together! you can't blame the people, just look at their situation…*".

4.1.2.2 Design

Staff participants did not generally consider design as an important aspect but did have strong opinions about the use of a condom. The most important elements of the design of Sayeba's method were functionality and material. The responses focusing on functionality were grounded on the comparisons to the current method used in the NHS, *Bakri Balloon*, "*I think the mechanisms of this method is far similar to the Bakri balloon, I don't know how much Sayeba's method can inflate to …*".

Although the perceptions of the material used in Sayeba's method were also based on comparisons to the current silicone balloon, its focus was associated with risk and the overall outcome.

4.1.2.3 Cost

No staff participant valued cost as an important consideration. However, cost was indirectly associated with two aspects, quality, and functionality. The general narrative of cost was exploratory, and the focal consideration were based on the assumption that low cost or affordability equated to low quality and functionality, "*it's great that its more affordable but at what cost, is it because there's things missing from Sayeba's method…my issue is that it will affect the quality of the technique…*".

4.1.2.4 Useability

Staff participants often conflated their responses with an aspect of design and functionality. All participants stated that the useability of Sayeba's method was simple, clear, and accessible. Furthermore, it was easier to understand, due to its similarities with the Bakri Balloon. Though all participants were not currently or had not performed the tamponade treatment before, through observation, provided them with confidence to perform it and credited the simplicity of Sayeba's method. The nature of such discussions was positive with tone of optimism, opportunity, and simplicity. However, all participants mentioned their curiosity of pain management and provoked some reluctancy. The consideration of pain management reflected knowledge, experience and a quality of patient experience and care.

4.1.2.5 Clinical Effectiveness

Clinical effectiveness was an important component which overlapped with many other themes. All participants stated the need for more thorough testing through larger clinical trials and piloting. Consequently, these participants expressed signs of uncertainty and more critical thinking towards Sayeba's method. The lack of clinical evidence was associated with its COO. It was suggested that the COO may contribute to its lack of quality evidence and that it must be assessed with caution. The nature of this connotation was negative due to the evoked linguistics, body language and facial expressions. The same participant echoed issues of risk, quality and design to be attributed to cost and the COO. The participant often conflated their utterance of COO with FI, "*…I don't think we can blame the creators of Sayeba's method, it's probably not their fault because they come from a very poorly regulated country and have to deal with cheap things which makes me further question the*

quality of the technique being thin, cheap, rough, more risky, I don't like the clinical effectiveness of this innovation or the lack of, but it bothers me more because it's a knock-off version of something we already have and it's just not acceptable for the NHS standards."

4.1.2.6 Shared Decision-Making

Though the shared decision-making theme was not explicitly considered an important factor, participants did express an opportunity to apply Sayeba's method. Most participants shared the perceived thoughts of patients regarding how they would feel about non-doctors performing the technique on them during a "*terrifying, critical, sensitive situation*". As Sayeba's method does not require the need to be highly skilled or hold a specific qualification, they felt that there was a positive outcome on a professional level, "*this also allows nurses to initiate a treatment rather than waiting on a doctor…there's an option to proactively train to do the method.*"

4.2 Group B (Only Frugal) and C (Only COO)

Participants in Group B were presented with information about Sayeba's method involving only the term 'frugal'. These participants were not given any information nor cues about its COO. On the other hand, participants allocated in Group C were presented with the same information about Sayeba's method but without any mention of the term 'frugal' and solely its COO.

4.2.1 Patient Representatives

4.2.1.1 Risk

The reference of Sayeba's method as a FI did not explicitly contribute towards the general risk perception. For many participants in Group B, risk perceptions were not specific to a component of Sayeba's method but rather one of the frugal attributes, cost. These risk perceptions even when posed in a hypothetical situation, were focused on the generalisation of risk, "*I assume because it's a cheaper and less faff type of thing, I would say the risk is high because you are missing some of those things that may make it safe so I get that its cheaper but is that going to be a consequence of safety…maybe!*"

To interpret the specificity, intensity and accuracy of these risk perceptions, participants in Group B and C, *as well as Group A*, were given a topic initial elicitor with a specific hypothetical situation. This elicitor would further explore the risk perception of Sayeba's method in real-time because often risk

is ‘threat-specific’ (Ferrer and Klein, 2015). People are typically influenced by what information is most salient or available to them therefore narrowing the focus on particular components of the innovation (Tversky and Kahneman, 1973). The responses from some participants in Group B heightened the intensity of risk which subjected Sayeba’s method to be more critically evaluated and thus deemed as high risk.

In contrast, the COO generally reduced the level of risk perceived by those in Group C. The general connotations and narrative of responses across all participants in Group C were positive. The COO was expressed as a positive outlook to risk through its simple design and mechanism, “*I don’t think this would be very high risk because it doesn’t involve much, or like minimal training, it’s almost identical to the current method they use.*”

4.2.1.2 Design

The design was perhaps the most mentioned component for both Groups B and C. The narrative of design was both positive and negative with features of the design applauding its ability to reduce risk and increase efficiency and cost whilst others felt that the simplistic design as counterpart to the required minimal training hindered its ability to be used in the NHS because the low-cost initiative increased the likelihood of risks and complications. Although, participants across both Groups were expressive about the design, those in Group C were generally more positive and those in Group B who were more critical when discussing the design. Some participants in Group B expressed that the design was due to the lack of funds, but this consequently led to the ability to produce something that was affordable, needed, and effective.

Features such as the material, functionality, mechanisms, application, durability, sustainability were predominately mentioned when discussing the design of Sayeba’s method. Discussions about the design of Sayeba’s method in both Groups were often conflated with the ‘cost’ component which dictated and justified the design and its simplicity.

4.2.1.3 Cost

Cost was a strong and popular theme as it was associated with and took focus across all themes (except for shared decision-making). The aspects of resources were aligned with cost and were discussed in a positive narrative. Both Groups B and C, though positive, were more studious towards the cost of the innovation and its logistics. Most participants in Group B and Group C found Sayeba’s

method to be highly valuable and meritorious as it could address national health concerns whilst developing techniques within the means. These participants empathised with the national concerns using the prevalence information provided to them during the presentation. Reference to being a 'frugal innovation' created a "*nudge*" for "*well-deserved*" attention and achievement for those in Group B.

All participants in Group C commended the innovation being developed in a LMIC due to the limited funds and resources available to them. These participants stated that more attention must be given to ideas, products and services developed in a LMIC and that a country like the UK should learn from those who have impeding limitations and develop affordable, effective and quality solutions to health concerns, "*we must look to those who've far out exceeded the expectations to address all kinds of health issues with limited money.*" Though participants exhibited an overwhelmingly positive response to Sayeba's method as a low-cost, effective, and efficient innovation, participants in Group B were more critical of cost than those in Group C as they critically assessed the various dimensions of cost.

4.2.1.4 Useability

Participants from both Groups B and C felt that the useability was "*simplistic*" and "*modern"*. Discussions about useability often involved the evaluation of other overarching themes, e.g., the design, cost, and risk. Albeit participants generally perceived Sayeba's method to be effective and efficient and of quality, there were still some forethoughts about the expulsion of the condom balloon tamponade, though this did not negate the positive perception of the innovation. Most participants in Group B wanted to acknowledge the risk of expulsion during its application which affects its functionality.

A substantial element within these responses was the risk of training other clinical staff such as nurses, paramedics, and junior clinical staff. The same consideration was echoed in Group B who also discussed how these factors would impact the outcome if less experienced clinical staff were able to perform the technique. The acknowledgement of the opportunity for others to gain an additional skill was also reported. The responses were equivocal due to the uncertainty of whether the training non-doctors did more harm than good to the perception of Sayeba's method, "*…Sayeba's method is a great innovation but the thing that concerns me, is the breakage of the condom.*"

Participants in Group B were generally more critical of the application though the context of this narrative was positive. One of the most highlighted critical considerations was the use of a condom.

It was perceived that condoms are cheaper than the Bakri Balloon and perhaps less effective because it's adapted for use compared to the Bakri Balloon which is developed for an intended use. This rationale cautioned the impact of cost, risk, clinical effectiveness, and its application to withstand the weight of the saline solution and the pressure of the condom balloon tamponade during its insertion into the uterus.

Participants in Group C focused on the application as the main theme of useability. No other component such as risks, training, concerns, and recommendations were mentioned. These participants solely focused on the actual technique of Sayeba's method and stated that it was "*simplistic by nature and resourceful by force*". Participants aligned the overall simplicity to the design and costs to the success of this innovation.

4.2.1.5 Clinical Effectiveness

Clinical evidence, success rates, rates of expulsion, side effects and complications did overlap with risk perceptions. Participants did not exhibit any significant concerns to the limited evidence of Sayeba's method because though they acknowledged that it needs to be studied further, this would not stop them from accepting it use in their treatment. The rationale of these perceptions were based on the limited resources available to the developers of the innovation but also its design of simplicity that allowed them to understand it and perceive its risks, "*…you can't really blame them because that stuff takes a lot of money…it's for sure before it gets considered here, it needs to be tested a lot more but it wouldn't deter me from supporting my wife to use it, I'd actually encourage her to use it, partly because it's so simple and quick it is.*"

However, one participant in Group B suggested that more clinical evidence was needed and associated this with its reference to a FI. Although the narrative of such discussions was positive, they felt that the 'frugal' aspect may cause more negative attention and scrutiny to the innovation, "*…maybe it's the word frugal because I get that its lower in cost but some people may think cheap or reused so maybe the small number of people that its tested on is put off by this I mean for me it sounds like a good idea and it's so similar to what's used now so I wouldn't have a problem with it other than nurses doing it but maybe others will notice the frugal part and they'll have more to say…*".

Some participants in Group B required more clinical evidence across different birthing methods such as "*natural water births*", "*c-section births*" and "*induced labour*". However, some participants in Group C condemned and attributed the limited evidence and findings to the innovation's COO but

remained positive about the developers of Sayeba's method. These participants felt that the COO was to blame for its lack of clinical evidence and primarily focused on the lack of funding and limited resources available in Bangladesh. The participants suggested that there was limited support given to developers in Bangladesh by their government and is perhaps the reason for its status as a LIC, "*Bangladesh is a tricky one because of all the politics and corruption it's the reason why the country and the people keep suffering…not everyone is as lucky as us here with the NHS and all these programmes that push people to develop ideas and the funding.*"

4.2.1.6 Shared Decision-Making

Most participants in Group B expressed the need to consult their partners (proxies) when making the choice of using Sayeba's method though it would be the same for current options. The theme of shared decision-making was not necessarily significant as some participants felt that the decision to accept Sayeba's method was not relative to the moment and may not reflect their actual decision if the event was to occur.

4.2.2 NHS Staff

4.2.2.1 Risk

Participants in Group B generally felt that though Sayeba's method was simple and much like the existing method used in the NHS, the risk would be near enough the same as with the Bakri Balloon (experienced perceived risks) or higher as it used a condom alternative, "*I think the risk is the same as the current method we perform…*" (same level of risk), "*…you may have a problem with the chance of it breaking because it's not meant to hold so much volume, 250 to 300 millilitres is a lot of fluid for it not to break its quite heavy too so yeah the thickness of the condom will also be a concern of mine…*" (higher risk).

All participants stated that due to perceived indifference in thickness between the condom and the Bakri Balloon would increase its likelihood of risk. The overall risk perception was compared to the current Bakri Balloon. The nature of such perceptions was negative, which was corroborated through tone of speech, body language, facial expressions, and linguistics.

Although most participants in Group B felt that the condom was an "*average*" and "*fine*" alternative to the current IBT, the risks and complication expectations was higher than for the Bakri Balloon. It was deemed that by reducing the cost of the most vital equipment used in the tamponade technique,

the associated risks will increase because of its unintended use as opposed to the Bakri Balloon which is developed for the intention to control PPH. The likelihood of risk to infection was greater for those in Group B because the condom was not intended to be as antibacterial, and antiseptic as compared to the current IBT.

One participant in Group B stated an "*intense fear*" of inserting the condom balloon in a patient who has had a caesarean sectional birth due to the susceptibility of infection being heightened and high risk. The risk perception for all participants in Group B often overlapped with the design and clinical effectiveness. Participants stated that the lack of clinical evidence illustrates the risk involved which was due to its uncertainty for the general population as it's been trialled on 23 patients which was deemed ineffective and invalid.

On the other hand, participants in Group C stated that although the condom was a "*clever*" alternative to the Bakri Balloon, the concerns about risk would be the same if not mostly similar to those associated with the current method. These participants were not overly censorious about the risks, "*…I assume due to its simplicity and comparison to the current IBT the risks would be the same, I can't think that the condom difference would be all that riskier…*". One participant stated that the perceived risks would be increased due to its COO but not by themselves. These perceived risks did not involve any features of the innovation, "*…so not me but I think you might have people thinking because it's from Bangladesh then it's got to be high risk, well you always have people like that, others might find this controversial even though its practically the same…*".

4.2.2.2 Design

The design was described as "*average*" but "*nice*" and "*interesting*" by some participants in Group B. These participants tended to dissect each individual feature and was monotonous and negative which was supported through the lack of variable body language, linguistics, and facial expressions. Participants coupled their thoughts by asking further questions, "*…it's not something that I would like to see in the NHS because we shouldn't be using a condom to do these things…are you using the same catheters? are the same antibiotics used? how longs does it take to inflate…you know I just don't get it; it comes across as a cheap way to put patients at risk…*".

Participants in Group C generally applauded the design and described it as "*creative*", "*adaptable*" and "*clever*". Albeit, these responses did not include a critique of the overall design, some participants did ask questions regarding the option to use latex-free condoms for those with latex allergies and where

the manufacturing and importation of equipment takes place. Additionally, participants from Group C acknowledged the adaptiveness, "*…can you use latex-free condoms because they are widely available*."

However, a condom was also reported to "*cheapen the design*" though it was central to its design. The nature of this discussion was positive as the participant upheld their initial thoughts about the innovation as being "*adaptable*". Participants in Group C were not overly critical or concerned about the differences, but rather interested in its conception, development, and technical properties. A topic initial elicitor was used as the condom was referred to being an "*unconventional idea for a country like Bangladesh"*. This sequence type was initiated to examine the use of the elicitor and the sequence of discussion. A sequence type is designed to generate a topic interactionally and mutually to further explore the process of thought in the natural environment of perception (Button and Casey, 1985). The interviewer asked the participant to further elaborate on its 'uncustomary' feature to which the participant added that the religion of the country (*referring to Islam*) condemns the use of condoms because of their "*really strong conservative religious views on sex*".

"…I say unconventional not in a bad way but in a way that's not familiar or acceptable maybe…it just because I think where it's a Muslim based country, they have really strong conservative religious views on sex and more so in places like this where it's not liberal so the fact that they thought to use a condom is really interesting and appealing but I don't know how the women used it but even how did they get it into the country with all of these beliefs…".

The narrative of such responses was positive but did express a level of uncertainty which was due to the limited information provided during the presentation. These participants expressed an overwhelming interest in Sayeba's method and applauded the innovation for addressing health concerns and its adaptability. These staff participants explicitly stated that although they do not typically consider nor ask about where a medical device or product is from, the COO, Bangladesh, made the innovation more attractive and added a unique selling point (USP), "*…the fact that it's from Bangladesh and uses a condom and not the epitome of innovation it will get the attention it needs and rightfully deserves in my opinion…*".

4.2.2.3 Cost

Participants in Group B associated risk and efficacy as being contingent upon costs. These participants provided criticism foregoing important aspects of a quality and medically approved innovation such

as using a condom instead of a medically approved Bakri Balloon or a different approved silicone IBT, *"it really doesn't sit well with me because if its reducing costs dramatically then it's also ignoring the risks that comes with a treatment like this. You need to have sufficient costs in order to correctly and fully evaluate the risks and all because it needs to involve a condom…*".

Furthermore, cost was associated with the type and timing of uterotonics. It was expressed that Sayeba's method could not offer the same quality medication as with the current Bakri Balloon, "*…if your lowering costs then can I assume that the type of medications prescribed like oxytocin and clotting medications are a cheaper alternative too or are they not given at all because of all the cost cutting…*". Though participants appreciated the cost benefits through affordability, it came across as cheaper because it uses a condom and therefore was deemed less effective and higher risk, "*…I like the fact that its different and uses a condom to save costs, but I can't help think it looks cheap and would pose more risk to the patient because I'm not sure it would work the same*".

The name sounded cheap because it did not involve a traditional name, it sounded Asian and assumed that the developer was of the Islam faith. The participant further supported their reasoning by stating the Bakri Balloon also sounded cheap but because it was medical grade and not a condom, it was not deemed as cheap, "*…it just sounds cheap, don't get me wrong, Bakri also sounds cheap but we know its medical grade so its appropriate compare to this a condom and named after probably after an Muslim women it was trialled on first or created by so it's not the traditional developer or name that you would hear like Michaels or Phillips, sorry to sound off like that…*".

Majority of participants in Group C expressed positive thoughts about the low-cost alternative. The affordability and the use of the condom enables the method to be effective and adaptable to various environments. Furthermore, it was perceived to provide more opportunities to be cost-efficient such as training workforce, reducing waiting times and increasing accessibility. Participants from Group C stated that the affordability of Sayeba's method made it an ideal alternative for the NHS, "*….it's all around great initiative cause think of the long term like your training people to do this so you don't need to wait for doctors and see more patients and have quicker treatment times…*".

4.2.2.4 Useability

Participants in Group B valued the ability for others to learn a skill. But this was also coupled with criticism as the technique was referred to as highly technical and requires advanced training and past

experience. The depth of the vaginal anatomy and complications is not something that nurses would typically know when compared to a doctor, "*I'm not sure if I would ever want to do it, it's too much of a liability of things to go wrong with a condom, it's far too technical…*". These participants questioned whether nurses and junior clinical staff would be able to prescribe medications like oxytocin or perform an infusion of intramuscular injections, "*…even with the training, we legally cannot dispense any medication…not sure how that would work…*".

In contrast, all participants in Group C stated that the useability of Sayeba's method was familiar and simplistic. They acknowledged that although they were not able to perform the technique, they understood how it worked and what to do from past experiences of shadowing the consultants, "*I would say I feel comfortable learning and doing the technique myself. I already have all those years of monitoring patients during the time they are receiving the treatment…*".

4.2.2.5 Clinical Effectiveness

Most participants in Group B found that the clinical evidence is not sufficient "*for even a decent review*". These participants stated that the inclusion of a condom to circumvent cost and the "*sheer lack of evidence*" illustrated its risk, complications, and success, which negatively affected every aspect of the innovation.

All participants in Group B stated that further testing was needed to appropriately assess its effectiveness. Participants provided a recommendation of removing the condom feature and find a low-cost medical standard alternative, "*I think the idea is there but it's just unsafe and cheap, my suggestion would be to remove the whole condom thing and find a low cost medical-grade balloon…*".

Responses from participants in Group C were mostly subdued when discussing clinical effectiveness. Although participants commended the innovation for its efforts in affordability and adaptability, Sayeba's method required further exploration through examining the effectiveness after different types of births and conditions, "*…for sure it needs more clinical evidence, just like everything we use in the NHS, we need to ensure we adhere to public and patient safety as a priority…*".

4.2.2.6 Shared Decision-Making

In Group B, though Sayeba's method provided an opportunity for less senior clinical staff, it was coupled with criticism and risk to the patient. The perceived perception of patients was considered

when allowing non-doctors to perform the technique. These participants expressed their discouragement towards allowing non-doctors to perform the technique on patients in which the nature of such narratives was negative, "*…the quality of our services and healthcare altogether is compromised if nurses who are doing this treatment are unaware of the critical situation…*".

Most participants in Group B stated that patients should get a choice in whether less senior non-doctor staff should be allowed to perform Sayeba's method on a patient, particularly as its not well studied and has insufficient evidence to explain success and efficacy. These discussions were negative and emotionally expressive, "*…the woman should get a choice absolutely, like I know I would like to have the choice having been in that position 2 times, both times I had PPH I would also want to know that it's not well researched…*".

4.3 Group D (No Frugal and No COO)

Participants in Group D received information about Sayeba's method, however this did not involve any mention of the term 'frugal' and its 'COO'. These participants were not given any information nor cues about its COO.

4.3.1 Patient Representatives

4.3.1.1 Risk

The general expectations of risk were positive in that they deemed it to be a safe and effective with the same assumed risks as those with the current Bakri Balloon. Most participants felt that Sayeba's method did not look nor sound high risk especially because of its similarities, "*…it's really similar to the current treatment in the NHS so I suspect that the same risks would apply or maybe less risk because it's a condom…*".

Some participants announced concerns of failure, specifically if the condom was to burst. Hypothetical situations of different birthing methods and predisposing conditions were used to express their risk perceptions, *"…if I have sickle cell anaemia and want a natural birth and if the balloon breaks, will it do more damage to me…*".

Associated risks of rejecting blood transfusions due to religious beliefs in the event of a haemorrhage and failed uterotonics was also reported. It was believed that if Sayeba's method could prevent the

need for a blood transfusion, they would accept its use in their post-delivery care immediately without hesitation, "*…I am Jehovah Witness so blood transfusions can't be accepted, would this work better so that I won't need a transfusion…".*

On the other hand, risk was heightened due to the name of the innovation which would subsequently cause a complete dismissal of its use. If the name was to remain unchanged due to political dimensions and cultural stereotypes, then it would not be widely accepted for use in the NHS, particularly by Caucasian women, "*…you're going to have a real problem with trying to get it into the NHS with that name because it will instantly signal off racism…*".

4.3.1.2 Design

Participants felt that the design looked similar to the Bakri Balloon, "*just as innovative as the current option*". The general tone and narrative though monotonous, was positive and exploratory which was supported by the interpretation of facial expression, body language, CA and linguistics. The design element of Sayeba's method was both unenthusiastic and the most verbally expressive theme.

Participants felt that a condom made the overall innovation look cheap though they acknowledge the creativity of the developers to use this idea. There were questions about whether a different low-cost alternative balloon existed and could be used because the thought of a condom, reflected a reuse and unhygienic approach. The tone and narrative of this discussion was conflicting and initiated a flight of ideas approach, *moving from one idea or thought to another*, in their design perception. The participant would use statements to circumvent the negative perspective to redirect and control the narrative as a positive passage, "*…the idea is a good one but using a condom just cheapens the whole idea together…colour looks dirty and something that can be reused so very unhygienic look…*".

Although most participants stated that the design of Sayeba's method looked safe, clean, and robust, some questioned its sustainability and ruggedisation, which provoked concerns of cost, functionality and risks, "*…I'm questioning whether the durability…it's not that strong and even though it's a good quick idea, the condom just looks cheap, its gonna cause some damage, leaks, breaks, tears…*".

4.3.1.3 Cost

Most participants stated that cost was a positive factor and would improve the NHS' challenges. Though costs for healthcare innovations is important to keep within conservative budgets, the quality,

safety and effectiveness should not be ignored and must be prioritised over the importance of costs and vice versa, *"……if it's too complicated or the bare basics are ignored than what's the point, you'll be in even more trouble..."*. The element of costs was not considered during decision-making. Participants felt that the developers should think about the end-goal first and work backwards so that costs was the end concern not the initial objective, "*I would say the priority is starting with the issue and then developing the product and then making sure it's not over the top with the cost…*".

A preference to higher-end, more expensive option over the more affordable option regardless of its design and functionality was reported. The more expensive innovations as perceived by participants, the more superior, because they felt that costs reflected effectivity, reputation, and success. A recollection to past experiences were frequent when discussing costs and its ability to provide performance, i.e., the development and launch of COVID-19 test kits and childhood experiences of growing up in a LIC. Past experiences living in LICs was compared to life in the UK to which costs represented superiority, status, and luxury. Participants felt naturally more inclined to choose expensive high-end alternatives irrespective of its results and associated risks. Though it was commendable for Sayeba's method to reduce costs, the difference in cost savings was not substantial enough to warrant a replacement, "*I get that this thing is working and cheaper but when I think about the grand scheme of things long-term, it's not that much of a saving…*".

4.3.1.4 Useability

These participants welcomed the opportunity for information to be simplified so that they could manage expectations and make more informed decisions, "*…I don't know why they don't make it as simple as this all the time…*". However, some participants stated that the information about its mechanisms felt unnecessary and too complicated to understand and that it was better suited for clinical staff, "*…I don't think this sort of information is needed it's just too much for me…maybe this information could be more to them [staff].*"

Concerns about the useability, focusing on its effectiveness after various birthing methods was also reported. Some questioned whether the condom balloon could stay in place after a water birth. Feelings of hesitancy and concerns of complete rejection of the innovation were increased when stating that information about a particular question was not known nor published, i.e., how Sayeba's method would react to different birthing methods "*ok that's slightly concerning, I don't really know whether I would now use it…*". Other types of negative feedback about the use of a condom and nurses being able to perform the treatment was noted. Life-saving treatment was believed to be only

performable by more senior experienced staff and therefore patients should not have to conform to this idea, that has not been trialled in the UK. Though they acknowledged that the useability is simple, it should continue to require a mandatory medical license and advanced experience.

The simplicity and the involvement of a condom conflicted thoughts about Sayeba's method. Some expressed that the application of placing the balloon was simple and straightforward, but the use of the condom complicated the approach due to its functionality and applicability. Some participants remained hesitant and unconvinced about the effectiveness of Sayeba's method, "*…I'm thinking what am I missing or what is the method missing…*"

Participants believed that condoms were not sustainable and robust enough, particularly as condoms were not intended for controlling PPH. The use of condoms would lead to catastrophic consequences to the patient because it simply was not safe to use and were not strong enough to withstand the weight of heavy saline. Sayeba's method was rated as a high-risk innovation due to insufficient functionality led by cutting costs. Issues with sustainability was also reported in that the use of rubber condoms would harm the environment. A recommendation was given towards developing an alternative environmentally friendly option that could still be as effective as the Bakri Balloon, "*is the rubber condoms going to be recyclable, cause if not then it's going to cause a lot more issues…I think the NHS are already pushing for sustainability…*".

4.3.1.5 Clinical Effectiveness

Participants in Group D felt that more clinical evidence was needed to reflect the authenticity of success and risks. The information provided was seen as ambiguous and scarce which reflected the participants' reluctancy to accept Sayeba's method in their treatment as of current. Though Sayeba's method was commended for its efforts in adaptation, it was unnecessary and the trial of 23 patients was not sufficient to provide any information about its success and failures, "*the method is fine and all but I don't think realistically its needed, it's the same and the cost saving isn't that dramatic and not tested on many people to give us an indication that it will work and its complications, it's too risky and not really useful…*".

The affordability of the innovation contributed towards the lack of clinical evidence. Low-cost was attributed to limited evidence which consequently and negatively affected all risk perceptions about the innovation, "*I think by saving money, the developers had cut these costs or pocketed these costs by not testing this method of enough people. This would highlight the high risk…*". On the other hand,

some participants felt that no further information was required because of its similarity to the current treatment. These participants believed that Sayeba's method had much to contribute towards healthcare innovations by thinking of more affordable options that can be accessible to all.

4.3.1.6 Shared Decision-Making

Shared decision-making was believed to involve being autodidactic, as consultants and proxies would not completely empathise and consider factors that related to the patient. Some participants relied on media outlets such as national news (TV), pregnancy podcasts, specific YouTube channels, pregnancy-related magazines, and forums e.g., blog posts to understand specific information and enquire about different healthcare innovation and services.

The inclusion of a condom was not merely novel to consider itself as an innovation as it was significantly similar to the current method using the Bakri Balloon. Furthermore, a recommendation towards not using Sayeba's method was reported, "*only cause it's a condom, does not make it new or unique, its literally done the same thing but replaced the balloon [Bakri] with a condom… I would shout to anyone not to use it.*" Conversely, endorsement to using Sayeba's method was increased if other woman had expressed a positive experience whilst using it, "*if you told me that someone else was fine with it and it worked great, then of course I'll consider it, but I would do more research into it*".

The typical conversations between patient and their consultant does not involve information about clinical data and thus was deemed "*overzealous*" and "*overwhelming*". Providing such information would only been useful and productive if it acknowledged a cause of concern such as death or high likelihood of complications.

4.3.2 NHS Staff

4.3.2.1 Risk

Participants felt that because Sayeba's method was a low-cost innovation, it was perceived as low-quality and thus would impact its ability to be safe for use. All participants required more information from the previous study results. Participants felt that 23 patients (previous study sample) reflected how poorly studied the innovation was and perhaps led to its developmental flaws and felt that it would be pure negligence to accept something like Sayeba's method in the UK's NHS, "*the size of the*

trial just is extremely small, there's just no way that it can be acceptable or even considered…these questions show how risky and dangerous it would be to use…".

There was particularly focus by all participants on who and what it has been tested on to receive such attention and acknowledgement. Sayeba's method was rated a high-risk innovation because it has rarely been studied since 2003 and even within that study itself. This was also coupled with the lack of rigorous testing nor requirements such as approvals from regulatory medical boards for it to be considered for use.

The high-risk nature of Sayeba's method was further deepened as some believed it should not have been tested on 23 women without receiving some regulatory or trialling approvals. A recommendation was provided that the current Bakri Balloon tamponade technique should be used, and more affordable approaches should be offered to these women rather than forsaking quality and safety protocols and acting in pure medical negligence. It was also rated as high-risk as the condom in this treatment was perceived to be "*dangerous*" and "*erratic*". Furthermore, the condom was believed to be unhygienic, and the level of infection would increase as a condom would not have tested the ability to withstand heavy weight and stretch.

4.3.2.2 Design

The overall design of Sayeba's method was described to be "*cheap*", "*flimsy*", "*fragile*", "*insignificant*", "*useless*" and "*dangerous*", primarily due to the condom use. Participants stated that safety and quality should never be overlooked nor excluded from a lifesaving treatment in healthcare, "*I can understand why it's a condom because of cost savings and resources available but even then, quality and ensuring patient safety should be number one…*". Some participants felt that Sayeba's method should not be referred to as an innovation as it only involved a name change and the use of a condom in place of a Bakri Balloon.

4.3.2.3 Costs

Participants provided negative feedback on the cost of Sayeba's method. Most participants felt that the limited cost issue was used to circumvent and disregard safety, quality, and effectivity in developing an appropriate PPH treatment, "*…it's a poor excuse, you know to say money is a major setback so we can't include more features or produce a better balloon or even to trial it on more patients…*". Sayeba's method was presumed to be a low-cost innovation due to its core component

involving a condom. Furthermore, one participant explicitly stated that they did not consider costs at all as they were not in a position to accept or reject products and services, "*I don't consider the cost too much if it can do the job safely…*".

4.3.2.4 Useability

Most participants felt that the useability was simple and straightforward as it is significantly similar to the current method, which made it easy to understand its principles and involvement. Though most staff participants stated that Sayeba's method was a "*cheaper*", "*ineffective*" and "*unnecessary*" innovation, its ability to provide an opportunity for less clinically experienced staff to perform a PPH treatment was commended. If an innovation can reduce the burden placed on nurses on a day-to-day basis, it would be advantageous, "*…one of the good parts or silvering lining may be the opportunity for nurses to be able to perform the technique, to improve our knowledge and skills…*".

Most participants stated that although the technique was familiar to them, the use of Sayeba's method would lead to dangerous and catastrophic outcomes such as infections, persistent and intense pain and potential death. The condom component was not intended to be used in the treatment for PPH and would inflict negligence and harm on the patient, "*it's so dangerous and neglectful, a condom is not going to save a life and its negligence for using it…*". The condom was seen as not being able to withstand the volume of the required saline and therefore deemed it to be ineffective and "*useless*".

4.3.2.5 Clinical Effectiveness

All staff participants in Group D considered clinical effectiveness when discussing risk, costs, design and shared decision-making. Clinical effectiveness was the most expressive theme in the context of both verbal and non-verbal communication. All participants negatively expressed that the current clinical data presented was not sufficient for use in the NHS, "*…there's no point in showing this sort of data to anyone as it doesn't indicate anything, the study was far too small to say anything and the NHS would want so much more data…*". The lack of clinical data was attributed to the innovators' cost saving initiative. The same narrative and reasoning were provided during the reported risk perceptions of Sayeba's method, "*if you cut costs or focus on being more affordable then the clinical data will be limited, we all know that cost a lot of money which is understandable, but this is why its high risk and not for the NHS…*". On the other hand, whilst the developers could focus on collecting and reporting more data, it would not negate its ill-compatibility in the NHS as perceived by these participants,

"*…collecting more clinical data will be good and beneficial but it's not eligible for the NHS because we have a working system that will not use a condom*".

One of these participants stated that there was no need to adapt this technique for the NHS. The sole reason of reducing costs will negatively impact the outcomes of the patient. They expressed concerns about the data available and referred to it as "*ambiguous*". The developers had taken "*shortcuts*" by reporting limited evidence to reflect some accomplishment but were not thorough enough to explore the associated risks. They mentioned that current NHS techniques, products and services come with risks, but appropriate assessments are completed and therefore eligible for use. This resulted in a negative perception towards the developers of Sayeba's method, because though they intended to provide a low-cost adapted tamponade treatment, the focus was given to costs, rather than the patient and their outcomes. Overall, all participants deemed Sayeba's method as a high-risk innovation as the limited clinical evidence reflected the disproportion of costs, safety, and effectivity.

4.3.2.6 Shared Decision-Making

All staff participants in Group D expressed that shared decision should be increased particularly when Sayeba's method uses a condom, not "*rigorously tested*" nor approved by UK regulatory bodies and allows less clinically advanced staff to perform the technique. Contradictory responses were recorded as participants believed that such information was not necessary to patients but felt the importance to mention the use of a condom as it was controversial and may elicit a rejection from patients receiving this method.

Participants stated that patients do frequently ask about prospective potential complications and how they are mitigated or treated. This is particularly heightened in those who have pre-existing comorbidities that can affect the actual pregnancy and outcome of labour such as PPH, "*I have noticed that more and more women are doing their research, so they come in a lot more informed than what we typically were use to…*".

Summary

Overall, Sayeba's method, though rated low-to-medium risk by the research team, was found to be one of high-risk by most patient representatives and NHS staff. Across all four Groups, risk was perhaps the most predominant theme discussed alongside clinical evidence as both were reciprocally mentioned to explain the other. In Group A, its high-risk rating was contingent upon its COO and the

lack of clinical evidence that Sayeba's method was able to acquire. Most patient representatives felt that though the idea of this FI to treat PPH was "*clever*" and "*practical*, it was only such in its COO and had no sense of belonging or need in a HIC like the UK. Furthermore, as its COO was mentioned by the researcher, both sets of participants were loudly expressive such that body language and facial expressions were clear to record and this changed the narrative of the discussion altogether. The idea of Sayeba's method was great for a LIC, though it was still recommended that more testing be conducted to ensure safety and risk, it was not necessary by most in a country which would not accept a condom alternative like the UK.

The frugality cue did have an impact on how these themes were perceived and worsened according to the number of utterances in Group B. For instance, at the first utterance of 'frugal innovation', most participants felt that it was a positive idea to treat PPH, however once more questions were asked about it, whilst further stating 'frugal innovation', perceptions became more negative as it anchored thoughts about the individual themes, particularly the design as a condom was perceived as "*cheap*" and "*scatty*" and had a direct association to cost which consequently facilitated perceptions about its clinical evidence and its validity. On the other hand, though most staff participants felt that Sayeba's method was "*simple*" and similar to the IBT currently being used, risk perceptions were more negative and higher due to its use of a condom and the lack of clinical evidence corroborated their views. These participants were generally unresponsive to the 'frugal' external cue.

Moreover, for patient representatives in Group C, risk perceptions were consistently compared to MNM and ADCS, such that there was a clear country animosity towards Bangladesh. Though India and Bangladesh are officially classed as LICs, India was far more superior than Bangladesh simply because there was a lack of acknowledgment or attention from media forums and innovation. Some patient representatives, though never visited either country, stated that they had heard about innovations from India and were familiar with its capability and culture in the UK as opposed to Bangladesh to which no participant had heard of innovation from this country and felt apprehensive to which risk was discussed in a hypothetical context. In contrast, most staff participants in Group C felt that the idea of Sayeba's method was an "*clever*" alternative and that risks would be hypothetically similar to the current IBT.

However, such perceptions were mirrored by patient representatives in Group D, which may have been attributed to the identifiable characteristic of its name. Therefore, there was a significant impact of the COO effect on perceptions of Sayeba's method for those who did receive the cue. It should also

be noted that those who had not received the cue used the name of the FI to presume that it was conceived in an Asian Islamic-based country to which was associated with a LIC. Furthermore, staff participants rated Sayeba's method as high risk, "*dangerous*" and "*erratic*". Here, low-cost innovations were perceived as low-quality to which many required further information about the FI, with a particular focus on the studies already conducted. There is motive to examine whether further clinical evidence changes the narrative of perceptions when their recommendations are addressed. The next chapter explores the perceptions of MNM, which is a FI that has acquired more clinical evidence and is widely used in many countries.

Chapter 5: Results for Mosquito Net Mesh

Chapter 5 examines the qualitative responses pertaining to the perceptions of Mosquito Net Mesh (MNM) for inguinal hernia repair. During the collation of these results, participants were presented with information about the MNM to which all were encouraged to take notes during the presentation and note any questions they may want to discuss during the interview section of their participation. Interviews followed directly after the commencement of the presentation. The content of the presentation varied accordingly to our factorial design of four Groups, whereby each Group were presented with either or both external cues (Groups A-C) or none at all (Group D). The analysis considers how patient representatives and NHS staff respond to the FI, though staff were only provided information about the MNM as opposed to patient representatives that could compare this FI with the others e.g., ADCS and Sayeba's method. Similarly, to the format in Chapter 4, the analysis of responses was grouped by six overarching themes of important components affecting perceptions e.g., **risk** (grouped with expectation and invasiveness as it was a prospective interpretation and measure), **design** (colour, ruggedisation, porosity, material, and weight), **cost**, **useability**, **clinical effectiveness** (clinical evidence, success rate, failures, complications, and side effects) and **shared decision-making**. Grouping of themes are mentioned where some themes included a combination of the overarching themes. Throughout some of these themes, vignettes were used to elicit responses i.e., exploring expectations, risk, and invasiveness. The chapter is divided according to the four Groups, merging both Groups B and C together, and further spliced by responses from patient representatives and NHS staff.

5.1 Group A (Frugal and COO)

Participants in Group A were presented with information involving the term 'frugal' and providing information about its COO.

5.1.1 Patient Representatives

5.1.1.1 Risk

Most participants rated the MNM as a low-risk innovation which was mainly attributed to its simplicity and likeness to the current synthetic commercial mesh. However, though it was low, the risk increased due to its application of needing a surgeon and being implantable. The MNM provoked a favourable response because if the MNM could mimic the human tissue, then the likelihood of complications and

side effects would be reduced as the rejection rate would be lower. These participants also felt that the MNM limited or reduced the need for a second hernia repair.

However, the MNM was rated as a high-risk innovation for one participant as they felt that by using any mesh irrespective of the MNM, would cause harm to the patient. The participant acknowledged the recent controversy surrounding vaginal meshes and confidently rejected its use dismissing the clinical evidence that demonstrates its effectiveness, "*…it was honestly heart-breaking to hear about those women whose lives are overturned by simply going along with a treatment that was supported and encouraged by the NHS and its doctors, surely more data should've shown that it wasn't safe or the complications it would cause…*".

Some participants did express feeling uncomfortable and uncertain with the use of mesh if there were no choices available. The interviewer presented a hypothetical scenario using the COVID-19 pandemic as an example. The participants were asked if supplies of the current commercial mesh were limited or unavailable and the surgery was imminent, would they accept the use of the MNM to be used as an alternative. Whilst most participants stated, "*yes*" they would accept, irrespective of the situation because it's an effective method, a few participants felt that having no other available options defaulted their choice accepting its use or foregoing treatment. "*I would rather say no to the mesh and live with the painful consequences of a hernia, my stance on it is so strong and no matter…*". Conversely, it was also stated that comfortability and satisfaction of the MNM would increase if it acquired the same regulatory approvals, CE marking as the ADCS and its rigour of clinical data. Some participants rated the MNM as high risk because it was not only frugal, but it was developed in a country with "*low reputation and no credibility*".

5.1.1.2 Design

All participants expressed that the design emulated the current mesh which demonstrated their risk perceptions to be similar to those of the current mesh. The MNM was described as "*really cool*", "*cheap*", "*ineffective*", "*unusual*", "*interesting*" and "*surprising*". Initially, only a few participants could illustrate the difference in design between the synthetic mesh and MNM. These participants were pleasantly surprised by the resemblance of MNM to the current synthetic mesh in regards to its appearance, colour, pore size, flexibility and weight. Participants acknowledged that though the mesh was similar to the commercial mesh, it's advantage of similarity to native tissue provoked a favourable long-term response. The COO was commended in their efforts to finding an effective and affordable solution which could offer even more benefits than the current commercial mesh.

The current commercial mesh was seen as "*unnecessarily complicated*". Most participants felt that innovations in the UK were "*overworked*" by including various components to make it look sophisticated and expensive when it offers nothing more than the pre-existing devices at an affordable price. However, few participants stated a dislike for all things mesh and felt that it should be discontinued for use in all NHS procedures. The mesh was associated with causing severe and irreversible harm and complications. The design simply offered nothing advantageous to patients as it was foreign. Furthermore, the NHS should not be seeking and considering FIs developed in LICs such as India as it was not suitable for the population of the UK.

Research and clinical evidence were perceived to portray an unsafe innovation because it did not receive any regulatory accreditation like the ADCS. The design echoed these perceptions of its COO and stated that the design "*…looks like a frugal cheap flimsy thing so no surprise that it's from a place like India…if it was from America then you'll just notice right away…*". On the other hand, most participants commended the innovation's COO in that LICs were creating resourceful and effective solutions for people everywhere around the world. The COVID-19 pandemic expanded some perspectives on the "*atypical countries*", "*…did you see how those countries [LICs] handled the COVID situation, honestly inspiring, I bet they used less money to do it too. I mean we were struggling here, and it took so long to just get a hold of things…*".

5.1.1.3 Cost

Most participants were not concerned about costs but did state that it typically reflected the effectiveness and design. These participants felt that the MNM was "*clever*" and "*effective*" in developing an "*out of the box*" alternative that could provide better results than the current option. Some participants felt that the MNM was the most like-to-like with the current option used in the NHS compared to the other examples presented. However, for few participants, the design did not reflect low-cost, "*…I would've never thought to look at mosquito nets for this idea even if it was right in front me, so it's really great that they could be that clever to think about these sort of things…*". These participants expressed positive thoughts about welcoming an adaptative approach which could contribute towards alleviating the financial burden imposed on the NHS, promote a more sustainable model and support innovators from LMICs, "*…we have the position to support those who are doing great things for people everywhere not just the poorer countries, and having it work and more affordable is also a win-win for the NHS…*".

Conversely, some felt that cost reflects quality and that the MNM being a more affordable option was ineffective because it sounded cheap and was developed in a "*low income country with poor environments*". As the resemblance between the two meshes were similar, there was no need to replace the current mesh despite its affordability and potential better outcomes. These participants were adamant that though they can accept different products from LICs, healthcare innovations from LICs was "*an absolute no go*". Healthcare was prioritised and posed a larger significance than everyday items, "*…I don't mind like having a CD player from China but my health is much more important, if the CD player broke, not a big deal it's not gonna kill me where this mesh might. It's not just India it's all of them low-income countries, the quality isn't quite right as the UK…*".

5.1.1.4 Useability

Most participants felt that the information about how MNM is used and placed was not necessary to know. Participants were more concerned about its associated risks more than any other factor. They expressed some positive feedback about its application mimicking the human tissue. Some participants felt that the COO was considered important in decision-making because it was autonomous in that there was a natural response to considering where the innovation came from to judge its quality, "*…when you go into a shop and see the price differences, your gonna wonder where it's from to indicate its price, I can predict that things coming from America is gonna be expensive compared to things coming from India …*".

Few participants felt that the useability was flawed because of its design, purpose, and cost. Feelings of scepticism trusting the MNM as it was an affordable option and not intended to treat hernia repairs were reported, "*…it makes me think that if it's cheaper than what's missing and it's not made to repair hernias…*". Though these participants disfavoured the MNM, reasonings to discourage its implementation were centred on its effectiveness as opposed to their general perceptions about the mesh material. Initially, these participants expressed that all mesh should not be used in the NHS regardless of success rate but here, these participants focused on finding benefits of the commercial mesh over the MNM, which found a complete dismissal of their initial perceptions about mesh. This could be attributed to its reference of FI and its COO.

5.1.1.5 Clinical Effectiveness

All participants expected more clinical data, risk assessment for longer periods of time and acquire regulatory approvals like the ADCS. Much of the discussion about the MNM's clinical data was

compared to the ADCS. Participants focused on the innovations being both frugal and developed in LICs and suggested that if ADCS could acquire such strong clinical data and approvals then it should be mirrored for the MNM, particularly as it is more implantable. Participants felt that more data was needed to further test out the effects and potential complications in the UK. They stated that frugality would have limited a feature which made them feel uncomfortable and unsure about its long-term use and recommended that it requires approval through testing in the UK.

Few participants believed that the clinical evidence was not suggestive of success. Whilst it was recommended that more data be collected and approvals be sought, these participants felt that the data would not be sufficient and valid as it was derived from an LIC. The COO was perceived as not possessing the necessary knowledge nor facilities to collect data in an appropriate and standardised manner like the UK, "*…I can't trust that the testing and all that stuff in India is gonna follow what England does, remember they haven't got all the resources and cleanliness, again it's not their fault they can't fix the whole country's image, it works for them but definitely not here…*".

On the other hand, there was more capacity to envisage its implementation in the UK compared to Sayeba's method. This was mainly attributed to the depth of the clinical data obtained as it was tested on more people, more countries, its COO, and its comparison to the commercial mesh, "*…compared to that condom in Bangladesh where there's barely anything to show for it, this is better. I don't like either, but Indian one and the drill cover one has potential here…*".

5.1.1.6 Shared Decision-Making

Most participants stated that if their surgeon was accepting of its use in their treatment plan with it being an affordable, effective alternative, then they would confidently approve its use. However, a few participants said that the MNM needed regulatory approvals and further testing to even consider it in their treatment compared to the ADCS, which made participants feel comfortable and safe, "*I think if the Arbutus system was able to get the right approvals because it demonstrates that it's safe and thoroughly tested then I would expect the mesh to have done the same especially if it's going to be living inside me…*". Though participants appreciated the importance of patient transparency and believed in informed decision-making, much of their healthcare experience has been centered on a shared decision-making approach between them and the medical staff, "*this isn't typically what I would experience, I normally come with questions to the doctor and he answers them and then we make a decision together…*".

Some participants questioned whether the information about the COO was necessary as it was presumed that most patients would not find this information important in making decisions. Some participants further expressed that having more choices can sometimes convolute information and consequently lead to making ill-informed decisions because it is based on unjustifiable stereotypes rather than important facts and data, "*…I understand its full transparency, but my doctor has never told me where something was from, and I've been able to make decisions without knowing and I'm still fine and healthy, but if you give this information out, it opens the stereotypes, racism and people not wanting it because it's from India, it's not right, why is it important, is it cause it should be, should I care…*".

5.1.2 NHS Staff

5.1.2.1 Risk

All participants stated that the risk would be the same as with any mesh used in surgery as it was another foreign material being implanted. Most participants expressed that if the product was not safe, it simply would not be used in its COO and the other countries mentioned during the presentation. Participants believed that the only risk associated with the MNM was the announcement of its COO, which could negatively impact the true perception of the innovation. One participant perceived the COO as a negative effect on the innovation for others, "*my parents emigrated from Africa to London will tell you first hand being judged differently to people who emigrated from India even that in itself will cause differences in how you perceive them so imagine if it's technology that come from these countries, it will be different than those coming from the US [USA], it will get people choosing one over another based on where it comes from rather than its quality and offerings, so it's better not to mention it…*".

A topic initial elicitor was used to explore the foundation of the participants' perception of LICs. The participant stated that their perceptions were based on their past experiences growing up in a society where there were blended immigrants in a "*rich, white-washed mentality culture*" and western media portrayal. The participant stated that the western media portray the vulnerabilities of these LICs but not the "*developed, modern, advance parts of the country. The media doesn't show that India has bigger and cleaner shopping malls bigger than the UK because this is what they want to show, we will always imagine low-income countries to be this inferior, poorer state because we don't physically experience it…*".

5.1.2.2 Design

The design of the MNM was described as "*the same with some perks when you look at it microscopically and has better performance to surrounding tissue*". Though one participant did have some experience using a similar type of mesh and the design was perceived to be the same as the commercial mesh, the design was deemed unimportant as it's quality and efficacy were their main concerns. However, the participant did acknowledge that "*I just want to know if it works and it's clinical evidence that's it, everything else is irrelevant because then I can assess the risks myself, if the design affects the outcome or whether manoeuvring the mesh better involves changes to the design that all comes from actually using it…*".

5.1.2.3 Cost

All three participants were monotonous and nebulous with their reactions towards the cost of the MNM. The MNM did not depict an imagery of being 'frugal' in respect to their perception of the term. The MNM though did not appear to look "*cheap*" nor "*affordable*", the inclusion of the word mosquito net, immediately represented that it was a low cost alternative to synthetic mesh because it was "*atypical*" and "*unconventional repurposing material*". Most participants felt that the name of the innovation could indicate that it came from a LIC due to the prevalence of mosquitoes which would subsequently influence thoughts about its low cost alternative and based on the COO, "*quality doesn't always represent cost because we see that everyday where low cost items can produce great results like an air fryer, but when you start to think about the name you will automatically have the impression that it comes from a low-income country and then you'll think it's cheap and poorly made…when you have the element of the country to guide your thinking and decisions you'll have other things that will take precedence…*".

5.1.2.4 Useability

All participants felt that the useability of the MNM would be the same if not better than the commercial mesh. Though, all three participants provided positive feedback about the MNM, they did feel that the useability and clinical effectiveness themes were the most important alongside shared decision-making to some degree. The application of the MNM was deemed important because it focused on the actual movement of the innovation which dictated its quality and efficacy. Furthermore, participants found it difficult to ascertain and assess its quality and risk without using the mesh to repair hernias which requires follow-up with patients as the outcomes ultimately affect

them. Though one participant used a very similar if not the same mesh whilst enrolled in the Doctors without Borders program, they could not with certainty evaluate its useability in the UK because the equipment and people are significantly different, "*people in Africa are desperate to have the surgery that you can't really imagine that being the same here, a lot more thinking and preparation goes into the surgery here so I can't really tell whether it would work here. In Africa, you're dealing with a different set of population, race, ethnicities so the contexts are different, and you cannot expect the same outcomes. It worked great there, no complaints though…*".

5.1.2.5 Clinical Effectiveness

All participants felt that the clinical data was minimally sufficient as they all required further analysis with particular focus on recent data in the UK. Though all participants appreciated and acknowledged the acquired data, it did not show much evidence longitudinally which could speak to its limited evidence on complications such as rejection rates, surgical site infections and repeated repairs. It was recommended that further testing be performed in the UK so that it complies with the medicine statutory regulations of trials, "*you'll have less of an issue getting this into the NHS if it performs more trials here because then you won't need to be concerned over whether or not it's approved clinically and it would validate your results, we do this with all of the new things that come in it needs to go through more testing for the NHS they aren't simply going to accept the results you give them so they might trial it out in clinics if it has overwhelming great evidence…*".

5.1.2.6 Shared Decision-Making

All participants stated that as the innovation involves an implantable mesh, it needs to be discussed with patients. All three participants stated that information about the type of mesh is shared with the patient during their clinical visit and/or pre-surgical assessments. In light of the recent controversy surrounding vaginal meshes, it was deemed even more important to be transparent with the patient as some may reject its use simply as it uses mesh, "*I've been doing this for a long time and I don't have any issues with meshes but I know how important it is and how significant it can be especially if patients are hearing about things going wrong with a particular device so it will make some apprehensive and that's understandable. It's important to make the patient aware of it and it's risks as with everything we do but then it's solely up to them and if they choose not to then we simply have to find another alternative…*".

5.2 Group B (Only Frugal) and Group C (Only COO)

Participants in Group B were presented with information about the involving the term 'frugal' only. These participants were not given any information nor cues about its 'COO'. On the other hand, participants allocated in Group C were presented with the same information on MNM whilst providing information about its 'COO'. However, in Group C, there was no mention of the term 'frugal'.

5.2.1 Patient Representatives

5.2.1.1 Risk

Some participants in Group B rated the MNM as high risk, the same as the commercial mesh. However, these participants' overall risk perception of the MNM was minimally better than the commercial mesh when prompted for further exploration. Participants felt that the MNM offered better quality and solution to potential rejection or "*host versus graft disease*" as this would reduce the risk. However, these participants would still not accept its use without further clinical testing in the UK and without acquiring regulatory approval from the MHRA. Participants preferred to have something medically-graded and developed for the specific use to repair hernias. Though they stated that the MNM was a good idea, it was not appropriate for the UK as it would be too risky to use in the UK and cause catastrophic damage to patients as there were no trials conducted in the UK with the diverse population. Few participants stated that the NHS need not to look for affordable options at the cost of employing high-risk innovations such as the MNM.

Another three participants felt that the MNM offered the same effect to risk as the commercial mesh which was advantageous to the innovation. Two of these participants felt that as the MNM resembled both human tissue and commercial mesh, it would already have had a thorough risk assessment and somewhat better analysis as both doctors and patients would know what to expect and these expectations would be realistic, "*if you think about it if the similar or same thing exists just using a different material that offers better results, then surely the risk would be the same with stronger evidence or reduce the risk because it wouldn't reject as quickly. You've also got the benefit of using the data of the synthetic mesh and applying that here so at least by the bare minimum you know what to expect and surgeons can advise accordingly.*"

Four participants in Group C stated that the MNM was of lower risk compared to the commercial mesh simply due to its outcomes and quality. All four participants expressed a positive review when

discussing its relevance and resemblance to human tissue. These participants though commended the COO's effort in developing such an effective innovation, felt that the MNM should be tested in the UK to gain a better perspective of the climate and environment among the British population. Two of these participants felt that the innovation may have different effects which will impact risk in different ways because the environment and climate was not the same nor similar to Africa, "*…suppose I have to think about whether this would work here, it works great and I'm sure it will here too, but we need to test it here because our people are different and it's not as hot and Africa may have sanitary issues which we don't have here but it would then change the process altogether which might make it more costly which is why I said it's great but would like it for it to be tested her.*" Another two participants felt that the MNM was high risk as it was developed in a country which lacked resources and therefore quality, this would indicate that it was unsafe to use as the clinical data was not enough and not acquiring regulatory approvals like the ADCS demonstrated carelessness.

5.2.1.2 Design

Most participants in Group B expressed positive reactions towards the design of the MNM as it resembled the human tissue and the current commercial mesh. These participants felt that by incorporating a similar design to both the current mesh used in the NHS and human tissue was its biggest advantage as it created a "*best of both worlds approach*". The design of the MNM pleasantly surprised most participants whether they favoured its use in their care or rejected it, because it was unconventional but unfathomable as something that is used to repel insects can be more suitable for human tissue. However, one participant expressed feeling confused as they did not understand how the MNM could work in the human body but also how it could repair a hernia in general. The participant felt that the design was flawed because it was "*cheap*", "*flimsy*" and "*unreliable*" as its intention was not for hernia repair but rather rejects something that attaches to it. The repelling nature of the material, its intention, made the participant feel that the human body would reject the mesh upon implantation and thus would reject its use altogether. However, most participants stated that the design was "*innovative*", "*accessible*", "*convenient*", "*affordable*" and "*sustainable cause you have multiple uses for one material*".

Most participants in Group C stated that though the innovation was "*successful*" in achieving a different use for the material, it's COO was its ultimate unique selling point (USP). These participants felt that Africa should be on the forefront of its marketing plan and will add an incentive to adoption in the UK because it was novel in itself to this country. These participants felt that the design was "*truly matched, like to like, it's the only innovation you've [interviewer] presented that is like to like so*

a proper comparison could be made here not like the condom one and Drill cover. All are very good but I think leading with the country will be its most unique wow factor and appeal to different markets like here because it's completely new here…". One participant felt that the design reflected its COO in that because Africa is a LIC, expectations towards its design was low and redundant, "*…it's cause it's from Africa, I can't trust it because I get the design is cool enough to work over there, it's not something we would want over here like it should not be considered because they don't follow the same rules as applied in the UK*". The design of MNM was described as "*cheap*", "*unsafe*", "*not reputable*", "*indecent*", "*unsafe*" and "*flimsy*".

5.2.1.3 Cost

Most participants in Group B felt that the cost reflected the reference to FI. These participants though made the correlation between 'frugal' and 'cost', did not consider cost in their perception of the innovation. These participants felt that the developers of the MNM were "*innovative*", "*inventive*" and "*charismatic*" with their repurpose of the MNM in a serious healthcare need. One participant felt that frugal meant "*cheap*" and "*low-cost*" to the extent where the MNM was described as "*flimsy*", "*fragile*" and "*unsafe*". Furthermore, the participant believed that the innovation was barely an innovation as it simply copied the same technique as the existing one. They felt that the safety and quality of the MNM look cheap in comparison to the ADCS which despite its low cost initiative, did not look cheap and had acquired regulatory approvals and CE marking which enabled them to feel comfortable and thus support it, "*I think unlike the drill cover, this one I know again it's from a poorer country but that one seems more likely or realistic because they've done all the checks needed to get those approvals and the fact that they have and there's a lot of evidence and it didn't look cheap, it's better than this slightly but either way it's not that safe because we need this done here and the materials needs to be approved by the appropriate people.*"

Most participants in Group C felt that cost was proportional to its COO in more ways than just cost itself. Two participants explicitly stated an association between low cost and India in the context of low cost resources and production, "*…they don't have many choices and resources and labour so it's easy to understand why everything is low price in India because if you think about it there's no rule to tell owners [innovators] off about cheap labour not having approvals and what not so because the lack of control is present, it's easier to purchase this way whilst savings costs at the same time…*". The interviewer used a topic initial elicitor to further explore the participants' ethical values to determine 'normative behaviours. These participants stated that the cost did not justify the rejection of all meshes as it was a controversial and irreversible harm to all patients, "*…no matter how much it costs*

I don't want nothing to do with it [meshes] at all it's a basic death wish…no absolutely not never and wouldn't recommended…".

5.2.1.4 Useability

Most participants in Group B felt that the useability was the same as with the current commercial mesh as it solely involved the use of a different mesh. Though there was an initial reluctancy for some participants, they commended the effort in finding something that closely resembled the commercial mesh if not better as it almost mirrored human tissue "*…had you said it was a new material and new treatment altogether I would've have been um'ing and arr 'ing but as you've described it and understanding how similar the treatment is and the material being so similar to our own tissue and that's the only change then it's a clear winner for all isn't it, it's simple and I like simple none faff, and is better for me I mean it's like literal tissue…*" Participants predicted that the useability would be simple and easy to follow as staff members would have already been somewhat aware of the technique with the change of using a different material, "*I suppose this isn't going to require much adjustment as it's only the fabric change so it should be fairly easy to incorporate and use. I think this makes it easier for us [patients] too cause we don't have to wait too long to have it used on us…*". One participant adamantly opposed to answering questions about the MNM's useability as the participant explicitly disliked the MNM due to the involvement of mesh and blatantly disfavoured it's potential adoption, "*I don't like the fact that it's using mesh again but I just can't help but reiterate it as it's actually just that it's a mesh, I don't even care if it's the easiest thing to use or brings about amazing benefits, not interested and I hope it's not easy to use because having this in the NHS is scary…*".

Similarly, to Group B, most participants in Group C provided positive feedback about the presumed useability of the MNM describing it as "*efficient*", "*simple*", "*easy to train*" "*effective*", "*alright*" and "*replicated*". Though one participant strongly disfavoured the MNM based on the COO as it was associated with below minimal standards across many factors, they did rate the useability to be simple to implement but too complicated for them to understand. Furthermore, it was stated that this information should be reserved for clinical staff as it was not necessary to know from a patient perspective. The participant felt that patients only need to know about things that effect their outcome, safety, risk and follow-up care or aftercare, "*…I think all we want to know is whether something works or not, is it safe, what's the risks, what is needed after the surgery, anything more is not needed, this is too technical for me and I don't think most people will want to know…maybe now I'm thinking do I want to know as it's from India, it's one that I would do more research in but not like this more like how it's made, chemicals involves and what not…*".

5.2.1.5 Clinical Effectiveness

All participants in Group B felt that the extent of the clinical evidence and research was partially limited and needed more regardless of whether they favoured the MNM or not. Whilst most participants were optimistic and positive in their narrative and description of needing more information before it could be used by their doctors, as third-person requirement, *they assumed the doctor would need more information*, some participants were confidently negative and discouraged by the "*lack of research performed*". These participants explicitly expressed their fears and concerns of using a low-cost, "*cheap*" innovation in surgeries due to the lack of further research. The interviewer had prompted whether these participants knew or assumed the cost of the current commercial mesh and whether they knew or assumed how much clinical evidence the current mesh had acquired. Participants felt more comfortable with the current mesh because they did not know the cost nor how much evidence it had but presumed it would be sufficient as it was used in the NHS for decades and for other medical operations such as stent placement in the Heart, "*no not really and I don't need to really think about it, the NHS is using and have been for I don't know ten plus years so I can trust it because that would be research and data in itself right and it's been used in the Heart for those stent things, my father in-law had one so this is more trustworthy I can't complain but your saying this is cheaper and it's been in use for how long and never in the NHS, you can't expect me to trust it. It's all about the knows…*".

Though most participants stated that clinical evidence was perhaps the most important and valued element of MNM, one participant believed that all meshes were harmful regardless of intent in the human body. The participant explicitly stated that had data been collected properly and for longer periods of time then perhaps meshes would have never been used in the medical setting and cause irreversible damage and significant injury, "*…this was the problem with the vaginal mesh and all meshes, these things should have been further researched and discussed for maybe even decades before it's use because it would have revealed that it's not safe to use and should never been used in humans. It's so foreign it's not meant to work at all and it doesn't, I would say this net mesh needs it so it can prove that it doesn't work and that all meshes need to stop being used…*".

Most participants in Group C stated that more research and clinical evidence was needed though they favoured the MNM and spoke positively about its COO. The interviewer had prompted further questions to explore whether the reputation of the COO influenced the acquired clinical data. Few participants expressed that though the reputation of the COO mattered to clinical evidence, it also influenced every aspect involved when developing innovations because it facilitated the process of

innovation identification, development, management and distribution such that these participants stated, "*I guess it's a given India influences these questions because it quite naturally dictates why the innovation is in demand and how it can be made with what's available and getting the proper licensing and distribution to all, I do like the net mesh, it has a lot of work to do, I don't know much, but it sounds like it needs more but I still like it and want to see where it goes…*". The clinical data was seen as a significant "*pushback*" from India as there were no acquired patents, approvals, country driven data and longitudinal risk analysis on MNM.

5.2.1.6 Shared Decision-Making

All participants in both Groups B and C shared the belief that all must be involved when making decisions about its use and overall acceptance as it involved an implantable device that could affect their everyday lifestyle and health. Though many of these participants expressed feeling overwhelmed with having vague access to this information, they still welcomed the discussion between the doctor and patient for full transparency and the decision to accept the mesh for hernia repair. Most participants stated that typically a discussion is had to inform patients about how the surgery is planned out, what to expect, pre- and post-surgery instructions and follow-up care. Within some of these meetings, some participants stated that they would expect to have this discussion with their doctors sooner rather than later but with a patient-cantered approach as the information is tailored to the patient, "*I agree that this type of information is needed but not this much maybe even just keep it for the doctors or other clinical staff because I won't get it and still don't. I think my eyes become larger when you mention things like India. This is where the surgeon needs to have this information so they can make definitive choices for us and keep us safe.*"

5.2.2 NHS Staff

5.2.2.1 Risk

All participants in Group B rated the MNM as high risk due to its primary intention. Some participants felt that all implantable devices and materials are high risk as anything foreign to the human body is associated with an increased risk, "*anytime you have something that's not suppose to be in there in the first place is gonna be high risk, but that's normal and we know and are trained and experienced enough to deal with it…*". Risk is particularly high when a mesh is used because it's associated with increased risk of mesh migration, mesh contraction, hernia recurrence, adhesion, pain, infection and bowel obstruction. Furthermore, one participant felt that the risk is even high than typical commercial

mesh, as not much research has been conducted on the MNM and it's not been used before in the UK so the unknown expectations make the MNM even more high risk, "*I'd say this mosquito net mesh is even higher risk than the ones we use now because you'll find that you've got complications already with mesh migration, mesh contraction, hernia recurrence, pain, infection….we don't know about these occurrences or likelihood with this innovation whereas we do now with the current ones so I think when we don't know too much about something we instantly deem it high risk especially if it's so similar to what we have which is already high risk…*". One participant expressed a more general and nebulous concern with the MNM, though most participants remained positive towards the innovation, "*when it comes to surgery any surgery it's immediately a high risk treatment so this would fall into that category and so it's high risk.*"

The risk perceptions of MNM for all three participants in Group C was deemed a high risk but expressed in a positive dialogue, "*to be fair it's a great opportunity to use something that we haven't used before and from what you stated granted it needs more data but it's a start to showing promise and you know it's performing better overall against the current NHS one but it would still be high risk for the fact it involves surgery and an implant.*" One participant generally felt that the risk would perhaps be substantially higher because it was a technique or device made in a LIC with limited findings, though the participant did express positive thoughts about the innovation, "*I have to realise that it's probably more risky because a country that's lacking in research and development and scientific data are behind this innovation. Don't get me wrong it's a great innovation because your using something out the ordinary and it's performing better, but the reality is that this is a slow burning process, it needs rigour, is a laborious task to perform, complete more trials and work on the innovation a tiny bit more before it can be used or talked about here.*" Another participant, similarly, to Group B, provided a vague risk perception of MNM describing it as, "*it's surgery, anaesthesia, it's already high risk, and you need I stress not enough you need more data to be considered for anything like that in the here…*".

5.2.2.2 Design

All participants in Group B provided positive feedback about the design of the MNM. Most participants highly valued the ability to get a "*like to like composite*" whilst being low-cost, "*I'm happy actually with the design, when you said mosquito net mesh, I actually wasn't that all surprised but I was when you talked about the details like the pore size, weight how like to like composite they are I wouldn't have known. I would've thought it would be more expensive if it tried to get a mirror image of our mesh but seems like it's done that by itself and still cheaper, you can't go wrong…I like it…*". These participants

mentioned that the design was not important as long as the functionality was optimal, "*the design is to be built around the purpose so if the mosquito mesh as it is can do the job perfectly right then great, we have lift off but if it includes so much hassle and fiddling around then it's probably not worth it. We have to consider the texture manoeuvring around, sterilising the mesh ready for inspection and insertion, it's a lot of things the design needs to consider…*".

The design element of the MNM was more focused on the innovations' COO. All three participants in Group C concluded the design of MNM as a positive development from India into the world of medicine. The mesh was described as "*lightweight*", "*practical*", "*durable*" and "*ideal for sustainable*", though participants made it clear that these were projections not reality as they could not feel and see the MNM in real life form. The approach to sustainability was commended and translated as purposeful for one participant as the MNM not only added further advantages to reducing recurrence rate, readmission rates and length of hospital stay but also increased multi use for one item and it's consequential accessibility whilst keeping costs lower than for the current mesh, "*it's an ideal situation, you've got a low cost multiple use for mosquito net mesh that can supposedly reduce so many complications or fairs better at least from the data you mentioned, one stop shop type of design, it's practical…*". Most participants stated that the design of the MNM was one that was similar to the current mesh and stated not feeling much significance to it, "*it doesn't affect me, how it looks, colours, shapes, the only thing that matters is that it works and I can use it and the surgical team can prepare it, that's all…*". However, the MNM was thought of as a "*forward-thinking initiative, it seems durable and lightweight, simple to use that's all you can ask for…*".

5.2.2.3 Cost

Participants in Group B stated that the cost for the innovation was as expected for the use of a MNM and the reference to frugal. Participants felt that though the cost was expected to be low in comparison to the current mesh, it "*may outperform the current mesh based on the clinical data provided*". All three participants generally expressed an inessential evocation towards cost as it was the least important factor in innovation adoption. The main importance for all the participants was that the MNM performs accordingly to the intended purpose and not focus on the cost as the primary objective. Though frugality had a positive association to cost, participants did not feel that this relationship was significant. The COO has little significance to the cost of the MNM for all three participants in Group C. Cost was the least concerning element of the innovation, similar to those in Group B. Though the MNM itself reflected the low-cost initiative as it was accessible, affordable and

multi-use, all three participants stated that the cheaper alternative did not fail in their efforts to improve hernia repairs and were excited to use the innovation in the future in the NHS.

5.2.2.4 Useability

All three participants in Group B stated that the useability was easy to understand, simple, precise and concise. Though the useability was described as "*user-friendly*", it did not involve much information other than its composition and limited clinical data. More information was needed for its application and preparation which was not necessarily provided in detail. It was believed that the limited information was perhaps attributed towards it being a FI in that because the innovators focused on keeping costs low and limited, not much information was tested nor provided about its use and application. The pre-conditions to the useability was deemed just as important as the application, outcomes and risks, such as training, clinical testing, side effects, manufacturing, importation and sterilisation. This, FI, associated with cost, was also translated to the pre-application conditions.

All participants in Group C felt that the useability of MNM was sufficient, practical and efficient. The COO was commended for its ability to develop an effective innovation with a similar application to the current mesh. A topic initial elicitor was used to explore the commendable narrative to the COO and innovation development. Most participants stated that India was not typically seen as innovators and therefore their development of the MNM for hernia repair was advanced and innovative in the field of medicine. The unconventional ideas and devices are what makes innovations novel. The useability of MNM was described as "*clear*", "*transparent*", and "*similar to the NHS mesh*". The limited useability or the "*non-fidgety*" steps was part of its culture in a LIC as resources are limited and the need is imminent. It was said that the UK has the "*luxury of time*" so they could invest in research and development and often incorporate nonessential components to make it look more attractive and appealing.

5.2.2.5 Clinical Effectiveness

All three participants in Group B stated that though the MNM is a positive step towards medical advancement and growth, the innovation still needed more clinical data and that the expectation would be the same for all innovations regardless of category e.g., devices, services and products. The clinical data obtained was not associated with the reference to FI unlike the COO. Participants all required further data longitudinally as all felt that the data collected was not substantial enough to completely assess the risks and expectations. Most participants also mentioned that the limited data

reflected its previous usage which came across limited in itself. Further data would be needed and regulated if it was to be considered for use in the UK as it already had apparent associated risk and further risk may be identified alongside complications with infrastructure, "*you definitely need more and it's a lot more, it's going to be expensive so I don't know whether this would still be classed as frugal because the mosquito net mesh will have to go through years and a lot of people to be able to be used here. You need to identify further risks other than the obvious ones…you will need to pilot this to figure out complications with the dynamic and safety and infrastructure whether it will work or create more issues for the NHS, maybe you'll need more staffing…*". It was agreed amongst all participants that this needs to be trialled in the real-time and documented for further clarity and assessment to be considered for use in the NHS.

Similarly, to Group B, all participants in Group C expressed the requirement for more clinical data. All three participants stated that the functionality and clinical data was the most important and significant elements of any medical service and product irrespective of the demand. Most participants felt that the COO circumvented the need for the innovation and therefore clinical data was limited. These participants attributed the lack of data to the COO and the need to invent an adaptive approach to repair hernias, "*…it's probably cause it's an Indian sought innovation, it needed the mesh to work so much and for some many cause of money or whatever the issue is was and sometimes when you have some data that's enough data to keep going but the reality is that, that approach doesn't work here you couldn't get away with that, you'll have push back after push back just for data and maybe design more so, so more data is needed if you want to jump start this whole thing here…*".

5.2.2.6 Shared Decision-Making

All staff participants in Group B felt it be unnecessary to inform patients about the use of the mesh as it is not within current practice to discuss the type but more so about the use of mesh itself. Most participants felt that most patients if not all will not care to know about the specific type of mesh as the information would not benefit them nor will they understand the technicality of the mesh. One participant though favoured the MNM, stated that "*…our patients won't understand the details and importance of the equipment and devices we use, we don't talk to them about the ECG, ultrasound equipment, we simply just say this is what's needed and here are the instruction…of course we provide more information on an information sheet about what things are but we don't expect them to read it or understand it hence why we talk about it in general…*". All three participants wanted to be involved in innovation implementation into the NHS as currently, their individual views and opinions are not considered unless it is a significant consensus among staff, "*if we can't agree on it then it's most likely*

stripped say if I wanted this mesh and others didn't or maybe 3 of my colleagues out of 15 wanted the mosquito net mesh, it wouldn't get incorporated unless maybe 13 others agreed…it's how it works, like this in the NHS…".

All three participants stated that whilst having complete control over medical decisions is great and encouraged for all patients, providing information and gaining consent to use one particular mesh over another is not required nor recommended. The additional information and technical guidance falls redundant when patients cannot understand it not asked for it, "*…there's no point giving the patient this info because firstly they haven't asked for it and in all my years of work, not one single patient has asked me about anything to do with their surgery other than the risks involved, they won't ask because they simply won't understand it…*". All three staff members shared a common need for involvement in innovation implementation. The involvement of staff's opinions and perspectives including trialling and testing was perhaps more important than the cost because if the innovation lacks all functionality but is cheaper than it reduces its own need, "*…for me I can't speak for my colleagues but I'm sure they'll agree, trust me, we want to be involved and be the ones to make the decisions of whether to have it used permanently because we don't have the primary goal of just saving money rather we are about the saving of lives the reason why we got into the job role, if we could do both then great but ultimately if we can't do our job because something is cheaper than what's the point in this discussion…*".

5.3 Group D (No Frugal and No COO)

Participants in Group D received information about the MNM, however this did not involve any mention of the term 'frugal' and its 'COO'. These participants were not given any information nor cues about its COO.

5.3.1 Patient Representatives

5.3.1.1 Risk

All seven participants expressed concerns and enquiries about the safety and risks associated with the use of MNM. The main concerns were attributed to its intent and purpose being a "*commercial material*". As the intention was alternated to be implanted into human bodies as opposed to repelling against insects, the risk perceptions were heightened due to the unfamiliar application, "*I think as with anything new I'm gonna be more weary and conscious of the safety with it, is it safer with the mosquito*

net mesh or no, I think if we switch the use although I think it's great, it might just make it more risky as it's not intended that way…". Some participants stated that that the risk was reduced based on the clinical data presented and the purpose of developing an alternative method, "*I think the mosquito net mesh is less risky cause why then come out with something to increase the risk or keep it the same and why have it exist in the first place when the goal is to make things safer and better altogether…*".

5.3.1.2 Design

All participants in Group D stated that the design looked "*high-tech*", "*sophisticated*", "*slightly humorous*", "*savvy*", "*smart*" and "*simple*", "*it is what it says literally a mosquito net mesh I mean the design is simple as well as its name, that probably also tells me that it's one of those things that keeps things real simple and clean and probably is safer…*". The design of the MNM made it look "*innovative*", "*contemporary*" and "*futuristic*". The interviewer had asked all participants about the importance of innovation acceptance and what elements were the most important for them when making informed decisions about their healthcare. The design of the MNM was important for most participants because it was an implantable product and consequently these participants felt that they were receiving tailored care and made them feel more secure in trusting the MNM but also valuable as a patient. All participants stated that they would accept the use of the MNM in their care because it made them feel part of the innovation implementation journey and medical evolvement. Some participants stated they would simply accept its use knowing it was "*innovative*", which meant "*brand new*" and "*first time use*".

5.3.1.3 Cost

Cost was considered a significant theme when exploring the perceptions of the MNM among patient representatives in Group D. Cost was directly associated with design, functionality and sustainability in that the design and functionality lead the interpretation of cost. As the MNM was perceived to be multifunctional, this aspect added to its expensive appearance and the product itself. Almost all participants believed that the MNM was more expensive than the current mesh used in the NHS simply by its appearance and usage. The presumption of its COO also added to the "*expensive*" but positive narrative as the majority of the participants felt that internationally produced items were more "*richer*", "*advanced*" and "*expensive*". Some participants considered the cost of importation fees, training, staffing, preparation of the mesh and sanitisation equipment which added to the presumed expensive nature of the MNM.

5.3.1.4 Useability

The functionality and useability of the MNM was an important aspect for all seven participants which was associated with risk and cost. As the useability of the MNM was an additional feature, *repelling insects*, the cost was assumed to be greater than the current commercial mesh. When a product has multiple functions, it is associated with higher cost but still exerting the positive narrative such that multiple functionality and easy useability is an advantage and a sign of prestige. Most participants stated that the useability was advantageous and easy to understand. This also translates to the assumed ease of use for surgeons, "*if I can understand how it's fairs with this one we have in the NHS, the bottom one [reference to image on screen depicting the current commercial mesh], then I can imagine how easy it must be for my doctor to use it in hernia repairs, I actually really love how different it is and abdominal and the fact that you can use it for different things…*".

5.3.1.5 Clinical Effectiveness

Clinical effectiveness was deemed to be an important factor for all participants in Group D when choosing to accept its use in their care. Clinical data was used as a way to understand the information about risks, cost, useability and design. Such associations among the themes relays the importance of one aspect on others in regards to understanding the content presented. For instance, clinical data was used to understand and evaluate cost and risk in such a way that it would reflect risk perceptions, if the clinical data showed more successful rates and limited risks, then participants would rated the MNM as a low risk innovation, likewise this would indicate the same for costs, if the MNM showed higher success rates, conducted in many countries and for long periods, acquired regulatory approvals, it would indicate an expensive innovation. "*…I'd say that it gives me more comfort knowing that it is successful or at least more successful, it's more encouraging for me to believe in it when it's more versatile and compatible for everyone so less side effects and can do so many other things because then I know it's safe in all aspects so overall it must be safe to use. Strangely enough it also doesn't hurt that it looks expensive and highly innovative like dura me with other things…*". Though all participants felt that the clinical data already collected was sufficient to indicate safe usage that subsequently led to all accepting its use in their care, one of these participants initially felt uncomfortable as it was a new innovation that included a new use which it was not initially developed for.

5.3.1.6 Shared Decision-Making

All participants expressed their confidence in making informed decisions about their healthcare and wanting to be involved when making decisions about alternative choices. Almost all participants mentioned that unlike their consultants, they know what it feels like to experience certain situations and lifestyles that influence their choice and thus want to make more decisions about their healthcare. Some participants expressed wanting access to information as opposed to researching it themselves to make decisions, "*…I would like the information like you've presented here and then make my choice I think if I was to search it myself I wouldn't get it it would be too overwhelming and then I'd just be lost and leave it up to them which is what I don't want*". Majority of participants stated that they already requested access to their medical information to keep updated and maintain their right in making informed decisions, "*…I believe when the whole process of online medical access came out, I requested it right away, it wasn't the easiest process but I did it and got it and right away went to the file to read what they recalled in my recent appointment and could see my blood test results. I recently was looking at herbal medication and wanted to see if it was compatible with my blood results. It's this sort of thing that allows me to make these choices even though it's not as serious as an operation with this mesh but could do it with this too…*".

5.3.2 NHS Staff

5.3.2.1 Risk

All three staff participants stated that the MNM was a high risk innovation as with any equipment used in the healthcare capacity. The MNM was particularly rated high risk as with the current mesh as it's an implantable device and foreign materials to the human body will always remain high risk irrespective of its advancement, cost, design, functionality, reputation, efficacy and quality. These participants though favoured and welcomed the use of the MNM, all required more information about its clinical data and the technical mesh properties, "*…what you've presented here isn't nowhere near enough even for me who doesn't really decide on things being used in this field, I mean yeah my opinion is sometimes considered really rarely but I don't get to decide and it's not on me but for me to use it and be comfortable with its expectations I need to know much more like what is the actual mesh made out of, is it stretchy, durable, can it withstand tension when flexed it's all of this that's the greater capacity of factors to think about and really grasp…*". Accounting for all three participants, risk was associated with the clinical effectiveness theme in that with each discussion about risk, clinical data was mentioned and navigated such perceptions of risk, "*…you can't assess risk without thinking about*

the data the product has acquired over time…with this mesh, I can't see it be enough but that's not to say anything bad against it or it's prospect in the UK, it's just not merely enough to get a real grasp on risk and that will affect how people think about especially me who has to work with it, you know I would want to know the technical nitty gritty stuff and the preparation methods stuff like that, how has it impacted the patient etcetera…", "*it's difficult for me to understand the risk involved when the clinical evidence provided here isn't conclusive and not really longitudinal, an equipment like the mesh and medications need to have a long history of tracking events like risks, complications, side effects, this isn't giving me that so that will be an issue…*".

5.3.2.2 Design

The design of the MNM was not considered a significant theme but was involved in some discussions about the perspective on costs, useability and risk. Though perceptions of risk was isolated from every theme except for clinical data, the discussions about the design involved information about its clinical data which directly impacted the perceptions of risk, *working reciprocally and indirectly*, "*…the design is standard of a mesh so nothing really stands out to me, when you mentioned innovation I expect some change or at least majority but this one doesn't seem like it has a major change, but it also tells me that cause of the design being similar and not really changing much from what we use now, the data it's got may indicate the same level of risk so I'm not saying it's far higher risk but maybe it's the same because the design is the same and that's why the data you've got may just show the same results too in the early phases on trialling…maybe it shows that there's not much money to back it if the design is almost the same and data is limited maybe this makes it more unsafe for use*". Most participants stated that the design falls redundant in making decisions to accept an innovation in their practice unless it affects the practicality, functionality and efficacy of its use. Design was described as "*simple*", "*unchanged*", "*relative to functionality*", "*easy*", and "*normal*". The majority of participants insisted on feeling the material of the mesh before considering its use in the UK, to evaluate its performance and quality to then assess its functionality and efficacy performance.

5.3.2.3 Cost

Similarly, to the design theme, cost was not considered a significant component to influence the decision to accept the use of the MNM into current NHS practice nor did it impact participants perception of the MNM itself. The term 'cost' was barely evoked and only used in the context of discussing design which was associated with the perception on its clinical evidence. The MNM was only presumed to be a low-cost innovation because of its limited evidence and perceived small

changes to design as it still involved a mesh for one participant. Though the participant provided positive reviews of the MNM, the low-cost reference did not alter or damage the perception of the innovation as a whole. The low-cost perception rather vindicated the limited clinical evidence and excused the minimal changes to the design of the MNM. However, the participant did question whether the low-cost initiative was to blame for the lack of changes made and the limited evidence acquired. Though cost did not appear to affect the participants view of the MNM's quality, its safety and risk was questioned because of the limited evidence obtained which was assumed to be driven by keeping costs low. However, the participant believed that this was just an assumption and not factual and therefore perceived the MNM to be a good positive innovation overall, "*…it's safe to say that it's just a possibility, an assumption as I don't know what is holding up more data providing it's been around for some time…I do really think it's a great way to proactively use other things around us that just makes sense and works and who cares if it looks the same and maybe a little cheaper cause it's a mosquito net mesh over a medical mesh, as long as it does it's purpose I'm fine with it…*".

5.3.2.4 Useability

All three participants felt that the useability faired similar to the current mesh because it didn't do not differ significantly in terms of design and performance. All participants in Group D stated that the useability would be rated higher if its clinical evidence showed a vast improvement in the outcomes, risks and complications. The useability theme was directly associated with the clinical effectiveness theme in that all participants stated that the true functionality of the MNM is made transparent through its clinical evidence to which was reviewed as limited, "*…you can't really tell if it works as good or the same or even bad because there's not much to go on, I can only assume it works the same maybe slightly better otherwise there would be no point in this innovation discussion and that it fairs very similar to what we currently use by design.*" The useability did have some association with the design theme such that it's functionality could not be assess without reviewing the design, *the simpler the design the simpler the useability and higher functionality*, "*…the design doesn't really matter unless it's going to trigger its ability to be practical and functional for example if you add in a lot of different elements to make it look all pretty and with bows on it, it's doesn't practically make sense it just wastes time and money…this looks pretty simple and clean so I would assume that it's functionality, usage is the same…*".

5.3.2.5 Clinical Effectiveness

All three participants stated that the level of clinical evidence was low and were adamant that without further testing and research, this could not be implemented anywhere in the world irrespective of the NHS. There was much importance given to the clinical evidence and trial data such that it appeared in almost every theme. The body language and facial expressions exerted when discussing clinical evidence was strongly confident and spoken in a passive tone in that all staff participants valued and understood the importance of data in using such innovations. All three participants expressed that the clinical evidence is the first thing that brings their attention to a new product or service, "*…if it doesn't have enough evidence to show it works then I'm automatically switch off I don't want to know anymore because it's a complete waste of time entertaining an idea you have no idea works, it's nonsense then…yeah we might see the design and think oh what's this and then I grantee everyone will ask so tell me more about the data, then how does it work almost going backwards…*". The more clinical evidence an innovation acquired, the better and positive perception an innovation will receive as this indicated the status of success and comfort to acceptance, "*…all I need this to have is more data for me to confidentially 100% tell you yeah I'll be happy to use it because without more research and data I'd be reluctant and uncomfortable with it altogether…you've got early signs of potential but I need more than this…*".

5.3.2.6 Shared Decision-Making

The shared decision-making theme was not a significantly reported theme, though it was mentioned and provided an insight to typical procedure when a new product is introduced. The theme also provides some indication on the natural behaviours elicited by the staff member which can demonstrate confidence in decision making and the trajectory of supporting innovations with and without the consolation of patient agreement. All three participants stated that they do not typically look for consent regarding whether to use a mesh as it's standard treatment to repair hernias. All participants also stated that they do not discuss any details about what is used other than when explaining what the procedure would entail and mention a mesh is used to repair the hernia. No patient has ever asked the staff members about what type of mesh is used or expressed concerns over the specific type, though they have expressed concerns about the mesh itself being used to which some patients were described as feeling "*more scared*", "*more nervous*", "*worried*", "*anxious about rejection and complications*", "*worried about recovery and healing*", "*stressed about disturbance to lifestyle*" and "*scared about another operation*".

Summary

Though the MNM was rated as a high risk innovation by the lead researcher due to its implantable nature and need for a surgical intervention, most patient representatives in Group A rated the MNM itself as low-risk due to its simplicity and similarities to the current mesh, whereas its application was rated as high-risk due to its need for a surgical intervention. Most participants provided a positive perception of the MNM as they felt confident with its use due to its technical composition, success rate and longevity compared to the current mesh. Though frugality may have dampened the overall perception, the term 'innovation' improved it perception to describe futuristic and advantage. Its COO influenced perceptions about its design, composition similar to biological tissue, useability as it still involved the use of experienced surgeons unlike Sayeba's method which sought to somewhat replace them with less experienced staff and clinical evidence as it was referred to as "*trustworthy*" and "*rigorous*" due to its widespread use and clinical studies. Though these participants were provided with the frugality cue, which is often associated with cost, they were not concerned about it due to the advantages of the MNM. Though some felt that cost reflects quality and MNM was an affordable alternative, it was ineffective because it looked cheap and was developed in a LIC. These participants believed regardless of how strong the clinical evidence; it was not suitable for the NHS particularly if both were similar to each other.

Some participants felt that the COO was critical during decision-making because it was autonomous in that a natural response to considering where the innovation came from resulted in the judgment of its quality. Though most participants appreciated its widespread use and clinical data, more was needed before it can be considered for use in the NHS. Here, the clinical data was compared to that collected for the ADCS, such that if it was possible for the innovators' of ADCS to conduct such studies, it should set a precedent for other LICs to do the same, particularly when it involves an implantable device or material. Furthermore, few participants believed that the data would not be sufficient and valid as it was derived from an LIC. In contrast, staff participants in Group A, felt that the risk was the same to that of the current mesh due its foreign material and further added that if the MNM was unsafe then it would not be used in its COO nor anywhere else. Some staff participants believed that the only risk associated with the MNM was the acknowledgement of its COO, which could negatively impact the true perception of the innovation. There were no significant associations between the external cues and the design, cost, and useability of the MNM such that it was discussed in its own respect. Though there was no associated between the COO and clinical evidence, all staff participants required more longitudinal clinical evidence with a particular focus on the UK population.

Frugality did not significantly facilitate patient representatives' perceptions in Group B, though a few participants felt that the NHS should not need to look for affordable options at the cost of employing high-risk innovations such as the MNM. Though discussions about frugality was conflated with costs, most participants did not consider cost in their overall perception of the MNM. Similarly, staff participants were generally unresponsive to the 'frugal' external cue except when discussing cost, though this did not negative impact the perceptions. On the other hand, for patient representatives in Group C, the COO did have a significant impact on shaping perceptions such that most participants felt that the MNM offered a better advantage overall than the current commercial mesh due its innovative properties explored by a LIC. Some felt that the UK had become complacent on using current methods because they worked rather than improving the outcomes for patients in the long-term as discovered by the innovators of the MNM. Here, the COO was a driver of perceptions towards the MNM. For staff participants in Group C, the COO facilitated the perceptions about the design and clinical evidence. Many of these participants applauded India's efforts to improve surgical complications and longevity of hernia repairs. The COO was also used to circumvent the limited clinical data obtained and was referred to as being "*expected for India*" due to the cost and resources. Though they did require further testing, the overall perception was positive, and acceptance was favoured.

Though all patient representatives in Group D expressed concerns about the risks associated with the MNM, all participants stated that the design of the MNM looked "*high-tech*", "*sophisticated*" and "*savvy*". Cost was directly associated with the design, functionality, and sustainability in that the design and functionality lead the interpretation of cost which was positive. All participants in this Group, felt that the clinical data obtained was sufficient to demonstrate safe usage and effectivity. In contrast, all staff participants rated the MNM as high-risk but as with any medical equipment and particularly as it is an implantable mesh. Though they favoured and welcomed the use of the MNM in the NHS, they also required more information about its clinical data and the technical mesh properties. The cost, design, useability, and shared decision-making of the MNM was not considered significant and received little criticism. In contrast, staff participants felt that the clinical evidence obtained was low and contingent upon its implementation or adoption anywhere in the world. It can be questioned whether the degree of clinical evidence is associated with the endorsement of a HIC such that if a HIC supported a FI, would there still be a need for robust and rigorous clinical evidence and if so, the extent to which is deemed sufficient and reliable. The next chapter outlines the perceptions towards the ADCS which does involve the endorsement and support from HICs.

Chapter 6: Results for Arbutus Drill Cover System

This chapter examines the qualitative responses pertaining to the perceptions of Arbutus Drill Cover System (ADCS) for orthopaedic surgery. During the collation of these results, participants were presented with information about the ADCS to which all were encouraged to take notes during the presentation and note any questions they may want to discuss during the interview section of their participation. Interviews followed directly after the commencement of the presentation. The content of the presentation varied accordingly to our factorial design of four Groups, whereby each Group were presented with either or both external cues (Groups A-C) or none at all (Group D). The analysis considers how patient representatives and NHS staff respond to the FI, though staff were only provided information about the ADCS as opposed to patient representatives that could compare this FI with the others e.g., Sayeba's method and MNM. Furthermore, the analysis of responses was grouped by six overarching themes of important components affecting perceptions e.g., **risk** (grouped with expectation and invasiveness as it was a prospective interpretation and measure), **design** (colour, ruggedisation, porosity, material, and weight), **cost**, **useability**, **clinical effectiveness** (clinical evidence, success rate, failures, complications, and side effects) and **shared decision-making**. Grouping of themes are mentioned where some themes included a combination of the overarching themes. Throughout some of these themes, vignettes were used to elicit responses i.e., exploring expectations, risk, and invasiveness. The chapter is divided according to the four Groups, merging both Groups B and C together, and further spliced by responses from patient representatives and NHS staff.

6.1 Group A (Frugal and COO)

Participants in Group A were presented with information involving the term 'frugal' and providing information about its COO.

6.1.1 Patient Representatives

6.1.1.1 Risk

The COO encouraged a positive risk perception in which participants were less risk averse in comparison to Sayeba's method. ADCS was rated low risk as it was practical, had a portable setting, and already implemented in some countries and gave participants the confidence in accepting it. The assurance of having only a senior experienced level staff using the innovation allowed participants to feel more at ease and comfortable.

Risk was discussed in the context of safety, infection prevention and management, complication rates, tool or component malfunction rates and sterilisation process and time. The process of involving two people to complete two separate roles in order to control the risk of contamination and subsequent infections and bacteria spread was indicative of how ADCS is low risk. The ADCS controlled risks as current sterilisation procedures may not be able to sterilise bodily fluids stuck between the crevices of buttons and notches of the drill thus the inclusion of such material incorporated an extra layer of safety and hygiene.

The trialling of ADCS and its current implementation in different countries reflected its safety. The acknowledgement of its use in the Canadian military provided an imagery of its practicality, performance level and avoidance of risks. If ADCS could be use in less sterile environments such as within military settings and had an absence of any reported side effects, the innovation must be deemed as low-risk. Participants stated that the ADCS considered every aspect of potential risk and mitigated such concerns through simplification, material composition and sterilisation. It was believed that the innovators of ADCS did not spare costs to develop an affordable innovation and ensured associated risks were prevented or at least reduced.

On the other hand, the opportunity for hardware drills to be used in conjunction with the innovation or potentially replace incumbent existing alternatives such as the Stryker drills, was a critical factor in the decision to dissent or reject its use in their care. Such high-risk perceptions were coupled with profound and expressive negative body language and facial expressions. These verbal and non-verbal perceptions were immediate from the utterance of "*compatible with hardware drills*".

All participants were asked what the term 'risk' meant to them. The most mentioned and important aspect to risk was safety and hygiene in the context of ADCS. The level and degree of risk was reported as different to that of Sayeba's method as risk could not be completely assessed as some were proxy to the innovation and not the target service recipient as opposed to the ADCS which was catered to all patients. Participants felt connected to the innovation because it did not apply to a specific gender and was applicable to all ages everywhere. Furthermore, as the innovation was compatible with the use hardware drills to perform orthopaedic surgeries, it was easier to understand and digest the information presented as it did not involve any technical aspect. This information and inclusion reflected a positive risk perception because they felt they could make sound and valid judgements and interpretations of ADCS.

6.1.1.2 Design

Most of the positive perceptions about ADCS was attributed towards its design. The design of ADCS shared many overlapping perceptions with several different themes i.e., risk perception, frugality, COO, costs, useability and clinical effectiveness. The clean and aesthetic imagery of ADCS provoked a positive discussion about the innovation. Prior to this, participants stated that the design was "*surprisingly, but pleasantly shocking*". Once the utterance of Africa and frugal was evoked, most participants expected the design to be cheap looking, using loose and thin materials and not well developed. Some participants stated that they had expected a more colourful design with transparent, thin and cheap material.

Perceptions of ADCS were compared to Sayeba's method, as Sayeba's method looked and felt like a FI, whereas the ADCS illustrated a "*shiny new clean drill system*", demonstrating modernism and technology advancement. The name 'Arbutus' sounded futuristic to the participants, which provoked questions about its costs, design, functionality and development. The clinical data obtained and usage in the Canadian military was not expected for an innovation developed in a LIC. These "*surprising*" expectations were seen as advantages and intrigued the participants to learn more and ask further questions.

Participants expressed that the occurrence of a global pandemic allowed them to be more open minded about innovations developed in LICs because of their "*clever ideas*". HICs cared too much about policy, politics and financial greed whereas those in less developed countries like Africa, put the people and their health and safety first and should be examples to the rest of the world.

Some participants were more expressive and elaborate with their responses when discussing the design of ADCS as "*modern*", "*sophisticated*", "*clean*", "*aesthetic*", "*robust*", "*durable*", "*strong*", "*portable*", "*expensive*" and "*compact*". Though all of these perceptions and descriptions were positive, the colour blue was recommended to be changed to white as it would align itself with medical technology. Most medical associated devices, materials and equipment would either be transparent, white, or opaque.

Most participants did enquire further about the maximum number of cycles for each cover before it is disposed. Alongside the exploration of the individual design features, cost was conflated amongst responses. All participants asked further questions about how the material was found, how it is sterilised and how much it costs to manufacture and sterilise each cover. Once receiving responses to

such questions, participants would naturally dissect individual visual features of the design. Though most participants favoured the ADCS and its use in the NHS, some did express some level of reluctancy surrounding the space or loose fabric of each cover. There were concerns about whether the surgeon would know which button to press and the different functions of the drill, as the fabric surrounding the drill appeared to be loose and obscured.

Participants noted that the material being somewhat "*waterproof*" gave the cover system durability and therefore made it more robust, withstanding different temperatures and bodily fluids. Most participants stated the design looked safe and flexible, some assumed, this would allow the surgeon to perform surgeries more effectively. The material was perceived as being breathable, for transfer of heat and soft enough to allow the surgeon to control the drill through the fabric without any hinderance, which made it acceptable and appropriate for use in the NHS.

The cover system was presumed to prevent the natural wear and tear of the expensive NHS surgical drills, which prolonged the lifespan of the drill itself. Participants felt that the linen emulated a "*doctor scrubs*" in terms of the colour and choice of fabric. Though participants acknowledged the complexity of surgeries in general, they felt that this aided in the turnaround times, application, and safety of all surgeries as the cover system prevented and control multiple factors that could cause catastrophic events.

6.1.1.3 Cost

FI in the NHS was seen as advantageous because it helps alleviate its current pressures and allows for the addition to outsource in regards to improving and increasing innovation development and inclusion from LICs, "*if we support restructuring low-income countries when faced on by hard times and destruction like the environment relief stuff, then why not support them when they also need it most as a whole by allowing and increasing awareness of these innovations which are absolutely wonderful and effective and efficient with so much evidence.*" FI was seen as being clever and more resourceful with creating innovative solutions that are affordable but does the task as effectively if not more than expensive innovations.

Most participants expressed some degree of excitement as the innovation was significantly more affordable when it's used as a whole system as opposed to just the cover system. All participants were positively surprised by the package offer as they did not expect any business model from a LIC like

Africa and demonstrated that the innovation was created with a well-thought-out plan and developed with positive and modern intentions for scaling.

The low-cost nature of ADCS did not demonstrate its visual features as the innovation looked expensive, modern and aesthetic, which felt aligned with the current equipment and devices used in the NHS. Participants were generally intrigued about the curation of the ADCS, from the idea to sourcing materials and its fruition. Associations between the support of organisations or people in Canada supporting developers of ADCS in Africa led to the belief that perhaps catapulted the innovation to its success. The innovators of the ADCS were appraised by the participants because they felt that the idea was not motivated by cost but in fact led by purpose, productivity, and safety.

Sustainable efforts provided by the ADCS supported the NHS' initiatives by limiting waste and prolonging the use of current equipment. However, there were some concerns about whether cost would be increased due to the sterilisation of the drill and the cover system as opposed to just sterilising the drill. Due to the design and affordability of the cover system, in addition to controlled risks, the expectations of using the cover system were widely positive with most participants stating they would accept its use in their care without any hesitancy. The fact that the cover system was developed in Africa, aided in its interest and acceptance.

6.1.1.4 Useability

Participants stated that the useability or application of the cover system was simple, straightforward and safe. The application was advantageous towards controlling risks and ensuring safety. Participants recognised ADCS' impact of adaptability and compatibility with different drills and drill endings. The participants appreciated the versatility of having different covers for different drill endings such as the saw and regular surgical drill. They felt that no element was left unexplored and left out as the cover system seemed to have thought of every feature and ease of use. Most participants expressed that Africa should be used as exemplars to innovation development in the UK, particularly those in healthcare.

Furthermore, the useability did not look like it was expected for a LIC like Africa. Though some participants explicitly mentioned that they did not have any stereotypical or negative thoughts about LICs and what they could do, it was not expected for an innovation developed in Africa to think about the multiple uses of one thing. There was an expectation to use additional materials, components and

complicated application to become more attractive or to "*keep up with the trends of the UK or the US*".

Some participants did express some concern about the surgeon's ability to see the buttons and use the drill itself, in addition to the overheating of the drill. Elements of useability or ergonomics such as weight, hold, functionality and drill endings were important for these participants. The weight of each cover system was thought to potentially impact its functionality if it weighed the already heavy drill down further. It was assumed that the current drills used in Africa were of lower weight than the standard surgical drills used in the NHS, and thus were seen as an oversight as the differences in weight could affect functionality.

6.1.1.5 Clinical Effectiveness

All patient representatives felt that the clinical effectiveness was appropriately conducted and aligned with expectations of the NHS. Participants overall acknowledged the extensive efforts and data obtained by the innovators which could provide a sense of quality and safety assessment for the NHS.

All participants appreciated that the ADCS had already acquired a CE marking and approved with the US Food and Drug Administration (FDA) and Health Canada. Regulatory approvals influenced the acceptability for the use of ADCS in all participants, though one participant did state that they would not accept it if a hardware drill was used as an alternative to the current Stryker drills. The participant stated that though they recognise the need for hardware drills during surgery in countries like Africa, it was not considered appropriate for countries like the UK, Germany, Australia, USA and Canada. The participant had associated the aspect of FI with the drill itself as opposed to the cover system which was the focus of the presentation.

Further questions regarding its functionality and performance which included component analysis was evoked. Such aspects included: pressure testing of the drill against bones, battery life, friction heating, sterilisation timing and equipment, durability, material decomposition and drill ending metal. This information was necessary for some participants because it allowed them to understand how the innovators of ADCS could maintain low-cost whilst adhering to optimal quality performance of individual components. The interviewer had to reiterate that the cover system was the focus of the presentation but did provide published information about the evaluations completed on the ADCS and the recommended drill. The ADCS was perceived to be a safe and low-risk innovation that was welcomed for use as it reflected a safer surgery.

All participants acknowledged the extensive clinical data acquired by the innovators of ADCS. The clinical data provided a sense of comfort and reliability in that the cover system was extensively tested and approved. However, one of these participants recommended that more testing should be conducted outside of Africa like the UK as populations and problems are different. The interviewer evoked a topic initial elicitor as further exploration of COO comparisons and clinical data was highlighted in the previous response. The adumbration of the interviewer provoked a positive response from the participant, showing signs of palpable and perspicuous positive facial expressions and body language reflecting, enlightenment, awareness and understanding.

6.1.1.6 Shared Decision-Making

Though shared decision-making was not a significant theme amongst most discussions about the ADCS, it was considered important for some participants. These participants felt the need to discuss such choices of use with their consultant and partner regardless of the specific innovation, solely because it was new to the healthcare system and elicited an uncomfortable feeling exhibited through body language, facial expressions and choice of linguistics. Though, most participants stated that the need for a shared decision for Sayeba's method was essential, the same requirement or behaviour was not necessarily mirrored for the use of the ADCS.

6.1.2 NHS Staff

6.1.2.1 Risk

Though all participants provided a favourable response to the ADCS in some respects, it provoked a dissection of its risk and potential complications.

The cover system was rated as a high-risk innovation by most participants simply due to the addition of an external material over an existing sterilisable drill. The linen cover though beneficial in the long term, added an extra task and prolonged the process of surgery preparation. Though some acknowledged and appreciated the need for two people to prepare the cover system for a specific drill in order to control for contamination, this approach was also seen as a flaw to the system and was interpreted to be unnecessary. The cover system was perceived to be problematic as it would add to the risk of infection due to its application and sterilisation. One participant further stated that the innovation is developed in a different country with different protocols to the UK so it would need a different type of attention and awareness. The drills in the US and Canada may be differed to the ones

used in the UK, so the functionality may be different or inappropriate for the surgical drills used in the NHS, "*the cover system may work for them but may not work for us*".

Other participants felt that though the cover system was great at its intention to control infections, bacteria and contamination, its application and context triggered it to be high risk. As the cover system was made with the intention to provide safer surgeries at affordable costs, it was done so in the manner to fit a different context such as accessibility in LICs whereas the UK does not have this issue. Though most participants did provide a generous and favourable feedback of the cover system, there were some indications of contextual and implementation risks to which some deemed its appropriateness for localities in LICs but not for the NHS. Albeit some recognised the acquired approvals from the FDA and Health Canada in addition to the CE marking, it did not justify its appropriation for the NHS as population and standards are different in the UK. Further comparisons of medications and protocols between the UK and the USA were used to corroborate and rationalise perceptions.

On the other hand, one participant felt that the cover system was a low risk and high reward innovation. The participant stated that the innovation would be low-risk because of its intention to produce safer surgeries by controlling or managing the risk of contamination, infection and other associated surgical risks. This risk perception was deemed to be low and very much in favour of the implementation of the ADCS due to its acquired regulatory approvals, CE marking and inventiveness.

6.1.2.2 Design

Most participants explicitly applauded the design of the cover system which was described as the "*inventive*" and "*simple*". Furthermore, it was thought that whilst the ideology of the cover system was "*clever*" and "*elementary*", the design felt short with the material and structure chosen. Meanwhile, though the design was thought to be suitable and "*fitting*" for the NHS, its application and conceptional foundation was not appropriate due its COO, particularly the intention to address accessibility issues. Concerns about slipping, increased risk of contamination, loose-fitting material and sterilisation procedures were most commonly discussed. The material was thought to absorb bodily fluids and increase the likelihood of infection to an exposed part of the body.

One participant stated that the design was significantly transparent and simple, "*you can see because its so simple and clear the advantages it brings, I'm actually really excited about this one because its so clean, simple and shockingly obvious and no one has thought about it…"*. Such benefits included its

simplicity of application, clean design, training, ease of implementation due to acquired approvals and CE marking, costs, risks and innovation development of those developed in LICs. The participant felt that the UK and the NHS should lend more support to innovators in less developed countries because they simplify effective ideas whilst leveraging available costs and resources, "*sometimes you don't know what is needed until your faced with nothing so why not use the same thought process when creating innovations, the people who don't have much, do it the best, we saw proof during COVID and now with this ADCS…"*

The addition of a linen cover over a surgical drill "*screams*" dangerous and "*slippery*". The cover would not allow the surgeon to see what is happening if the drill malfunctioned whilst in the cover system, and the surgeon may not be able to see what settings to choose on the drill, if it was covered, which increases the likelihood of catastrophic outcomes. The participant stated that the efforts towards autoclaving was "*excessive*" and "*unnecessary*" and would incur further costs to the NHS.

6.1.2.3 Cost

Though all participants acknowledged and valued the intention in creating an affordable and effective innovation, most participants stated that the cover system was unnecessary and would incur further costs to the NHS. The ADCS was seen as simply not needed in the NHS as the current sterilisation protocols of all surgical equipment was effective and "*unbroken*" and was by no means appropriate for the NHS.

Though the design did not look cheap, the cost saving between what is used now in the NHS and the ADCS is not significant enough to adopt. The addition of the ADCS could inflate costs to the NHS further as it involved sterilising addition equipment and further testing in the UK which is expensive. Furthermore, the linen material was not perceived positively as the cover system was believed to fail sterilisation protocols within efficient turnaround times and therefore deemed the information presented inaccurate, glorified, or miscommunicated. Furthermore, it was believed that the real cost benefit would come from replacing surgical drills with hardware drills, which was reputed as impossible and controversial for the NHS.

On the other hand, one participant reported the cost saving as substantial, coupled with improved surgical safety and lower risk rates. The business model was referred to as being "*sophisticated*", "*advanced*" and "*thorough*". Though the participant focused on the cover system as opposed to the option to use a hardware drill, the participant did express concerns with the use of hardware drills for

surgery albeit they appreciated the need in LICs. The participant mentioned that the business model was pragmatic, sustainable, and simple, which makes it easier for the wider NHS Trusts to ensure that there is always a consistent supply of the cover system linens.

6.1.2.4 Useability

All participants expressed that the ADCS could effectively encourage and improve surgical outcomes and make surgery safer, however most participants felt that this would not be ideal and appropriate for the UK's NHS, whilst one participant felt that the cover system could mirror the same effectivity in the NHS.

It was believed that if innovators in Africa could do it even with the support of a HIC and limited resources, then why does a HIC like the UK itself find it so challenging and expensive with exposure to unlimited resources. The application was described to be "*simple*", "*straightforward*", "*innovative*", "*quick*", "*easy*", "*sustainable"* and "*durable*". A participant recognised the double-layered feature of the cover system and felt that this made the innovation safer and more durable against various surgical exposures such as temperature, bodily fluids, skin, bone and etc.

6.1.2.5 Clinical Effectiveness

The innovators' ability to conduct and acquire rigorous clinical data despite having limited resources to funds and materials was applauded. Furthermore, the innovators' acquirement of the CE marking, FDA and Health Canada approval, aided in the safety of the ADCS and corroborates the accuracy of the clinical data. These reasonings made one participant feel "*comfortable*" and "*inspired*" when thinking about the prospective adoption of the cover system in the NHS. The participant acknowledged and commended the efforts of the material following a legal standard for medical barriers.

Most participants felt that though the clinical data seemed to project valid and conclusive results, its rigour was faulted to the specified COO in that the population it was tested on, were part of the country that endorsed it such as Africa and Canada. The accuracy of the clinical data was questioned and whether results were obtained using the same surgical drills as opposed to hardware drills. A topic initial elicitor was used to explore views of the COO and rigour of clinical data. The interviewer had asked the participant whether the same value would apply to homegrown innovations who acquire data in a UK population. Participants believed that the thought process would differ completely

because less is expected from LICs whereas the UK there is a stringent procedure and policy, which would deem them "*automatically valid*", "*it's almost like you have to work harder because you're trying to get the attention from the UK which is a mainstream market…"*.

6.1.2.6 Shared Decision-Making

The theme of shared decision-making was not significantly important among the respondents as it did not typically affect them. Such information about what is used in surgeries is "*unnecessary*" and would confuse the patient entirely. It was suggested that if patients became aware that the ADCS from Africa, it would cause an" *uproar*" of rejection and controversy between patients and the NHS. This complete rejection was attributed towards the feeling of patients paying taxes and expecting the best duty of care and service from the NHS, and the assumption that ADCS would work in an opposite direction to ensure that such expectations are achieved, "*it would be counterproductive and inappropriate on many different levels*".

6.2 Group B (Only Frugal) and Group C (Only COO)

Participants in Group B were presented with information about the ADCS involving the term 'frugal' only. These participants were not given any information nor cues about its 'COO'. On the other hand, participants allocated in Group C were presented with the same information on the ADCS whilst providing information about its 'COO'. However, in Group C, there was no mention of the term 'frugal'.

6.2.1 Patient Representatives

6.2.1.1 Risk

The safety element of the cover system made the innovation low risk for most participants as its sole intention was to create safer surgeries which made participants feel confident and comfortable in the use of the cover system.

Some participants in Group B recognised and acknowledged the innovators intention to place the patients' safety at the forefront of its development and described it as "*…refreshing and encouraging*" that the innovators valued patients more so than "*…chasing money*". The cover system itself was safe and low risk, except for the option to potentially replace surgical grade drills with hardware drills. The option to use hardware drills would infer a high risk rating in which they would immediately reject,

"*as long as it had all the necessary approvals and had undergone testing, then I'm fine with it, I'm comfortable with it but not the hardware drill part…*". Participants felt that the cost of the innovation or the initiative to develop something low-cost or more affordable does not mean that it's high-risk and this cover system is an example to this effect.

However, some participants expressed feeling unsure about whether the innovation truly added or reduced risk. These ambiguous concerns about risk were due to the preparation of the drill and removal of the cover system. The switching of the cover system was a concern and rated high risk as they felt that the bodily fluids from the cover could seep into the crevices of the tool to which sterilisation may miss and cause catastrophic effects for the next patient the drill is used on despite the drill being concealed by the ADCS. These participants emphasised that each surgical equipment should be sterilised, not protected, to comply with the duty of care each patient deserves. Furthermore, the material of the cover system was reported as easily breakable which could cause catastrophic outcomes for the patient and considered it unsafe and extremely high-risk.

Some participants in Group C stated that the cover system was a low-risk innovation and felt comfortable in accepting it in their care. The cover system was noted as making surgeries safer as it took the initiative to ensure safety was adhered to by requiring two people to prepare the drill. The more people involved in such preparations, demonstrated greater level of importance and compliance. These participants stated that the CE marking and acquired regulatory approvals demonstrated the innovation's low-risk rating as the innovation was tested against legal standard procedures, "*…remarkable job making sure everything was achieved and in place for future projects around the world…*" and that the innovators' were exemplary to the rest of the world and showcased that "*…Africa were innovators too*".

Though a favourable impression of the ADCS was provided, the COO highlighted a need to inspect the risk of the innovation even more so than not being aware of the COO. It was recommended that the COO not be mentioned as it may influence the patient wrongly. A topic initial elicitor was used to explore this perception of the COO and its negative connotation. The interviewer asked the participant why they felt that the COO would impact opinions of patients in a negative way. The participant stated that less developed countries "*unfortunately do not get the recognition they deserve*" as people's perception of the country is stagnant in the past and since then as the country has not developed profoundly, the perceptions are going to be poor and negative.

Though, one participant favoured the innovation initially, when asked about their risk perception towards the cover system, they stated that the risk of the ADCS was high because it involved the addition of an extra layer that would harbour bacteria and bodily fluids. The cover system was believed not be sterilisable. The participant felt that the idea behind the cover system was positive and "*a step towards innovation"* but was compared to adding materials on other tools like scalpels to help reduce sterilisation times and prolonging its use further. The participant questioned whether the innovation was needed in the NHS but could understand its use and need in Africa.

6.2.1.2 Design

Most participants in Group B expressed positive reactions towards the design of the ADCS. It was recommended that the colour of the linen be "*white*" to demonstrate a cleaner aesthetic and reflect a medical equipment. The design was described mostly as "*simple*", "*clean*", "*minimal*", "*effective*" and "*affordable*". The design was thought to make the innovation unique and successful, "*sometimes it's the simple and obvious things that are really the effective ones and give you the best results"*. The design also reflected its *"affordable nature*" in that it did not include anything *"…extravagant, extraordinary, expensive, it's just a piece of material isn't it*".

However, for other participants, its suitability was not deemed appropriate for the NHS. The design was not as "*elegant as expected*" as the colour and material looked "*cheap*", "*thin*" and "*unsanitary*". It was believed that the material could not be sterilised and would increase danger to common bacteria and make patients more susceptible to infections such as surgical site infections and sepsis.

Conversely, participants in Group C felt that the design looked "*sleek*", "*medical*", "*modern*" and "*clean*". Though, there was an overwhelming positive attraction towards the cover system and expression of pride and fondness of the innovation as it was conceived in a LIC, the cover system did not "*look or feel*" as if was "*African*". A topic initial elicitor was used to explore further perceptions about the African standard of innovations. It was said that the equipment or medical devices developed and used in Africa are "*…purposeful and resourceful, like you would see plastic bottles hanging with a piece of tubing giving saline to a patient and the bottle would not be new or clean, you can see its been through it, that's real Africa, this cover does not look or feel like Africa, it looks like rich countries, London UK and America…*". It was presumed that the cover was developed and manufactured in a HIC for people in Africa as the design of the cover system fit the aesthetic alignment of the NHS rather than those expected from Africa.

Participants felt that the design was appropriate for the NHS as it simplified the nature of preparing for surgery. The turnaround times and efficient recovery of equipment and devices is ideal for the NHS. The simple and "*non-fussy and hassle-free components*" made the innovation more applicable and suitable for the NHS. However, there was a recommendation that the material be more customary to the drill as it looked like loose fabric, which could make the innovation potentially dangerous for use. Furthermore, the linen could contain "*grippings for texture*" and a colour change to transparent to make it more comfortable and safer for the surgeon to use.

6.2.1.3 Cost

Most participants in Group B felt that the cost of the innovation did not reflect its design as it looked expensive, which differed from their interpretations of the term 'frugal' "*affordable*", "*low-cost*", "*cheaper*", "*within means*", "*basic*" and "*tight with money strings*".

It was reported that the cost of the ADCS reflected its ability to save costs in other areas such as sustainability, durability and prolong use of equipment. The innovators' ability to "*think long-term*" referring to its business model was acknowledged. However, its success and support due to the "*backing of Canada*" was questioned. Though some participants expressed a favourable perception towards the use of the ADCS, they remained sceptical about its financial status and its potential for scaling. The ADCS sounded as though the innovation was developed in Canada and funded by a Canadian organisation but for people in Africa. This same narrative was mirrored when discussing its scaling opportunities as it was perceived as Canada achieving such success and not Africa, "*…it's got a spin the Africa thing into it so it sounds more cool and innovative*".

A topic initial elicitor was used to explore the positive perception of Africa and its appeal for attraction. The interviewer had asked the participant why they felt that Africa would increase attention to the ADCS and why it was considered "*cool*". The participant expressed that the ADCS would be a "*…typical innovation from Canada otherwise, you know it needs that flair, that unfamiliarity about it that will get people talking like look at this inventive thing from Africa, a revolutionary thing coming out, it's because we don't hear of this stuff happening often do we, so it gets people talking otherwise it's just oh yet another thing from Canada…"*.

6.2.1.4 Useability

In both Groups B and C, most described useability as "*minimal*", "*efficient*", *easy*", "*straightforward*", "*hassle-free*" and "*quick*"., which would allow for more surgeries to take place each day. The ability of the cover system to be switched out in one minute was found to be a great initiative that could make a profound difference to surgical waiting lists. Though many participants favoured the ADCS, some participants in Group C expressed some uncertainty and concern for the surgeon's ability to change drill functions through button changes and resolving any malfunctioning situations through the cover. Concerns with the over-heating of the tool when drilling or sawing hard materials like bone was also reported. It was recommended that the design take into consideration the full useability and functionality features and not just the protective aspect of the drill, as overheating could cause dangerous effects and therefore recommended adding "…*cooling function or design to the cover, maybe some holes…*". Other concerns surrounded the chosen textile and whether it would be "*slippery*" or "…*uncomfortable when it's all wet and soiled, that's got to be uncomfortable and a mess*". This questioning echoed their risk perception of the ADCS, though these participants also favoured its use in their care.

6.2.1.5 Clinical Effectiveness

All participants in Group B though provided varying perceptions, all felt that the regulatory approvals, thorough and substantial clinical data made the innovation appropriate for discussion. Participants in Group B felt that the data collected made it easier to understand the aspects involved and assess risk accordingly. The clinical data demonstrated that the innovation was safe to use and implement in the NHS. These participants also felt that the clinical data highlighted the importance on patient safety and valued the effort of conducting such assessments on several people. The acquired approvals and clinical data made them feel "*comfortable*" and "*satisfied*" with its potential use.

However, some in Group C expressed concerns about reaching different diverse populations, confidentiality, consent, transparency and eligibility. Though the majority response were favourable, most participants did not appreciate the opportunity for hardware drills to be used and stated that the option should never be considered for use in the NHS. Concerns about the lack of reported side effects was highlighted as participants felt that "*everything had flaws*". These participants expressed that though the innovation was simple, the minimal components would suggest that it had limited features and therefore would inflict some negative result on the outcome. It was recommended that further testing for longer period of time in the UK to assess potential drawbacks be conducted.

Most participants in Group C acknowledged and accepted the clinical data obtained by the innovators. The acquired clinical data made participants feel "*comfortable*" about its use in their treatment. The acquired regulatory approvals and CE markings facilitated the participants' views of risk and expectations. However, it was recommended that the clinical data follow those using the ADCS in the other 15 countries for long periods of time which would "*enrich the case for its use*" in the NHS. However, one participant in Group C did question its validity and rigour as data was collected in countries which endorsed the innovation e.g., Canada. The participant felt that the clinical data reserved some level of scepticism due to the supporting countries.

One participant in Group C expressed that the COO would influence the validity and reliability of the clinical data. The participant recommended that the COO not be mentioned as it's "*…not important and would cause unnecessary bias and stereotypes of rejecting something that is potentially great for them only cause it's from a poorer country…*" A topic initial elicitor was used to explore the perceived thoughts of the COO and impact on others' views about innovation. The interviewer asked why they felt that the COO would negatively impact people's perception of the cover system and whether they had experienced this narrative before. They were "*not bothered about the country it was made in or comes from*", however others, like their mother, would be, because of what they have experienced in the past with certain technologies and products. The participant stated that their mother would assume that low cost meant low quality, because that's what their experience with products have produced in their native countries. They further stated that if the COO and price is not mentioned and looks sophisticated as the ADCS does, then this would change the stereotype forcefully and purposefully.

6.2.1.6 Shared Decision-Making

The shared decision-making theme was not substantially critiqued for most participants, but it was however considered for two participants in Group B during the decision to accept the ADCS. These participants felt that it was important to know certain information from the surgeon to help make decisions. Both participants reflected on past experiences during their diagnosis of cancer and stated that much of their research and understanding was driven by self-discovery because they felt alone in their diagnosis but also felt the emotion of "*…not knowing everything, because my doctor felt that I wouldn't understand it or didn't agree with it…*". Since then, both participants proactively explore and investigate innovative techniques and treatments for diseases that can help both the patient and the NHS, which led them to participate in this study and become PPIE representatives. Both participants

appreciated the information provided and although acknowledged that the information was more concerning to the surgeons, they felt "*valued*" and "*part of the process*" of improving the NHS.

Most participants in both Groups felt that they did not need to know any information unless it affected them at the specific time. Some participants in Group B questioned others for wanting to know more as opinions and views could cloud judgement towards allowing certain things which are inappropriate into the NHS for permanent use.

One participant in Group C echoed similar perceptions of shared decision-making, however this perspective was attributed to its COO. The participant stated that as the COO was provided to them, specifically Africa, they would ask more questions about it. The interviewer had asked the participant, what about the COO made them feel more curious about the innovation. The participant felt that LICs, although "*good at adapting*", the quality is not the same as in the UK. The participant expressed the need to consult with their doctor for more information and to determine its safety and suitability for them and in the NHS. The participant stated that they typically depend on their doctor to make decisions in their best interest as they were more experienced and knowledgeable.

6.2.2 NHS Staff

6.2.2.1 Risk

The overall risk perceptions of ADCS from those in Group B were rated as low risk as it incorporated an extra layer of safety and hygiene compliance. Participants felt "*satisfied*" and comfortable with the acquired regulatory approvals and a CE marking which demonstrated a successful compliance standard. The risk assessment was believed to have followed a standard compliance measure consistent with the NHS. Their risk perceptions both demonstrated the ADCS to be low risk as the product was "*…non-invasive…*", "*doesn't require any elaborate attention as you would for a new drug or drill ending, there's nothing dangerous about it…*". One participant felt that though the innovation is "*affordable*", it did not replace anything so it would not warrant a thorough assessment compared to a replacement technology more expensive or significantly cheaper than the current one.

All participants in Group C rated the ADCS as low risk. Their risk perceptions were attributed to the design, application, useability, acquired regulatory approvals, CE marking and clinical data. Participants expressed a connection between risk and practicality in the ADCS' COO. Initially, all participants commended the innovators on placing patient safety first, however when discussing risk,

some felt that the innovators had to create this cover system because it used hardware drills during surgeries that placed patients in a vulnerable, potentially dangerous position.

6.2.2.2 Design

All three participants in Group B stated that the cover system looked "*great*", "*strong*", "*resilient*" and "*solid*". Participants felt that the design did not encapsulate something that was low cost or affiliated with an affordable approach. The interviewer asked the participant to elaborate on their meaning of the types of features affiliated with low cost and high cost. Participants mentioned that the material chosen looks "*durable*", "*thick*", "*comfortable*" and "*resilient against different surgical conditions*". Similarly, in Group C, all participants felt that the design looked "*expensive*", and the cover was assumed by most participants to be developed by a UMIC or a HIC. The design was reported to represent wealth because the concept involved an addition to current equipment as opposed to a reduction or replacement. The assumed COO and design were also attributed to the idea behind the innovation of increasing safer surgeries which demonstrated an objective often driven by sophisticated and elaborate healthcare institutions and organisations based in a HIC. These participants expressed that patient safety, and surgical or clinical adherence would not be a priority for LICs like Africa because there's an urgency to address a need efficiently and sometimes in the process, hygiene and safety compliance is foregone or misplaced. Participants generally believed that whilst LICs have potential in healthcare innovation, to meet the standards of a HIC such as regulatory procedures, trialling, population, legal structure, and insurance, is difficult.

6.2.2.3 Cost

Participants in Group B stated that the innovation appeared to look expensive and felt that the business model was "*well thought-out*" and "*comprehensive*". In Group B, cost was not deemed as important factor to consider its use in the NHS. The mere existence of a potential and prospective financial model demonstrated that though the innovation was referred to as a 'frugal innovation' it was everything but that in all other respects. The offering of a subscription service was reported as being ideal for the NHS as this is the "*…norm for the organisation, this is what we currently doing*". However, the thought of using a hardware drill is "*unsettling*" because it would not share the same durability as a Stryker surgical grade drill. Participants were fearful that the drill endings would fall off or leave remnants of metal inside the patient whilst operating and thus believed that the cost would not be a sufficient and appropriate sacrifice in the NHS.

Similarly, participants in Group C did not deem cost to be important though it does reflect a certain degree of inventiveness, sophistication, and reputation, as long as the ADCS was effective in increasing safer surgeries, the willingness to accept its use was favoured. Participants stated that the business model of the ADCS was "*simple*", "*clever*", "*sustainable*" and "*direct*". Most participants stated that they do not get a choice in what is used in practice and do not prepare the surgical equipment, so cost would not be a component for them consider. Not knowing the cost of any equipment used in their workplace, it was assumed that equipment current being used would be expensive. Participants believed that the COO should not reflect cost as things from China, India and Afghanistan are no longer cheap to make nor supply to the rest of the world. However, as the world and innovation has developed and advanced, LICs look to be the "*true innovators*" to supply the rest of the world and as the demand is high, the cost for materials and quality will simultaneously increase which will subsequently increase the overall sale price, "*these countries [LICs] are no longer gonna be seen as cheap.*"

6.2.2.4 Useability

The useability of the ADCS was rated important and favoured by all participants in Group B. The design of the cover system reflected its useability features which were expressed as being "*strong*", "*compact*", "*durable*" and "*easy to use*". However, though participants favoured the ADCS, most of these participants felt that perceptions may differ for those having to use and prepare the equipment. These participants felt that the surgeon may find it difficult to navigate the drill whilst encapsulated by the cover system because its new to practice and may take time to adjust. Furthermore, the cover system is solid green in colour, which could make features of the drill difficult to see such as the nodes and speed buttons. Participants stated that the space between the cover and the drill appeared to be loose, which could impact the useability causing it to be high-risk, "*irreversible complications*" and thus recommended the linen "…*stick to the drill more, like our medical gloves on our hands or in this picture [shown on the computer screen]*".

On the other hand, all participants in Group C described useability as "*simple*", "*easy", "quick*" and "*clean*". Its design and functionality demonstrated an assumed COO as being a HIC. Participants however did express some concerns of compatibility or "*holding*" as the linen looked loose. Though they appreciated the loose textile as it could make preparation easier and quicker, the looseness of the cover system may affect its functionality altogether deeming it unsafe to use as it could "…*slip out the surgeons' hand…*". It was therefore recommended that the material be transparent and perhaps a little tighter to suit the practicality of its use for the surgeon.

6.2.2.5 Clinical Effectiveness

All participants in Group B acknowledged and appreciated that ADCS acquired the necessary regulatory approvals and CE marking. Participants stated that the collation of clinical data should be ongoing as it adds to the enrichment of data and strengths the case for potential implementation for the NHS. The continuation of clinical data could allow for a more comprehensive assessment of the ADCS as it would involve diverse populations from different parts of the world. All participants felt that the acquired clinical data was sufficient for consideration into the NHS. Participants did recommend its temporary use in the UK on a pilot basis before it's permanently implemented for further testing and usage.

All participants in Group C stated feeling "*satisfied*" and "*comfortable*" with the clinical data collected. However, it was recommended that more thorough and extensive clinical trial needs be performed to capture the risks associated with useability and functionality for transparency and risk management. Concerns were raised as the clinical data for ADCS did not report any complications nor any negative feedback, in which all participants were suspicious.

6.2.2.6 Shared Decision-Making

Though the shared decision-making theme was not a significantly important theme, all participants in Group B stated that the need for translating this information to patients was unnecessary as it the level of competency would be different and limited. Furthermore, all participants would like to be involved in the decision-making process when incorporating new products and services, "*…the voices of people who actually use it should be the most important, you know it's always strange to me and doesn't always occur to me until I think about it, that we are essentially force to use what the bosses say is good enough, like it doesn't matter what we think…*".

Similarly in Group C, all participants felt that there was no need to introduce information about the cover system to patients as it did not directly affect them, though they acknowledged that patients would understand it as it was simple and clear. They expressed wanting to be involved when making decisions about what is used in their services as it would affect them the most, "*…if I liked this cover innovation say if it got introduced by the NHS and we used it and liked it and then all of a sudden they said no, we are not interested and withdrawing the innovation, it's like we don't get a choice and we don't get a say, then get left with something more difficult to use…*".

6.3 Group D (No Frugal and No COO)

Participants in Group D received information about the ADCS, however this did not involve any mention of the term 'frugal' and its 'COO'. These participants were not given any information nor cues about its COO.

6.3.1 Patient Representatives

6.3.1.1 Risk

The general risk perceptions of the ADCS were rated low across all participants. Some participants felt that the ADCS was low risk due to the intention of the innovation in providing safer surgeries. By acquiring such approvals and CE marking demonstrated that it is safe to use in addition to the innovation actually being used currently in other countries. Participants expressed that the cover system was designed to prevent infections, spread of bacteria and other complications, so it was believed that it could not cause further or additional harm to the patient, "*…when something is there to be protective then you can't expect it to cause more harm than good, like gloves and masks that the surgeons wear, granted gloves could get left inside the body cause we've heard of gauzes doing that and causing massive amount of pain, but leaving this [ADCS] behind inside just seems impossible…*".

Though participants generally rated the ADCS as low risk, there was some concern regarding the risk to the surgeon. The design of the cover system was reported to limit the view of the drill as it's was completely encapsulated and opaque. The loose material was also mentioned as "*risky*" as the linen had the potential to cause slippage. Furthermore, participants felt that the drill end could cut the fabric, adjoining the linen notch, if it was used at high speed. These features of design would provoke some participants to change their risk rating from low to medium, "*…I'll change it from low to medium risk or not even that I would say erm low to middle range, definitely not high risk…it's just cause I didn't think about it before until you asked me to think about risks you know…*".

6.3.1.2 Design

Participants stated that the design of the cover system looked "*expensive*" and "*practical*". Though the design of the innovation looked aligned with what was expected from the NHS, the spacing between the linen and drill was too much in that the linen was recommended to be tighter and conform to the drill like a glove. The interviewer asked participants what they expected the devices and equipment to look like in the NHS and why. Participants typically see or imagine the equipment

to look "*…sleek, expensive, thick, agile, rugged, sturdy things of that nature and the colour you know the greens, blues and whites…*" in the NHS and would expect new innovations to fall in line with the current apparatuses. Most participants felt that the design was simple and straightforward and transparent with how it is used and what it does, which made the application easier to understand as opposed to Sayeba's method, though involved basic equipment, the application was far too technical for comprehension.

6.3.1.3 Cost

Cost was not regarded as a significant component in the consideration of using the ADCS for those in Group D. Though some participants expressed that cost is important when developing an innovation and sustaining it within the NHS i.e., costs must be kept affordable enough for the NHS to update the stock and retain its supply, it should not be at the forefront of innovation but rather its purpose. Participants believed that the ADCS achieved this narrative by ensuring patient safety was upheld and complied with rather than developing something or a process more sophisticated and increasing costs. At the end of the interview, all participants were presented with the information about the innovation's business model. The reason for this positioning was because the mere mention of 'hardware drill' may have elicited or provoked a propensity to its perceived COO being a LIC or as a low-cost innovation, which may have biased responses to further questions. This association was notable during interviews with other Groups.

Once participants received this information, half of the participants were positively astounded and believed it could be a "*marvellous*" addition to the NHS with a cost saving of 94% if they had incorporated the use of hardware drills. Similarly, to other groups, the use of a hardware drill was thought, by most participants, to decrease safety and increase medical negligence as these drills were not appropriate for the NHS.

6.3.1.4 Useability

The useability of the ADCS was described as being "*simple*", "*easy*", "*fast*", "*excellent*" and "*adherent to hygiene*". The requirement of two different clinical personnel attributed towards its positive review. The need for two people during preparation provided a sense of comfort and confidence that safety was the upmost importance and hygiene was at its highest compliance. Participants stated that as the design and application was simple, it would enable the NHS for efficient adoption and would not require further elaborate training compared to a new procedure or sterilisation protocol, "*…it's so*

easy to do and understand that my 12-year-old daughter could do this and probably does in some form during her science class in year 8…the NHS should do this because it's so simple and puts patients first…".

6.3.1.5 Clinical Effectiveness

All participants expressed feeling "*relieved*" and "*comfortable*" with the extent of clinical data available compared to those collected for Sayeba's method. Though some participants recommended needing more clinical data for Sayeba's method, all participants in Group D, felt that the amount of clinical evidence collected was satisfactory and appropriate for considering its use in their care. However, some participants did mention the difference in the innovations demonstrates the need for clinical data and testing which was dependent on the type of equipment used and technique delivery, "*…with the other one, Sayeba's method, that involves an actual placement of a device or whatever into the body to control bleeding right, so that should need a lot of data whereas this one its literally placing a material over a drill that the surgeon already knows how to use and protects them and the patient and the drill, so I suppose that too will need data but not as much as I believe it to require…*".

Participants expressed that the innovators of Sayeba's method should follow suit with the innovators of the ADCS, to test and gather supporting evidence for its effectiveness which can also be used to gain approvals. Though many participants favoured both innovations to be used in their care, they did feel that the ADCS was far "*more safer*" and almost automatic with decision-making because of its advantages and intention to promote safer surgeries, "*…I wouldn't even think twice about this one [ADCS], it's one of those things that you just automatically expect to be used because of what it's trying to do and has achieved…*".

6.3.1.6 Shared Decision-Making

In comparison to Sayeba's method, most participants felt that with the ADCS, there was no need to consult them or require consent for it to be used in their surgery. Few participants stated that the direct impact would be on the surgeon and the scrub nurses who prepare the equipment as opposed to them as potential recipients of the surgery. These participants rated the ADCS to be "*safe*" and "*reliable*" for use to which they felt an indirect impact by the innovation as it would prevent or reduce the likelihood of complications and infection or bacteria transference via the surgeons' application of the innovation. However, some participants felt that medical equipment used in highly complicated settings such as surgeries should not require any involvement from the patient, "*…it doesn't matter*

does it, why do I care if this is being used unless it properly affects me, its not just this its everything, why need to know when it doesn't affect me, its like talking to me about all the stuff they [clinical staff] use, you know gloves, scrubs, light bulbs, knifes [laughter] its not necessary to know, at least for me…".

6.3.2 NHS Staff

6.3.2.1 Risk

All three participants rated the ADCS as a low-risk innovation. The general perceptions about risk were nebulous as it was unanimously expressed that the cover system was entirely "*safe*" and "*applied a layer of precautions*". All participants agreed that having obtained the FDA and Health Canada approvals and the CE marking demonstrated and reflected the innovations' safety compliance and adherence to standard practice in healthcare. Though most participants stated that the acquired regulatory approvals had no influence in their low-risk ratings, such perceptions were based on factors of design and functionality, "*its such as simplistic and clear design or innovation that you can just see how it works and how to use it clearly so you know what your getting yourself into or what to expect, and when you can see these things it makes risk management a lot easier and because this only has a few associated with it, I would say this is low for sure…".* The participant was asked to clarify what the "*few associated*" risks of the ADCS were to which they replied, the risk of missed sanitation and handling/operating the covered drill for the surgeon due to lack of practice and loose-fitting material.

6.3.2.2 Design

Whilst all participants favoured the overall design of the cover system, each provided a recommendation for adaptation and improved functionality. All participants recommended the linen be tighter to conform to the drill as it was assumed that the functionality would improve and reduce the risk of it slipping out of the surgeon's hand. The design was expressed as looking neither expensive nor cheap, and fell in-line with the conventional aesthetic and design of other equipment used in the NHS, "*…it just looks like any ol' equipment, oh sorry material we use, it actually reminds me of the material of our scrubs, so it doesn't look cheap or expensive, just looks like the NHS…*". Though the design was practical during the preparation and maintenance, the colour of the linen was recommended to be transparent so that the functionality could be improved, "*I'm not a surgeon to say the least, but for me anything that obstructs my view of something vital like a drill, I'm not gonna be able to use it, I wanna see the buttons even if I know how to use the drill and if it malfunctions I need to see it before I use it on the patient, so yeah I'd say I prefer it to be clear plus it would look nicer*

wont it?". One participant had catechized whether the ADCS can be referred to as a innovation as it was described as being "*simple with a bit of material, like there's not much inventiveness about it or is it the idea of placing something on the drill that makes it innovative, I don't know I'm just struggling with how this can be a innovation – I see it as like technology or clever devices or staining for tissues, something like that but not really this…*".

6.3.2.3 Cost

Likewise, to patient representatives allocated in Group D, cost was not regarded as a significant component in the consideration of using the ADCS. All participants mentioned that the cost for the current equipment and devices were unknown to them and not important when considering which equipment to use, as its effectiveness and safety should be the only factors in question. Participants stated that though one can assume the cost of things in the NHS and particularly now as the NHS' consistently announces its financial pressures, it does not influence the way services and care is provided. Participants felt that there is a duty of care irrespective of the types of equipment used to the UK population, "*…the cost is neither here or there with me, I mean when you mentioned the cost all I could think about is that information might be important to the procurement department as for the people purchasing it because that's what they [emphasised] care about but not for all the rest of us, we don't even know how much the scrubs we wear every day or the soap or even the water bill, why should we it's not our job, our job is to provide the best care possible, but I get why your asking and it doesn't reflect the quality of the things we have…".*

As the COO was correctly predicted by one participant, the cost was presumed to be lower than what is used in the NHS. The participant expressed that the cost for the ADCS was "*more affordable*" as the mention of the 'hardware drill' implied that the current costs was high and that this option could make it more affordable or reduce costs overall. Most participants assumed that the cost for the ADCS was high, "*you wouldn't use a cheap fragile equipment to protect a high tech, expensive piece of device, it wouldn't make sense, it's like insurance for a car or phone, its not cheap but more money is needed to protect high valued items…*". Furthermore, the information about the business model implied that the linens were expensive to portray a cost saving or affordability to the procurement staff when in reality it was not honest, "*…it's like them BOGOFF [buy one get one free] deals in supermarkets or having discount codes to use online, like here we give you 20% off but then mark the original price of the item as higher, so your not aware of the fact your paying full price when your using the discount, its all part of marketing isn't it, these business models…*".

6.3.2.4 Useability

All staff participants rated the useability as "*easy*", "*quick*", "*sufficient*", "*user-friendly*" and "*sustainable*" - in regards to preparation time and supply maintenance. The overall useability was reported as being practical and pragmatic in many regards, "*if we were to use this on a regular basis and the supply all of a sudden stopped because of whichever reason, we can still continue to do our jobs and surgeries can continue because we don't necessarily need this innovation to continue, but it's great to have them because these linens are easy to use…*". Though the involvement of two people during preparation was reported as potentially "*excessive*", though understandable, participants recommended it may be more sufficient for one individual to prepare the surgical equipment. Though all three participants felt that the useability of the ADCS was generally positive, all participants in Group D recommended that the linen be tighter fitting to the drill to avoid any catastrophic consequences and increase safety for the user i.e., surgeon.

6.3.2.5 Clinical Effectiveness

All three participants felt that the clinical effectiveness was appropriate and adequate for consideration into the NHS. Once participants became aware of the COO (at the end of the interview), though they recognised that the innovation had acquired some necessary approvals and CE marking to adhere to national standards, approval from the MHRA was needed for it to be considered for implementation in the UK. It was recommended that further testing and piloting be conducted in the UK to enrich data from diverse populations and more relevant for its implementation. All participants stated that they would like to use the cover system in some capacity of preparation as the acquired clinical effectiveness made them feel comfortable about its use and practice, "*…I would like to test this out cause it seems quite easy to use and safe to use and I'm intrigued cause it looks cool, I mean I don't anticipate anything bad happening, it's got what it needs for me to show it safe plus I can't see anything bad happening with its use except maybe that loose material will cause some havoc…*".

6.3.2.6 Shared Decision-Making

The theme of shared decision-making was not significant though most participants provided commentary about the decision-making process and the level of information provided to patients. Most participants felt that the information about the cover system was not appropriate for patients to know as most were unaware of the equipment currently used in the NHS. It was deemed appropriate and necessary if it impacted the patient, but as this innovation caters to the handling of

surgeries more so than the patient outcomes, it was not necessary, "*…it would be more of an issue for the surgeon and the theatre staff than the patient so I assume they wouldn't need to know, to be fair, I don't think they would want to know as it would just make the situation of having surgery more scarier for some and a highly anxious situation which just make it worse, so erm yeah no I wouldn't say it's appropriate, I mean in my experience no one has ever asked…*".

Summary

The ADCS was perhaps the most favoured FI by most participants from the examples presented for numerous reasons including its purpose of providing safety control and limiting surgical complications, its design to fit the medical aesthetic, its COO, its name sounding innovative and expensive and its endorsement and support by HICs through the acquirement of approvals from known regulatory bodies e.g., the FDA and Health Canada. The COO stimulated a positive risk perception such that it was consistently compared to Sayeba's method and was found to be superior in every attribute which catapulted its image even further. The general risk perceptions from patient representatives in Group A revealed that the ADCS was rated as a low-risk innovation due to its widespread study, use and support by known regulatory bodies. In comparison to the previous FI examples, the ADCS was held at a gold standard of what an innovation conceived in a LIC should be and attain for appropriate implementation in the UK's NHS. These participants receiving both external cues (Group A), focused on the COO rather than frugality when discussing most of its attributes. Frugality was not associated when discussing risk at all and was largely facilitated by the image of its COO. The design, COO, cost, and useability of the ADCS had influenced its perceptions about frugality rather than the anticipated variable reaction of frugality leading perceptions about the attributes.

As the COO and the term 'frugal' was stated further, most participants expected the design to reflect low quality using loose and thin materials and poorly developed. Some participants associated a colourful design with transparent, thin, and cheap material with the idea of Africa, to which they were "*pleasantly surprised*" that it looked expensive and fit the medical standards. Both external cues impacted the perceptions of sustainability as ADCS was thought to alleviate the financial burden, increase accessibility, and reduce waiting times and support development and inclusion of innovations from LICs. one of the most predominant drivers of positive perceptions was the acquirement of approvals from known regulatory bodies such that all patient representatives felt that the clinical effectiveness was appropriately conducted and demonstrated its readiness to be used in the NHS.

On the other hand, the attainment of regulatory approvals provoked staff participants in Group A to further dissect the attributes of the ADCS such as risk, design, cost, and useability. Most staff participants rated the ADCS as high risk due to the additional material placed on an existing drill. Though they appreciated its efforts and design, these participants felt that it would hinder the functionality of the surgical drill to which they are already used to working with every day. It was also described as overwhelming and burdensome as staff had an additional step in preparing equipment for surgery in addition to needing two staff members for perhaps one job. Though some participants felt that the ADCS was a great initiative to control infections, bacteria, contamination, it was the application and context that resulted in its high-risk rating. Though they acknowledged and valued the intention in creating an affordable and effective innovation, the cover system was described as unnecessary and would incur further costs to the NHS. Most participants felt that though the clinical data seemed conclusive, its accuracy and rigour was faulted to the specified COO such that they believed results were bias to the countries endorsing the FI.

Most patient representatives receiving only the 'frugal' cue (Group B) stated that the ADCS was safe and reliable and could offer many advantages to the NHS. The core premise of the ADCS surrounded patient care and increasing safer surgeries to which was typically seen as the opposite outcome to something being frugal. Though these participants very much favoured the ADCS, some did not favour the use of hardware drills over surgical drills, though it would make the overall FI even more affordable. Within Group B, most participants rated ADCS as low risk though this would change if the use of hardware drills were to replace surgical drills. For some participants, the design, useability, cost, and shared decision-making was positively influenced by its frugal initiatives such that these attributes did not represent something as frugal but rather the opposite and expensive.

On the other hand, staff participants rated the ADCS as low risk as it was a preventative innovation limiting the adverse complications of surgical interventions. They felt satisfied with the degree of approvals obtained. The impact of frugality was discussed as typically cost is used as a measure of risk, because if the product is significantly cheaper than the curiosity and critique would be higher, however the staff participant did not overly critique the ADCS despite its reference to being a FI. Similarly, patient representatives in Group C, rated the ADCS as low-risk and were in favour of its use in the NHS. Some participants felt that the COO should not be mentioned as it may influence a patient wrongly towards its dissent or become overly critical towards its use. Risk perceptions were attributed to the design, application, useability, acquired regulatory approvals, CE marking and clinical data. These participants expressed a connection between risk and practicality with the COO.

Many of these aforementioned perceptions and narratives were mirrored by patient representatives in Group D such that the ADCS was again rated as a low-risk innovation, primarily due to its intention to provide safer surgeries. The ADCS received overall positive perceptions with a limited degree of criticism regarding its potential complications such as the extra material surrounding the drill possibly causing slippage or caught in the notches of the drill. Though staff participants in Group D also rated the ADCS as low risk, the granularity of perceptions were nebulous and brief. These participants felt that having regulatory approvals demonstrated a successful and safe compliance to the standards required in the NHS. Similarly, to patient representatives in Group D, staff participants were not overly critical of the ADCS though all did provide a recommendation for adaptation and functionality which was mainly regarding its design. The next chapter discerns these trends alongside those obtained from the aforementioned chapters and applies the SCT to further understand and interpret behavioural and expressive responses.

Chapter 7: Synthesis Chapter

Chapters 4, 5 and 6 presented the responses to questions based on a semi-structured topic guide, including how innovations were perceived according to design, useability, cost, risk, clinical effectiveness, and shared decision-making, by patient representatives and NHS staff. Chapter 7 will discuss the synthesis of high-level trends across the presence and absence of external cues, level of invasiveness and descriptive responses from patient representatives versus NHS staff whilst applying the SCT to interpret and understand behavioural and expressive responses. The use of linguistics, expressions and speech analysis was interpreted by the combination of TA and CA. Further rigour was also provided with the use of SA to understand the sentiments of responses and quantify the impact of such feelings with the level of intensity. This would help understand predictive behaviours such that the impact of sentiments predicts prospective outcomes or actions of behaviours towards an exposure like a FI. The SCT demonstrates the different ways in which participants perceive the innovations based on external and internal factors, *determining the reasoning of their responses, whether the perception was based on an innate experience or observational learning, determining the factorial cause of the response to then find alternative ways to regulate such perceptions* (Bandura, 2017). All three core constructs of the SCT were active in the interpretation and understanding of perceptions to which its TRD model demonstrated the effect of one variable on another. Furthermore, as proposed in the SCT, some variables are more active than others e.g., the environment posed a significant influence in how participants viewed innovation, frugality, and the COO such that many deemed LICs as not appropriate for the NHS. Overall, the SCT constructs, and its ideologies help ascertain the origins of perceptions, its accuracy, limit bias, and subsequent regulation and behavioural change strategies.

In summary, the SCT model provides a framework for understanding, predicting, and changing human behaviour. The SCT focuses on how individuals, irrespective of age, operate cognitively based on their past social experiences and how these connections then influence and evoke certain intentions, behaviours, and development. The relative SCT domains will be applied to the qualitative results for all three innovations. The SCT constructs can help support and facilitate the understanding of such behaviours, *responses*, and may help indicate how they can be regulated for future assessment and studies of acceptance of FI. The qualitative results in this chapter were separated into three dimensions, *according to the aims and objectives of this research study*, (1) trends between Groups A (presence of both FI and COO cues) and D (absence of both FI and COO cues), (2) trends between invasiveness of innovations (MNM – most invasive, Sayeba's Method, ADCS – least invasive) and (3) trends between responses from patient representatives and NHS staff.

Sentiment Analysis Results – All Groups (A-D)

Our thematic analysis and CA found that though frugality was associated with negative expressions, the SA demonstrated this expression to occur in variation according to the utterance of specific keywords, which at times heightened the choice towards rejection of the FI as opposed to acceptance. The SA model across all Groups corroborated the results found from the thematic analysis and CA, as the term 'frugal' was associated with a negative polarity, whilst the term 'innovation' was associated with a positive polarity though both were discussed as two distinct concepts. When discussing the FIs, participants across all Groups generally would contribute the positives with the innovative parts of the product or technique, which would be translated across other features such as cost, clinical effectiveness, design, and useability. We used a word cloud visualisation feature called Knime to demonstrate the polarity variance across each Group when frugal and COO was mentioned as opposed to the utterance of one and neither. This step was conducted after the pre-processing step of classification.

Figure 4 demonstrates the type of keywords used by participants to describe the innovation with and without the cues. The words in coloured in red are those with negative polarity whilst those in green have positive polarity. The words that were most frequently used according to each cohort and exposure to cue(s) as shown in bold font. The most frequently used words were "*great*", "*interesting*", "*innovative*", "*smart*", "*savvy*", "*expensive*", "*futuristic*", "*smart*", "*practical*" and "*creative*". Each if these have a polarity rating. These word clouds provide a temporal projection that can track the progress or changes of FI over time by simple classification and polarity analysis. However, Figure 4 shows how each feature and cue resulted in a singular polarity score and negations. Furthermore, it shows as part of the lexical resources used e.g., SentiWordNet, each word is assigned a 'part of speech' (POS), unique ID, a positive and negative sentiment score. For example, the word "*cheap*" is illustrated as 'a (adjective – POS tag), 02365201 (unique ID), 0.175 (positive sentiment score) and 0.976 (negative sentiment score). The reason for a positive and negative sentiment score is due to a polysemantic meaning of words and the context in which it is uttered. For instance, stating the word "*cheap*" is not necessarily a negative thing when spoken in the context of reducing costs but is spoken with a negative connotation when speaking about risk. However, to find the pure orientation of the word, two lexical resources were used consisting of positive and negative words, which were then compared to find the most accurate result.

For those who were exposed to both cues 'frugal' and 'COO', the frequency of the terms increased according to specific features. Though 'frugal' was not associated with healthcare for most

participants (both patient representative and NHS staff), its meaning shared a common understanding and thus sentiment.

Table 8: Comparative Sentiment Scores for Group A (COO & Frugal)

	Patient Representative			NHS Staff		
ADCS	96.10%	2.40%	-1.50%	34.40%	63.10%	-4.44%
MNM	87.50%	11.40%	-1.10%	51.14%	40.81%	-8.05%
Sayeba's Method	8.78%	4.49%	-86.73%	2.96%	1.72%	-95.32%
Sentiment Polarity	Positive	Neutral	Negative	Positive	Neutral	Negative

Table 9: Comparative Sentiment Scores for Group B (Frugal Only)

	Patient Representative			NHS Staff		
ADCS	82.40%	14.30%	-3.30%	52.39%	45.33%	-2.28%
MNM	63.20%	30.20%	-6.60%	53.10%	43.48%	-3.42%
Sayeba's Method	16.28%	8.60%	-75.12%	5.62%	11.78%	-82.60%
Sentiment Polarity	Positive	Neutral	Negative	Positive	Neutral	Negative

Table 10: Comparative Sentiment Scores for Group C (COO Only)

	Patient Representative			NHS Staff		
ADCS	77.60%	18.40%	-4.00%	57.23	19.90%	-3.40%
MNM	61.60%	7.20%	-31.20%	49.40%	41.89%	-8.71%
Sayeba's Method	13.90%	6.20%	-91.90%	25.40%	18.90%	-55.70%
Sentiment Polarity	Positive	Neutral	Negative	Positive	Neutral	Negative

Table 11: Comparative Sentiment Scores for Group D (No COO & Frugal)

	Patient Representative			NHS Staff		
ADCS	97.36%	2.00%	-0.64%	51.30%	44.30%	-2.13%
MNM	91.41%	7.54%	-1.05%	57.23%	41.79%	-0.98%
Sayeba's Method	86.30%	11.30%	-2.40%	41.56%	56.44%	-2.00%
Sentiment Polarity	Positive	Neutral	Negative	Positive	Neutral	Negative

The COO held significant weight in possibly dampening the positive sentiment of the MNM in Groups A and C for NHS staff. This could suggest that the positive polarity in Group A for MNM by NHS staff (51.14%; see Table 2) was attributed to the perception of frugality as opposed to the COO. A consideration for this result could be implied as the positive polarity for the same innovation by staff members, was higher when just exposed to the 'frugal' cue (53.10%; see Table 3). Thus, much of the positive sentiment in Group A may have been attributed to the 'frugal' effect. The same effect was

recorded when no cues were provided which led to the overall positive sentiment to be higher than those recorded for Group A and whilst no cue was provided (57.23%; see Table 5). This may be further corroborated by the lowest positive sentiment recorded from those in Group C to which only received the 'COO' cue (49.40%; see Table 4). In Group B, the overall negative polarity scores across all three FIs were lower than that reported for Group A for both NHS staff and patient representatives (see Tables 2 and 3). This could indicate that the COO held more weight in mediating perceptions than the 'frugal' cue.

NHS staff in Group C showed the most variation between the three sentiment polarities (see Table 3). Results indicated that the COO alone provoked the highest negative sentiment compared to other Groups, potentially demonstrating that the COO is the main driver of a negative perception and consequential rejection of the FI for professions. Furthermore, it showed that the COO could spilt the narrative of an opinion due to certain features which could be influenced by how the COO was perceived. For example, perceptions about the material used and the design of the FI were influenced by the COO as some described these features as "*unnecessary*" and "*potentially dangerous*" but when discussed in the context of 'cost' and 'risk', the COO was used to excuse and negate the chosen material and the design to which shifted the narrative and increased negation, switching between positive, neutral, and negative.

The overall positive sentiment for patient representatives in Group C is lower than those detected in Group A which received exposure to both cues. This suggest that patient representatives process the COO cue more negatively than the 'frugal' cue and furthermore more negatively than professional staff. Furthermore, though the 'frugal' cue could evoke a more positive perception than the 'COO' leading to acceptance, its absence could also increase it further as seen in Table 5. Additionally, certain countries were perceived to be superior to one another and more acceptable than another e.g., India (MNM) and Africa (ADCS) were perceived as more positive than Bangladesh (Sayeba's method). This is effect is further heightened when the LMIC is endorsed by a HIC such as the USA, Canada, and UK.

7.1 Trends Between Groups A and D

7.1.1 Understanding of FI

For patient representatives in Group A, the presence of external cues of 'FI' (utterance of "frugal innovation") and 'COO' (utterance of the actual country the innovation was developed in e.g., "Bangladesh") elicited a more blatant expression such that it was evident and bold in response and, for most, a favourable response to all three innovations. Approximately, 97% of patient representatives provided their consent for the use of all three FIs in their care, however this was not without constructive criticism. All participants, irrespective of Group, were first asked a generic question about whether they required more information about the innovation. This question was positioned first to try and elicit an open, unfiltered, unnavigated response and to evaluate any equivocal projections based on the two cues of 'frugal' and the 'COO'. Only a few patient representatives asked for further clarification about the term 'frugal' whereas other patient representatives may have explicitly or implicitly understood the term.

One of the most noticeable trends was the lack of further clarification or response to the term 'frugal innovation' by staff participants in Groups A as opposed to patient representatives in Groups A. The position of assumed understanding of what the term 'frugal' meant could be explained by some of the personal attributes of the SCT such as knowledge, expectations and attitudes and environmental factors such as social norms, accessibility, and influence of others. The interviewer had asked all participants in all Groups about what the term 'frugal' meant to them or what they understood it as which generated a synonymous understanding and linkages to external forces such as environment, social norms, intrapersonal experiences. Furthermore, one could argue whilst using the SCT to explain such a behaviour that those who did not ask for further clarification demonstrated a sense of self-efficacy, skill, or practice in that they believed they understood the term or could understand the term through conversation or presentation of the innovations as opposed to asking for further clarification and this would be a skill in itself. Furthermore, it also demonstrated presence of behavioural capability in that those in Group A believed their knowledge and skillset could influence their behaviour with confidence because their previous experience provided a grounding for possible outcome expectations. This skill could have been acquired through environmental factors and/or cognitive factors as a matter of 'normal attitudes' and previously acquired knowledge through dissecting the terms and formulating expectations of what the term 'frugal innovation' meant. Conversely, such absence responses to the initial question could demonstrate certain behavioural trends of selective attention and interest, such that those who did not ask for further clarification may be implicitly

expressing their disinterest in the term or content. It is reasonable to argue that many patient representatives may not have responded due to receiving incentives to participate and could be displaying expressions of disinterest, which is corroborated at times through nebulous and monotonous responses when using prompts. When given some examples of frugality, some patient representative responded with adjectives that are often associated synonyms such as "*cheaper*", "*affordable*", "*flimsy*" and "*fragile*" to further confirm their understanding and conflated frugality either implicitly or explicitly with cost and quality. Initially, the body language and facial expressions of some female participants when presenting the FI examples confirmed some degree of hesitancy but when provided with more information, these expressions turned more confident and positive.

Furthermore, with the evocation of frugality, some of the participants confirmed the importance and possible influence of the external cue which was extenuated throughout the individual interviews. In contrast, no NHS staff member had asked for the definition of 'frugal innovation' across all three innovations, but rather noticed and deconstructed the term explicitly and implicitly which led varying commentary that was both negative, though a small number of staff, such as "*cheap*", "*floppy*", "*recycled*", "*thrifty*" and positive, most members of staff, "*sustainable*", "*affordable*", "*accessibility*", "*adaptable*", "*purposeful*", "*simpler*", "*competitive*" and "*equipped*". However, the 'frugal' cue also elicited a minimal and monotonous expression from a few staff participants, "*alright",* "*OK*", "*fair play*" and "*decent*".

No participant had expressed hearing the term 'frugal innovation' previously but could ascertain what the terms meant individually, which both posed an opposite meaning to one another. An example of this was observed when most participants believed 'frugal' meant something to do with cost, lifestyle, adaptation and accessibility all within a negative narrative of cost whereas the term 'innovation' was referred to as novel, new and expensive. However, when both terms were fixed to one construct, '*frugal innovation'*, the overall perception was negative to which the term 'frugal' weighed significantly more than the term 'innovation'. Noteworthy, was the inclusion of 'innovation' that broadened the perspectives of the FI as a whole, which allowed participants to respond positively and remain optimistic about its use. The addition of the 'COO' cue for those in Group A as opposed to Group D who presumed the innovation's COO, shared many of the same expressions but were not as apologetic for such responses nor did they need assurance from the interviewer, which may have been attributed to some having received confirmation of about the COO and some not being told until the end of the interview coupled with the lack of criticism in comparison those in Group A. The dynamics of free expression followed by the need for reassurance could demonstrate the presence of

environmental attributes such as social norms, *acceptable social attitudes,* and stereotypical behaviour, personal attributes such as attitudes and behavioural factors such as *the lack of* skills and practice.

The term 'frugal' was also associated with discussions about costs and budgets, which were recorded as being more analytical concepts as opposed to design and shared decision-making, which can be thought of as more subjective and abstract concepts. Cost was not significantly mentioned in responses from those in Group D, *no evocation of 'frugal'*. This could suggest that the term 'frugal' was highly associated with the concept of cost and quantitative data that subsequently provoked further discussions about the cost of each innovation and thus more scrutiny. From the initial evocation of 'frugal innovation' in Group A presentations, the discussions with staff participants focused on the technical aspects of all three innovations and how the features and the innovation itself compared to the current practice and tools. However, we cannot rule out the implication of presenting the COO alongside 'frugal innovation', as the presentation sought to provide an equal balance to both external cues, such that every time the term 'frugal innovation' was mentioned and positioned, the 'COO' was also uttered and presented, *according to the Thinking, Fast and Slow Theory* (Kahneman, 2011) (see *Methodology*). Discussions about the innovation itself, perceptions, and utterances of 'frugal innovation' often conflated perceptions and conversations about its COO by both staff and patient representatives in Group A as opposed to those in Group D. These discussions then implied suggestive assumptions and perceptions about each innovations COO, which subsequently led to at times, *though positive*, stereotyping behaviours, supercilious and condescending narratives. On the other hand, most participants in Group D were open-minded, mostly positive, welcoming and "*innovative*" in their mindset to involving themselves in the evolution and potential adoption of the innovation into the UK's NHS.

7.1.2 Association Between Cues and Criticism

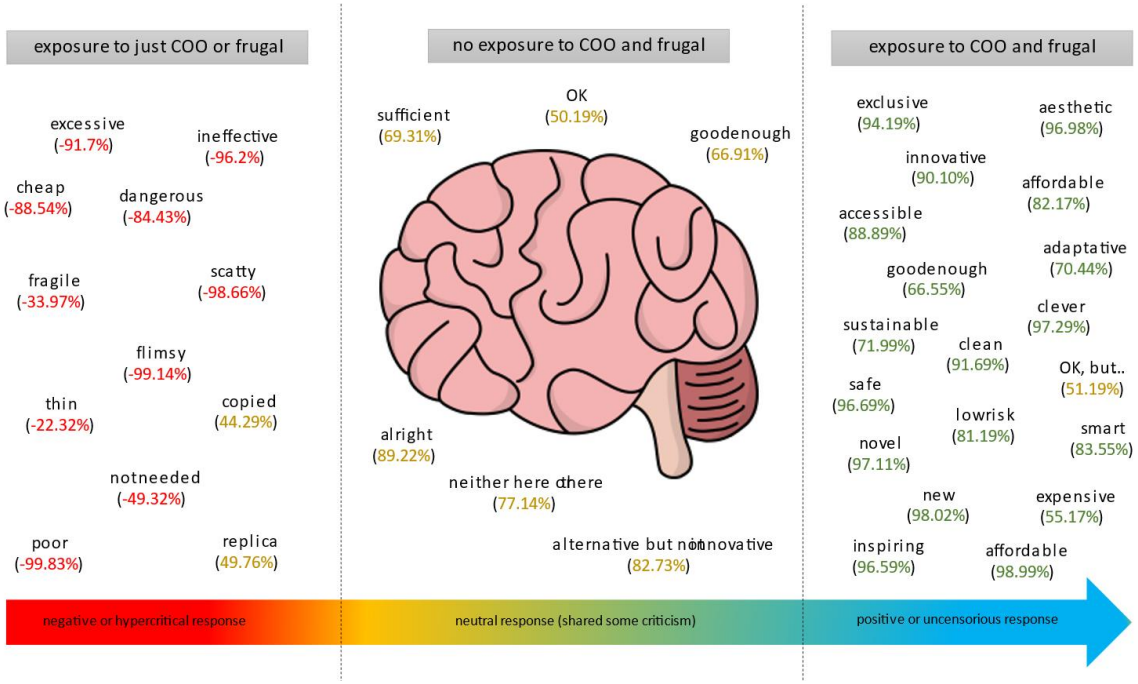
Although those in Group D did not receive the 'frugal' and 'COO' external cues, the overall perceptions of all three innovations seem to mirror those found in Group A. The degree of criticism was lower than those in Group A which may suggest that presenting more information or the evocation of suggestive 'new terms', increases the likelihood of criticism, which may be attributed to the unfamiliarity consequently provoking further assessment of the innovation. Another explanation could be that participants were motivated to find some negative or weakness because the overall perception of the innovations was 'too positive', fitting the suggestive narrative that not all things are perfect and need to apply a recommendation. Such responses are understood and explained by the notion of relying on

information that is familiar to assert an expression which poses dependency on the personal and behavioural constructs of the SCT. These constructs are dictated by the participants' processing of information feed by the environment, such as media, word of mouth, social norms which moulds the perception to a country's affinity to animosity.

Group A scored a higher negative polarity score than those in Group D, who were not exposed to any cues (see Tables 8 and 11). Furthermore, there was a larger proportion of participants who shared negative subjectivity scores such that token and features were significantly and explicitly more negative than those reported from Group D. Term frequency of 'frugal' and 'COO' and other associated synonyms were higher in Group A (n= 266; n= 311) than those in Groups B (n= 112) and C (n= 262). This could be attributed to the lack of exposure to external cues, however identifiable information e.g., the name of the innovation, could not extend the same value to those in Group D. Both external cues were uttered in every response by patient representatives in Groups A, B and C. Common tokens used in Group A to describe the FI included, "*cheap*", "*thin*", "*unsafe*", "*risky*", "*unreliable*", "*dangerous*", "*creative*", "*innovative*", "*sound*", "*clever*", "*sustainable*", and "*effective*". In contrast, common tokens reported in Group D included, "*effective*", "*clever*", "*affordable*", "*durable*", "*smart*", "*neither*", "*sufficient*", "*alright*", "*ok*" and "*good enough*".

Tokens reported in Group D were more neutral than positive though the typical syntax may suggest positive outside of SA models. This may be due to the preprocessing method and a baseline level of pragmatic features which provides context to the formation and development of such terms in addition to the implicit language detection which discerns tone of speech e.g., sarcasm, irony, and humour. Furthermore, Group D reported more detection of negations than those in Group A, which meant that the tokens used to describe a FI, reversed the polarity of a perception, shifting its overall meaning e.g., "*neither here nor there*", "*cannot judge it fully*", "*alright*", "*none of them…*". Negations and stop-words were not removed from the data as this would cause an increase in computational costs and reduce our model's accuracy.

Figure 15: Comparative Tokens with Polarity Scores



As participants in Group D were not exposed to the external cues, 'filler information' was implicit and presumed which often led to a neutral polarity rating and objective classification (NHS staff only) as opposed to subjectivity classification. Participants used information about the name of the FI, material used, useability features, clinical evidence, and the lack of accreditation to overall perceive the FI, though many did not inquire about validating this information. A level of uncertainty dictated the neutral polarity whereas those receiving the external cues in Group A, expressed a level of certainty and confidence to express their perceptions which either led to a positive or negative polarity in most cases. The high number of negations in Group D compared to those in Group A were most likely attributed due to the lack of certainty thus projected a more neutral, conservative polarity score and subsequently, its overall sentiment. Some aspects, features, and tokens of the ADCS from patient representatives in Group A provoked an overall positive sentiment because it was based on the information given, thus specific factors and contexts can mediate overall acceptance through positive polarity. However, this was different for staff members in Groups A and D (Figure 15).

7.1.3 Structural Changes in Expression

Notably, the narrative of free and *unfiltered* expression could suggest that there was influence of self-efficacy as participants believed they could address their points and beliefs without a consequence. This is because they may have expected (outcome expectations, personal factor) reassurance from the interviewer and/or felt comfortable and confident (personal factor) in expressing their true beliefs

of the innovations and its COO. Patient representatives who were more expressive and critical of the innovations in Group A were mostly employed in other non-healthcare related industrial sectors. As the SCT posits, behaviours evoked are a product of an individual's learning history – their intellectual and physical capacities and their present perceptions of the environment.

Across all three innovations between Group A and D, COO served as a significant factor in the perception variations of the innovations but also in its consideration of acceptability. Most participants in Group A conflated the two cues explicitly, interchanging 'frugal' and 'country of origin', or implicitly, by responding to the question "*does the country of where the innovation is made or developed matter to you?*" and discussing frugality in place of the COO. This speech illustrated a form of stepwise transition, *a conversation moving routinely from one topic to another, forming gradual and naturalistic discussions* (*indicative of comfortability and acceptance of talk*). These participants explicitly stated that the COO is one of the most important components of accepting the innovation in their care. This is because the COO served as an indication of reputation, trust, experience and innovation development. Conversely, those in Group D, although a small proportion of participants, shared the same attitudes towards the presumed perception of the respective COO.

In Group D, most participants were able to correctly presume the region of the COO due to the name of the innovation itself, i.e., Sayeba's Method sounded of an Asian or African decent and MNM sounded as though it belonged to the African region due to the prevalence of mosquitos compared to other HICs. Here, the name of the innovation or its characteristics or intention may have been used as a proxy to ascertain or subconsciously link its information processing to its COO. Therefore, it demonstrates the challenge to discern the impact of the COO cue itself by those in Group A, as the SCT cannot highlight the driver variable such to expose the domain eliciting the need for the association. For instance, while we can acknowledge the presence of importance on the COO, particularly in response structure and linguistics, it is difficult to understand what provokes one to presume the COO or the need to consider the COO, irrespective of consciousness in order to process the information. we can assume that cognitively and psychologically this has associations with the country affinity and animosity, particularly when assessing how responses are framed to different segments of the interview e.g., risk, image, reputation, and clinical evidence.

7.1.4 COO Effect on the FI Name

On the other hand, for most participants in Group D, ADCS although sounded like it was developed in a HIC due to the specific sound of the word 'Arbutus', which many participants believed it conveyed "*futuristic*" and "*innovative*" elements, the innovation itself, *protective cover material for a surgical drill* and its capability to be used with a hardware drill, led some participants to believe it's true origin was a LMIC or UMIC. Though most participants in Group D provided positive feedback and overall acceptance of it use in their 'hypothetical care', the descriptions about the design, clinical effectiveness and cost were consistently tangled with its perceived COO and compared to other innovation examples i.e., the clinical effectiveness of Sayeba's Method was compared to the clinical effectiveness of ADCS as they acquired regulatory approvals which was also conflated with risk.

7.1.5 Country Affinity and Animosity

Noteworthy, is the acceptance of some COOs as LICs and not others. Specific countries, though belonging to the same LIC classification, were given superiority over others or described as being more reputable such that it mirrored the likelihood of acceptance and overall perceptions of the innovation. Furthermore, the same association was echoed in responses from those in Group D, *without the presentation of its COO*. These associations were influenced or somewhat facilitated by the possession of '*known*' regulatory approvals such as FDA and Health Canada. The link to a HIC whether it was indirect, *nothing to do with the development of the innovation itself but approvals obtained* or direct, *supporting the development of and facilitating the innovations' adoption*, led to the overall approval and appreciation of the innovation. Though the ADCS and Sayeba's method were less invasive in comparison to the MNM, participants in both Groups A and D were more positive and accepting of the ADCS and MNM than Sayeba's method.

Additionally, participants in both Groups also favoured the MNM more so than Sayeba's method. Whilst there are many factors to consider in this association such as design, intention of the innovation, materials used, useability, risk and clinical effectiveness, the COO did have a significant influence on all three of the innovations' overall perception irrespective of how invasive the innovation is and its perceived risks. After the commencement of the interview, innovations developed in India and the country itself was described as "*up and coming*", "*in the midst of innovation greatness*", "*one to watch out for*", "*homegrown*", "*creative minds*" and "*threat to innovation giants*", whilst innovations conceived in Bangladesh and the country itself was described as "*unpredictable*", "*not really innovators*", "*still small, long way to go*", "*neither here or there*", "*cheaply made*",

"*outsourcing*" and "*not really heard about it at all until now*". The overall narrative of some participants in Group A who favoured the two innovations, *though obtaining more data would make Sayeba's method more acceptable*, and provided positive feedback, showed some patterns of superiority and condescension, with statements such as "*unconventional innovators*", "*fairplay going after the giants*", "*threatening the marketspace*" and "*small fish in a big pond but better idea*".

7.1.6 HIC Endorsement Effect

Some participants from both Groups A and D stated that the support from a HIC made the innovation safer and more reliable and felt that as Sayeba's method did not obtain such regulatory approvals and was not supported by a HIC in any publicised capacity, the COO was to blame (*political position and economic status*) and further criticised the reputation of science, medical data and innovation development, though most of these opinions were from those in Group A. Some of these associative links were mirrored in response from those in Group D, though the innovations' true COO was not confirmed until the commencement of the interview, the COO was for the most part presumed correctly. Most participants in Group D shared many of the same perceptions about the legitimacy of the clinical data and overall reliability as those in Group A. These participants, under the presumption that two innovations (MNM and Sayeba's method) are conceived in a LIC or LMIC, and mostly provided positive feedback, believed that the clinical data was "*flawed*" as the process of collecting data could not be reliable as there was no legal standard to follow, and the limited number of trials and testing and the absence of HIC support, indicated its lack of reliability. It was suggested that if those in the innovation's COO, e.g., Bangladesh (Sayeba's method) and India (MNM), did not want to participate in trials whilst including their own populations or their own population had hesitancy in being involved, then it should not be expected for the general population in HICs, to want to use it or have it trialled in the NHS.

7.1.7 Presumed COO Effect

In contrast, where the COO was presumed and not presented, most participants in Group D provided overall positive feedback and provided a sense of optimism towards learning from those in LICs and the "*true innovators of the world*". These responses were mostly based on the perceptions about the presumed COO as opposed to a clear presentation of the COO. Many of these responses were also coupled with past experiences of using products and services in LICs which may have triggered the differences in perceptions as they were not led by the topicalisation of COO but rather generic questions about the innovation. Such perceptions of those in Group D were mostly limited and less

critical which may be attributed to the absence of external cues, though the perceived COO was mostly correct, and participants were mostly unemployed, with some having previous experience working in the NHS. The ability to express concerns, recommendations, and free flowing perceptions without needing reassurance suggest that there was an influence of acquired knowledge, self-efficacy and confidence in expression.

Although, participants in Group D were generally less critical which may suggest an influence of acquired social norms in a working environment in that opinions and feedback from NHS staff in a working environment was generally not welcomed nor required. This assumed association was confirmed in some of the responses from patient representatives when discussing the design of the innovations, risk perceptions informed decision-making about their healthcare. Here, we can demonstrate the triadic reciprocal determinism (TRD) model which illustrates the presence of all three constructs simultaneously during the expression of perceptions and how the degree of each construct varies in narratives.

The staff responses from those in Groups A and D did not vary significantly except for when discussing the foundations of the innovation which was focused on the COO (Group A only). Notably, though participants in Group D could presume the COO, their overall perceptions did not vary significantly from those in Group A. This behaviour may be explained by the lack of importance of the external cues on the innovation which may be attributed to their advance knowledge, attitudes and expectations (personal attributes) of the different features of the innovation and how that applies to their current practice. Furthermore, these staff participants may have self-regulatory skills to keep up to date with current innovations and practices through self-efficacy (behavioural attributes) and time management which can be confirmed by their participation in our study and discussions about how and why they keep up to date with current scientific research. The narrative of such expressions from those in Group A differed from those in Group D in the context of structure. Perceptions from staff participants in Group A were less structured and more informal than those in Group D. The difference may be subjected to the type of information provided as opposed to presumed. Personal attributes such as knowledge and attitude may have been more suggestive and impactful in those in Group D as the presumed COO was not important in any factor compared to those in Group A, which seem to justify or reason some criticism with the COO. Furthermore, the differences may have also been influenced by the non-confirmation of the COO for those in Group D which may have provoked participants to be more restrictive in their expressions.

These factors and its interplay suggest that though the TRD model is accurate in demonstrating a multifaceted interaction of factors, it does not however demonstrate the driver construct or domain which is solely influencing one variable more so than others, thus it is challenging to ascertain when to intercept and alter the dynamic of communication and interpretation. When developing interventions to manage active variables and moderators such as social norms, self-efficacy and reinforcements, it must demonstrate the order in which each can be managed and altered to produce the desired outcome of acceptance. For instance, both staff and patient representatives in Group A initially provided positive perceptions based on the understanding of frugality and the benefits of the COO on its uniqueness, however perceptions were subtly changed to involve criticism when discussing risk and clinical evidence according to a specific innovation whereas this behavioural capability was consistent among those in Group D. The consistency of expression and narrative could be demonstrated by the lack of importance on the external cues and the purpose they serve of the processing of information to the extent in which neither would need to be uttered to formulate perceptions. This may be demonstrated through their responses and the activity of personal and behavioural domains of the SCT such that self-efficacy was dominant through lived experiences which help to shape environmental cues such as social norms.

On the other hand, the subtle transitional changes in attitudes and expressions of those in Group A is difficult to conclude whether the comparison of risk to other innovations like ADCS provoked criticism of the MNM and Sayeba's method or the COO on the clinical evidence and acquired regulatory approvals for one innovation and not others – did the environmental domain influence criticism and subsequent behavioural factors such as skills and self-efficacy in the belief that certain innovations were riskier than others because of the COO or the innovation itself or its ideology or did the personal domain attributes dictate how one felt about the COO in the context of risk. This interactional interplay could not be concluded and thus limited the understanding of certain behaviours when transitioning from positive to negative and vice versa.

Summary of Trends Between Groups A (Presence of Both FI and COO Cues) and D (Absence of Both FI and COO Cues)

- Assumed understanding of 'frugal' innovation could be explained by personal and environmental attributes of the SCT.
- Those who did not ask for further clarification demonstrated a sense of self-efficacy, skill or practice in that they believed they understood the term or could understand the term through conversation.
- The self-efficacy domain was particularly active in staff participants across all Groups. This in turn may have been attributed to the behavioural construct in that lived practices developed attitudes towards self-efficacy.
- The staff participants in Group A believed their knowledge and skillset could influence their behaviour with confidence because their previous experience provided a grounding for possible outcome expectations and risk perceptions.
- Self-efficacy demonstrated the freedom of speech with confidence as beliefs but it also shows the lack of when participants sought reassurance from the interviewer.
- The limited criticism by staff participants in Group D compared to those in Group A may be explained by the influence of social norms in a working environment in that feedback from employees is generally not welcomed or considered in their respective location or that the level of expertise differs (behaviour) in the action of the certain personal attributes such as the attitudes towards the innovation.
- Staff responses from those in Groups A and D did not vary significantly except for when discussing the foundations of the innovation. Though Group D could only presume the COO, perceptions generally mirrored those of Group A. This could also demonstrate the variation in the active states of the TRD model irrespective of external cues.
- The more information presented to the individual, the stronger the presence of active states of the TRD constructs. This was supportive of the conclusive responses obtained from those in Group A compared to the those in Group D for patient representatives only.

7.2 Trends Between Invasiveness of Innovations

7.2.1 Degree of Risk and Acceptance

One of the most significant trends found among the invasiveness of the three innovations was the impact of the design on risk aversion. Most participants across all four groups felt that though the MNM was the most invasive innovation of the three examples, it was less risky than Sayeba's method. The causation for such an association was the design element, specifically the condom element that was described as "*cheap*", "*thin*" and "*not purpose intended*", which was further exacerbated by the COO for those receiving the cue to equate to a dangerous innovation. Furthermore, the ADCS, *least invasive*, was found to be the least risky, but this was primarily due to the attainment of regulatory approvals not the innovation itself as this was found to be high-risk due to the material used and its involvement with surgical use.

The application of the SCT to the trends between invasiveness of innovations could perhaps serve the most significance as it involves the direct behaviour of intent (desired behaviour, *acceptance through risk*) within the trend, i.e., risk perceptions, *how risk averse is the individual? and why?* and the intent to accept the innovation, *would the individual accept or reject based on the risk perception of the innovation?* The design, useability and clinical effectiveness of each innovation was reported as drivers of risk perception, though such perceptions were contingent upon the influence of external cues, i.e., for some patient representatives in Groups A and C, the COO provoked a negative risk perception to Sayeba's method because Bangladesh was expressed as a country unable to obtain legitimate and transparent clinical data, which consequently led to its rejection to use and ultimate implementation.

The external cues of frugality and COO served as influencers or companions towards reducing risk, which was also seen in the MNM innovation, *most invasive*. Specific COOs were shown to reduce the risk and perceived invasiveness such that it reflected how the functionality was perceived, *improved*, and circumvented the use of particular materials e.g., MNM. The COO was also used to circumvent the perceived risk. On one hand, most participants raised concerns about the limited clinical evidence obtained for Sayeba's method, which dictated their risk perceptions and overall distaste towards the innovation but used its COO as a plausible cause for this concern. On the other hand, though the MNM had more clinical evidence and use than Sayeba's method, its COO was used to circumvent and increase its possibility for success in a HIC. This notion of the country dictating risk and general perceptions of the innovation suggests a significant dependency on country affinity and animosity as opposed to the internal information about the innovation e.g., technical, design, compatibility, and

functionality. Such information processing is dictated by the belief in the COO, irrespective of its explicit utterance as participants actively sought, whether subconscious or not, to connect the COO to the information presented. This is demonstrated through the presence of behavioural patterns of the SCT domains such that the behaviour and personal constructs have reciprocally dictated the shaping of environmental norms.

One of the most significant findings of our SA model was the association between invasiveness, risk, accreditation and COO. These features had a positive polarity in the context of meaningful information and those that would drive the overall acceptance of the FI. Such features also scored highly in the subjectivity classification such that though some features i.e., invasiveness (88.54%), accreditation (99.18%) and COO (83.88%), which are objective measures or outcomes, were expressed in a subjective manner. For example, some participants in Groups A and C expressed that possessing a board-certified accreditation was important and gave them confidence to accept the ADCS. In contrast, those in Groups B and D stated that though accreditation is important, the COO should not dictate its aim in obtaining one and provoked a negative response to Sayeba's method which did not have one. The 'COO' was isolated as a key aspect and feature in the SA model for all four Groups and resulted in the narrative that if the FI is supported or endorsed by a HIC through its perceived safety and compliance measures, its likelihood of being accepted for use in the UK is increased, thus its overall sentiment is positive. Furthermore, as the syntax for each individual person is different and unique, we found no deception detected in our SA models compared to those conceived during the TA and CA models.

7.2.2 The COO Effect on Risk

Notably, the more positive the perception of the COO, the less risky the innovation was described as, i.e., MNM, the most invasive example, was seen less risk averse than Sayeba's method, which involved a temporary acute invasive technique of inserting a condom that inflates with saline in the uterus to control bleeding post-birth. It was expressed as "*somewhat invasive*" and high-risk because it was a technique that involved insertion into an "*intimate area*" and that area was deemed high-risk in addition to the use of a condom which by some participants across all groups was described as "*cheap*", "*ineffective*", "*scatty*" and "*dangerous*". The adjectives used to describe their overall perceptions were conflated with their perceptions about the COO. India was expressed as "*up and coming*" whereas Bangladesh was described as "*unpredictable*", "*not really innovators*" and "*cheaply made*". Though both COOs were referred to as LMICs, Bangladesh was seen worse off than India with

respect to innovation development and marketing as participants had heard of innovation advancements and science derived from India but none from Bangladesh.

Some patient representatives across all four Groups rated Sayeba's method as the riskiest innovation among the three presented, which was initially based on the design element. Many of these participants felt that the condom alternative was "*not innovative at all*" and "*completely dangerous*". Under the personal attributes of the SCT's TRD model, we noticed that these participants expressed some knowledge of innovation and the expectations for these innovations to be successful, though what they thought about innovation was primarily conceived in HICs which set the standard that Sayeba's method could not obtain based on various factors. The perceptions from most participants across all four Groups elicited a response that could be understood through the lens of outcome expectations, self-efficacy and reinforcements through learned behaviours or past experiences.

Risk perceptions were primarily dependent on the perceptions about the COO as opposed to the contents and features of the innovation, which suggest that the COO was a dependent variable of risk. Individuals across all four Groups, whether the cue of the COO was provided or presumed based on identifiable characteristics, rated risk accordingly to the perceptions of the COO such that the outcome expectations of the innovations were based on how they valued the COO. For instance, individuals valued Africa and India higher than Bangladesh, with some stating that they had used products made in LMICs prior which set the standard or anticipated consequence for that specific country, "*look I've used stuff made in China and India before so I know what to expect, if you ask me about the charger I got online for cheap made in China I'm gonna assume it's not gonna last long and it might explode cause I'm sure it's not made out for this country but it's different cause my t-shirts were made in India and its great quality and lasted long but I guess that's the point of these countries making stuff they all have their niches and what their known for, once you've used it you'll know what to expect, which isn't a lot compared to stuff made in America cause you know why you're paying more, your guaranteed that quality and at least warrantee…"*.

This motivation of perception suggests that the COO dictated the perception of other factors and used the construct to facilitate the degree of acceptance. These cognitive trends demonstrate the interplay and significance of the personal and behavioural constructs which determine the processing of the environmental domain e.g., based on what was already acquired in terms of experience, knowledge via media, training, or education, shaped the attitudes and cognitive actions e.g., self-efficacy to in turn process what was provided by environmental cues such as social norms, accessibility, traditions,

and situational contexts. Again, though the SCT can illustrate the presence of variables involved when interpreting actions and behaviours in a given situation, it does not provide confirmation on the driver variable, nor does it explain the degree in which it interacts with the other domains. Furthermore, as behaviours and its subsequent actions change over time, it is difficult to anticipate that the same variables to their degree will be the same in a different situation at a different point in time during the course of one's life, e.g., only cause a participant states that Bangladesh is not a country that they affiliate innovation development with, this can change overtime due to increase exposure and attention and thus changing the initial perceptions of Bangladesh.

Those in Group B, who only received the 'frugal' cue, rated all three innovations, in summary, as medium risk, though such perceptions were based more so on the design and information about cost as opposed to having any influence of COO. The information about cost was conflated with perceptions about frugality and what the term meant to participants. Group B, similarly, to Groups A (exposure to "frugal innovation" and "COO" cues), C (exposure to the "COO" only) and D (no exposure to external cues), the attainment of regulatory approvals demonstrated a sense of prestige, luxury, and "*high reputation*" as it was supported by those in HICs and used in other countries more so than Sayeba's method. Some participants in Groups A and C stated that Sayeba's method was an 'innovation' for its own, meaning that the risk was appropriate for the Bangladeshi population as it was only tested in that specific country. Therefore, the risk was "*too high*" for the participants to use and the UK population but appropriate for the Bangladeshi people. This response was also linked to how participants viewed and valued clinical evidence and how expectations around evidence-based medicine is facilitated by the perceptions of the COO.

Groups A, B and C rated invasiveness far higher for Sayeba's method than those in Group D which corresponded to a negative polarity score and thus negative sentiment. However, the invasiveness for MNM was mixed between neutral and positive, despite the research team rating the FI as highly invasive due to its implantable nature. Similarly, this was expressed in the context of accreditation, clinical evidence and COO (Groups A and C only). On the other hand, those in Group D rated invasiveness for Sayeba's method as completely neutral whereas the ADCS and MNM were rated as positive. Here, although the participants were not exposed to the COO cue, it was presumed and expressed conservatively as opposed to passive and abrupt as reported in Group A and C. The perception of features such as the design, risk, cost, and useability also dictated the view of invasiveness for each FI across all four Groups (see Figure 15).

7.2.3 Risk Perceptions Through Observed Learning

The understanding of perceptions could demonstrate the impact of observational learning through the environmental construct in that these individuals may have become influenced at some point in time via media, social circles, expectation, and reinforcements through past experiences. These domains all interact to provoke a transition of perceptions about LMICs suggesting that certain LMICs are more acceptable than others based on their perception of the specific country at that given time which are dependent on external factors such as if the individual had received information or linkage to innovation to a specific COO. An example of this interplay of domains was when some individuals valued the MNM, though the most invasive, higher than Sayeba's method, low to medium risk, because they had not heard of innovations being developed in Bangladesh as opposed to India, which provided the individual a sense of comfort and confidence in accepting MNM over Sayeba's method. Although we can argue that the understanding of the transitional perceptions of specific LMICs is attributed to the aforementioned domains, it is difficult to ascertain which domain provoked the presence of others or whether certain domains acted as drivers and facilitators of others, whether the COO was more influential than the behavioural capability of one's perceptions about risk.

Risk perceptions are not solely based on past experiences forming outcome expectations, but they could also be understood and derived from observed learning which in turn could inflict a certain behavioural capability in that the essential knowledge and skills shapes their ability to perform a behaviour, which is often processing of technical information which involves an interplay of all five domains of the SCT. However, the SCT posits that a change in the environment will automatically alter changes in personal and behavioural attributes to evoke a certain action, which we may not be accurate, particularly in our analysis. Staff participants significantly assess risk from a technical standpoint as opposed to an emotional standpoint, typically observed in patient representatives. Some staff participants across four Groups acknowledged that though they had their personal risk perceptions about the innovation, they would encourage staff to base their perceptions about risk based on their own experiences and opinions about its suitability, which shows some activity of self-regulation. For instance, the environmental dynamic of using a similar alternative to MNM in a LMIC did not change the risk perception of it being used in a HIC and neither did their expectation to consequences.

However, this interaction yields the inclusion and interplay of perceptual learning and self-efficacy, *an experience-dependent form of learning which shapes ones' ability to understand and attribute specific variables to certain factors such as sense of smell to specific environments or food or sense of hearing*

to a specific emergency vehicle or appliance, though the SCT does not incorporate this factor into its analysis of behaviours, particularly within the environmental context. We can argue that though much of learning and lived experiences formulate our perception on all things and situations, behaviours are not solely grounded on observations filtered by personal, behavioural and environmental contexts. Some perceptions from staff participants across all Groups noted the interference of behaviours learned through theory as opposed to observations, which supports the claim that though the SCT constructs can help understand behaviours, it does not necessarily explain or describe how specific constructs are related nor its degree of impact on one another. Therefore, albeit behaviours could be understood in a sense of short-term activity, domains such as perceptual learning, outcome expectations and self-efficacy is challenging to ascertain whilst applying the SCT.

7.2.4 COO Effect on Clinical Evidence Perceptions

The value and perception of clinical evidence or evidence-based medicine was contingent upon a specific country such that UK and the USA equated to reliable and trustworthy value, Africa equated to reasonable value, India equated to justifiable and redeemable value and Bangladesh equated to inappropriateness and dangerous value, which all affected risk perceptions. This was exacerbated when patient representatives factored the concept of frugality (Groups A and B – only receiving the COO cue) as the financial position of the country and stereotypes projected a controversial view towards risk and invasiveness irrespective of the specific innovation. Those in Groups A (exposed to both cues) and C (only exposed to "COO" cue) rated the invasiveness of each innovation higher ("*high-risk*") than those in Groups B (only exposed to "frugal innovation" cue) and D (no exposure to external cues). Whilst innovations may be highly invasive or is coupled with a high probability of side effects, it becomes justifiable depending on the specific COO such that HICs would equate to an automatic reasonable and appropriate risk as the stereotype suggests that HICs follow stringent and lawful standard procedures to place awareness elsewhere so that participants do not actively seek the information as they do with innovations conceived in LICs. The distraction towards information processing is significantly high when the innovation is and presumed to be developed in a HIC.

Though the behavioural capability was present in all staff participants, it did not vary according to the COO or presumed COO as it was not deemed important in the evaluation of risk. Furthermore, as all staff participants acknowledged the positive acquirement of regulatory approvals from known bodies in HICs, it did not limit or alter their perceptions of risk as they felt that many approved medical innovations currently in use in the NHS are not appropriate and should not have been implemented. This interaction suggests that though the environment was important in encouraging positive and

independent social norms, it did not dictate the activity of certain attitudes towards the COO or innovation nor reduce or improve self-efficacy.

Again, the COO may have been the significant confounder in perceptions about the innovations. Overall, most participants in both Groups A and D provided positive feedback and were ready to accept the use of the innovations except for Sayeba's method, which was contingent upon obtaining further clinical data and conducting trials. Though this concern was also shared with the use of the MNM, most participants trusted the use of this innovation in their care as the clinical data reflected its superior use compared to commercial mesh, which overall reduced the risks. Additionally, it was reasonable to expect limited clinical evidence from the innovators of the MNM due to its COO but as India frequently developed innovations and were more known than Bangladesh for innovation, it was justifiable for acceptance and reduced risk perceptions compared to Sayeba's method.

Furthermore, there were some participants in all Groups, who felt that no matter where the mesh was developed, how much it cost, or saved the NHS, and what intention it had in surgeries, it should never be used in a healthcare setting because of its recent controversial use, *vaginal mesh* (O'Neill, 2021). For the sole reason of the controversial vaginal mesh, the MNM was deemed unacceptable by some participants irrespective of the external cues presented. Though the MNM is presented as the most invasive of the three innovations, because its implantable and the risks associated would be that of the surgery itself, the overall risk of its actual use as opposed to the innovation itself was rated as low risk for most participants. This was because the clinical data on the use of the MNM was shown to prevent and/or reduce the very same risks commonly associated with hernia repair. Such risk perceptions from most participants across all four Groups were synonymous and positive.

Noteworthy, was the narrative towards Sayeba's method to which the innovation itself was rated as low risk as it involved a temporary technique, it did however involve the so-called "*unique selling point*" of a condom which was seen as both "*resourceful*", "*clever*", "*dangerous*" and "*cheap*". The condom element of Sayeba's method was described both as a positive and negative by some participants across all four Groups as the use of a condom reflected medical negligence, but the idea of its use reflected adaptation and resourcefulness. Approximately half of the participants felt that the use of a condom as an alternative to the Bakri Balloon, *currently used in the NHS*, would increase the likelihood of future complications as the limited clinical data provoked its rating as a high-risk innovation. A possible causality of such ratings may have been attributed to the placement of this presentation, such that Sayeba's method was presented in between the presentations on ADCS and

MNM, thus it may have set a subconscious standard of risk assessments and regulatory approvals in addition to reflection of COO and frugality for those in Groups A, B and C. Moreover, Sayeba's method was rated as a high-risk innovation, though it was the least invasive innovation, by all participants across all four Groups despite the same standard of control given to the staff in performing the technique as participants could not perform the technique themselves. This trend could demonstrate the impact of presenting both external cues, regulatory approvals from known bodies and the influence of clinical evidence on perceptions of innovations.

Attitudes towards innovation were positive and reflected a sense of prestige, luxury, and expensiveness, but when coupled with 'frugal' for those in Groups A (exposed to both external cues) and B (only exposed to "frugal innovation" cue), this dampened the positive effect and provoked criticism to some extent. This may be explained by the presence of various personal attributes such as values, goals, outcome expectations, self-efficacy in the belief that more affordable innovations could not attain a high standard of quality and would place patients at risk. The presence of these personal attributes may have formed through environmental factors such as reinforcement through bad publicity on various media platforms on initial thoughts to reject the innovation (behavioural attribute), social norms in that the individual has been raised in specific setting/climate to expect a certain standard of healthcare, and/or influence from others around them (environmental attributes). This relationship and causality may have been confirmed by many participants as they seek advice and guidance from close family and friends prior to accepting any treatment or service.

This interaction of different SCT constructs was further observed when a participant felt that Sayeba's method was too risky because it was conceived in a LIC despite being born and raised in a LIC themself. The participant expected the innovation to be dangerous and lacking in all safety procedures that no matter what the clinical data would suggest, they would simply reject it because they believed their outcome expectations was accurate and real and expressed that now living in a HIC, they would expect at minimum the same standard of care. The same participant recommended other family members still living in the LIC, Nigeria, to visit a healthcare service in a HIC like the UK's NHS for treatment.

Risk was also rated higher for Sayeba's method compared to the ADCS and MNM as it allowed those who do not possess a medical degree to be able to perform the technique which was seen as life-saving treatment. Though most participants, both staff and patient representatives, encouraged and welcomed the opportunity, others found this to somewhat increase the innovation's overall risk and the likelihood for further complications. This was because some staff members in all Groups felt that

patients would strongly disagree and did not feel confident enough in the anatomy of the female reproductive system and believed that this would take more time than learning the technique. Furthermore, though most patient representatives across all four Groups favoured the opportunity to have other staff members use Sayeba's method and recommended that competency tests be given to demonstrate training and success, they remained hesitant and uncomfortable with the potential for this to occur in their treatment. Most patient representatives expressed wanting clinicians to use Sayeba's method if it *had* to be used in their treatment for PPH in the case there were no other alternatives and worked faster and more effective than the current PPH treatment. On the other hand, they also felt that it was better and more systematic approach as opposed to injecting patients with medications.

Table 12: Comparative Sentiments of Invasiveness for Group A

	Patient Representatives	NHS Staff	Average
ADCS	99.19%	83.49%	91.34%
MNM	79.99%	67.83%	73.91%
Sayeba's Method	-92.37%	-93.99%	-93.18%

Table 13: Comparative Sentiments of Invasiveness for Group B

	Patient Representatives	NHS Staff	Average
ADCS	96.39%	81.94%	89.17%
MNM	88.44%	61.29%	74.87%
Sayeba's Method	-88.17%	-88.43%	-88.3%

Table 14: Comparative Sentiments of Invasiveness for Group C

	Patient Representatives	NHS Staff	Average
ADCS	96.20%	73.26%	84.73%
MNM	79.18%	49.27%	64.23%
Sayeba's Method	-96.11%	-89.66%	-92.89%

Table 15: Comparative Sentiments of Invasiveness for Group D

	Patient Representatives	NHS Staff	Average
ADCS	95.79%	87.16%	91.48%
MNM	88.11%	70.10%	79.11%
Sayeba's Method	-67.71%	-51.01%	-59.36%

The results of invasiveness across the four Groups revealed that negative sentiments increased based on the perception of features through the analysis of tokens (see Figure 4). If a feature is seen as significant such as the material used, design or useability in that one does not require extensive training to apply the technique, which can be seen as a positive and negative attribute, once coupled with a negative perception of a different feature, its overall sentiment would be negative as opposed to positive. Thus, ADCS (PR= 96.89%; NHS staff= 81.46%) and MNM (PR= 62.12%; NHS staff= 73.03%) were reported as having a higher average positive and neutral polarity score across all four Groups compared to Sayeba's method (PR= -86.09%; NHS staff= -90.77%) (see Tables 6-9). Some of the features of Sayeba's method which were shown to dictate the overall negative polarity and its ultimate rejection to use, includes its COO (Groups A and C only), design, material used, limited training, lack of clinical testing and evidence, name, and no accreditation despite the FI being the most similar and most cost efficient to the current UBT method used in the UK. Sayeba's method also had the lowest variation of negation across all Groups even whilst those Group D used implicit 'filler information' to express their perceptions. These trends are indicative that more information produces a rigorous perception that can lead to a negative sentiment and ultimate rejection but also adds to the conclusion that it is the 'necessary' information that can prove both valuable and acceptable.

7.2.5 Demographics and Perception Development

Another significantly reported trend was the age of participants as previous experience or knowledge seem to influence perceptions of risk and innovation in addition to the target user. An example of such an interaction could be observed when speaking with these participants aged 40 and over and those aged 30 years and younger. Generally, younger patient representatives seem to be more involved and interested in innovation development but less concerned with the risks associated and cost compared to older participants who were not as inclined to stay up to date with the current innovations but were more concerned about the risks associated and the cost to the UK population through taxes and the

NHS. The degree of certain personal attributes such as self-efficacy, expectations, attributions, beliefs, and values varied among the two demographics of participants.

An observed example of this interaction was the differences in expectations of those who are older as two participants had previously undergone a hernia repair to which their expectations of the MNM were more thorough, broad, longitudinal, and neutral as opposed to the younger participants who were more optimistic, positive and cross-sectional with their expectations as they saw risk as short-term rather than long-term (older participants). This interaction could also explain the hesitancy towards certain innovations among those who were older than the younger participants who were generally less risk averse. The lived experience (behavioural and environmental attributes) and knowledge (personal attributes) gained from the experience of consenting the initial hernia repair seem to suggest that all three constructs allow for a more objective, thorough, and long-term assessment of risk and further confirms the presence of all three interacting factors on the intent to evoke the behaviour to accept the use of the FI in their care. The same interaction also demonstrates the degree of impact of specific constructs on the overall outlook of the innovation and how lived experiences could perhaps control risk perceptions.

Summary of Trends Between Invasiveness of Innovations (MNM – Most invasive, Sayeba's Method, ADCS – Least invasive)

- Risk perceptions by patient representatives were largely based on the COO (those exposed) and the reliability and validity of the clinical evidence for staff participants.
- Risk was rated accordingly to the perceptions of the COO such that the outcome expectations of the innovations were based on how they valued the COO.
- Sayeba's method was rated as the most high-risk, by both staff and patient representatives, due to its COO, use of a condom and allowing less experienced staff to use it on patients.
- Some staff participants' interpretation of risk resonated with a personal rating such that their behavioural, personal and environmental capacity encouraged colleagues to use to the innovation and review the risk individually.
- Though staff participants across all Groups acknowledged the acquired regulatory approvals with an implicit association to the COOs or affiliated countries such as the USA and Canada, it did not dictate their risk perceptions which was rather focused on technical aspects.

7.3 Trends Between Responses from Patient Representatives and NHS Staff

7.3.1 Differences in Narrative Processing and Transitions

One of the most apparent observations among responses from patient representatives and NHS staff across all four Groups was the differences in the narrative of communication (verbal and non-verbal), the extent of expression (degree of elaboration and exploration), the initiation and duration of such responses, and the interpretation of the term 'frugal'. Staff participants across all four Groups often expressed perceptions in a systematic, monotonous, less exploratory, but more critical manner, in that staff were more concerned about and prioritised the technical information and its transparency over more abstract concepts such as design, cost and shared decision-making. The personal attributes of the SCT such as knowledge, skill, outcome expectations, attitudes, forethought capability, *carefully considers the consequences of actions, goals and plans subsequent actions*, symbolising capability, *forethoughts about the possible experience and testing it through with rational methods*, self-regulatory capability, *often involves person and social norms to evaluate one's behaviour and alter as necessary* and self-reflective capability, *evaluating one's own behaviours and altering them to conform to the consequence and societal expectations*, were all present when assessing the responses of staff participants and could demonstrate such analytical interpretations of speech. These personal attributes coupled with being a specialist in the specific medical discipline and the background it provides such as the professional knowledge frames the linguistics, tone and narrative used during the interviews but also how perceptions are formed. For instance, the tone of confidence and structural exploration comes from knowledge about the topic and/or experience. This can help demonstrate the predictive ability of the SCT in explaining acceptance behaviours and identify key interventions that could increase acceptability initiation and maintenance.

The overall perceptions from patient representatives in Group A were positive and optimistic about the future of FI and its implementation into the NHS. Notably, the more information that was provided, the more *completed* the innovation felt to most of these participants. When asked whether they require more information which was posed as the starting question to the interview, most participants stated "*no*", when asked "*why*" by the interviewer, they felt that the information presented was well concluded for them. The length of the content and the content itself was described as "*digestible*", "*understandable*" and "*sufficient*". Most of these participants explicitly or implicitly understood the term 'frugal' and stated various adjectives commonly published in relevant literature with most conforming to constructs such as 'adaptation', 'accessibility' and 'cost'. Discussions about costs were often conflated with design and clinical evidence and weighted significantly as discussions

were compounded by the use of 'frugal innovation'. Though the term 'frugal' did not directly and explicitly influence the responses from these participants, the interpretation of 'frugal innovation' significantly influenced every aspect of the innovation from cost, risk, design, useability to clinical effectiveness.

The systematic narrative and the lack of exploratory approach in response to certain topics across all four Groups could demonstrate that most *if not all* staff participants were more concerned about the associated risks, clinical data and useability of the innovation as opposed to external factors such as cost, accessibility, frugality and where the innovation was developed. The lack of explicit response to external cues on influencing specific perceptions about the innovation such as the COO or reference to FI, suggest that there was a significant presence of various personal but professional attributes and perhaps was the most dominant construct in the SCT TRD model. Furthermore, it could also suggest that the personal attributes were the drivers of other SCT constructs such as behavioural and environmental. The personal attributes were seen as simultaneous to the behavioural construct of the SCT as responses to specific questions about the innovation's useability and risks were grounded with reference to previous experience, knowledge, attitudes which formed their ability to perform with similar alternatives showing skill, practice and self-efficacy, *believing that one could use the innovation if it was to be implemented into the NHS with more trialling information*. This interaction also shares some effect of symbolising capability as some staff members expressed wanting to try the innovation through potentially dangerous trial and error process of learning from experience. This would also inflict environmental attributes and the self-reflective capability (personal attribute) as they adjust to the working environment and social norms of moving forward with current research and innovation.

Staff members across all four groups mostly navigated and facilitated the interviews themselves without many prompts, i.e., as one question was asked by the interviewer, most responses would address the question as tailored and required by the question evoked but then would involve a follow-up question or topicalisation, in which a key term opens a forum for further and different discussion. Staff members seem to have more questions and criticised the innovations' lack of obtaining clinical data in the UK. A strong response, both verbally and non-verbally, was recorded when both external cues were elicited. However, the responses were even more evident and elaborate when just the 'COO' cue was elicited compared to just the 'frugal' cue itself and no external cues at all. The degree of expression and criticism only varied for those who were given both cues and just the 'COO' cue according to specific innovations, such as Sayeba's method, i.e., staff participants in Groups A and C were more expressive and critical of Sayeba's method than those in Groups B and D about the same

innovation, though those in Group D were still exploratory, this was not negative. The same trend was also recorded for discussions about the MNM across the same groups, though this was not observed across all four Groups discussing the ADCS. All staff participants across all four Groups acknowledged and responded to the obtained regulatory approvals of the ADCS.

Sentiment scores varied between patient representatives and NHS staff across all four Groups. Though these changes consistently fluctuated due to the features, tokens, and aspects of each FI, they were largely dependent on the exposure to the external cues, COO and FI. NHS staff members used professional and thorough linguistics such that they did not necessarily fit into the social syntax of a patient representative and our lexical resources did not detect any scientific language used in our interviews. Our SA models for NHS staff participants indicated a higher overall neutral (35.79%) and negative polarity (-22.42%) and lower subjectivity classification (28.44%) compared to patient representatives across all Groups and all three FIs (10.34%; -25.46%; 87.93%). This is because much of their responses were based on factual information being presented and their own training and knowledge, reducing the counts of subjectivity and increasing objectivity. This passive and direct narrative often facilitated the interviews which projected a lower average negative sentiment score.

7.3.2 The Criticism Response to External Cues

Patient representatives in Group D, who did not receive any external cues, were overall less critical of the innovations, and expressed positivity and optimism for the innovation's implementation and its future. The main differences in narratives among the two Groups (A and D) could be explained by the variations in behavioural and personal domains in accordance with exposures to external cues such that particular attitudes towards the COO (those in Group A) implied a specific response to the innovation. Self-efficacy was significantly more present in those in Group D because patient representatives relied on their belief of the presumed COO based on the names of the innovations which may have been used as proxies. These participants expressed a certain level of confidence in knowing that their perceived COO was correct such that they were able to provide positive reactions to the innovation whilst still remaining objective. It was difficult to ascertain and understand the perspective of the COO distinctively from their perceptions of the innovation as they often overlapped implicitly, compared to those in Group A, where explicit perceptions of the COO and innovation were provided.

However, all participants, staff, and patient representatives, across all four Groups, were more critical of Sayeba's method than any other innovation presented, irrespective of cues used during the

presentation. Nonetheless, the degree of criticism varied once cues were introduced, i.e., most participants in Group A were more critical of Sayeba's method than those in Group D in all aspects about the innovation. In this instance, knowing more information about the innovators and innovations allowed these participants to make thorough evaluations as opposed to those in Group B (only exposed to the "frugal" cue) and D (no exposure to external cues) who certainly asked more questions about the so-called *missing information*, e.g., "*where does it come from? how much does it cost compared to the current one? how much cheaper or affordable is it? who are the innovators?*"

The so-called 'missing information' demonstrated the presence of specific behavioural and personal features such as knowledge, expectations and attitudes which may be driven by the skills and practice that they may have acquired in particular environmental contexts such that they express self-efficacy in acknowledging that there is 'missing information' and challenge it to ask for further clarification or information. Simply asking "*how much cheaper or affordable is it?*" can illustrate one's interest, skill, knowledge, expectations, and attitudes to its access in community (environmental domain). The exploratory associations with technical information seem to mirror staff responses which showed the presence of the same features but acquired through a different environmental and cognitive process e.g., acquired knowledge and attitudes of staff may have stemmed from their education and experience in practice.

Conversely, staff participants across all four Groups receiving information about one innovation pertaining to their medical discipline with more technical language were generally monotonous and nebulous with their responses, except when discussing risk, design, useability, and clinical data. Responses from most staff participants was direct and often spoken with a confident approach. Eliciting a response from staff participants did not take as long as patient representatives, as most staff members already understood the background of the innovation, its purpose and useability. The nature of such discussions overall across all four Groups were very constructive, systematic, and efficient, which may have been attributed to time constraints as all participants were still employed by the NHS and some attending interviews during their working hours. Additionally, these participants were familiar with the risks associated with certain techniques and conditions and thus navigated conversations about risks and felt comfortable and confident providing recommendations in a technical forum.

7.3.3 Communication Changes to External Cues

The patterns of communication among staff participants across all four Groups compared to patient representatives differed significantly. Most staff participants were notably more restrictive with both verbal and non-verbal communication when discussing the innovations whereas patient representatives were more expressive and elaborate with their responses, often involving personal information and experiences and apparent visual and nonverbal expressions such as raised eyebrows, smiling, leaning into the screen and vertical head nodding. On the other hand, both external cues did elicit a minimal response, compared to patient representatives, in some staff participants with a particular emphasis on the COO. The 'frugal' external cue (Groups A and B) did not elicit a strong response, but the COO did show some clear and bold expressions, particularly when discussing the ADCS compared to MNM and Sayeba's method. This may have been attributed to the innovation being an addition to the current surgical drill, the acquired regulatory approvals and affiliation with a HIC.

The responses to such cues and information may suggest a strong presence of personal factors such as knowledge, expectation and attitudes in that staff participants, irrespective of Groups, attended the interview with an agenda to seek out information about the innovation in relation to their medical speciality or prioritised the information being presented as opposed to proposing a personal view onto the innovation where a professional perspective was expressed in the context to its use. The lack of response to the 'frugal' cue could also suggest that cost or affordability was not a concern to them which could demonstrate that their personal attributes or cognitive factors such as prioritising knowledge, attitudes to medical devices and patient safety and attitudes to healthcare were stronger than those at the organisational level e.g., procurement staff, who may prioritise cost over the useability of the innovation as they were not the direct or intended outcome/service recipient. This however is difficult to determine particularly as our participant sample did not include any procurement staff, though the study did seek to recruit this position.

An example of this working variable (personal factors) was when a staff participant in Group C (only exposed to the "COO" cue) expressed their recommendation to trial the MNM in an NHS environment which may result in differences to when it was used in a similar alternative in a 'Doctors without Borders' programme in a LIC. The participant though shared their experience of using a similar MNM alternative, this view was professional as opposed to sharing any personal contexts. Though they had experienced the use of an MNM-like alterative to treat hernia repair in a LIC, they felt that their experience with its practical use (behavioural factors) should not trigger its implementation and

capability for the NHS as their colleagues (environmental factors) would have to experience the use of a MNM in a familiar setting and judge for themselves.

Conversely, the aforementioned interaction differed significantly in responses from patient representatives, as most of them felt that they would consider the thoughts of close family and friends and were considerate of *vicarious learning* (personal factors) and social norms (environmental factors) to support their decision making. Examples of this interaction was when most patient representatives would rather use the insights of 'trusted' others to judge and experience the use of the innovation in the NHS first to assess the risk and success of its use then to take the chance of accepting its use first. If the innovation was proven to be successful with the support of regulatory bodies such as the MHRA, FDA and Health Canada, it would suggest that the innovation was safe for implementation into the NHS and its overall use. The acquired regulatory approvals imposed a sense of fact-checking and gave the interpretation that it had completed mandatory clinical trials. The approval would represent the use of the innovation as a "middle person" so that others around their immediate circle did not have to, which demonstrated the personal and behavioural attributes of calculated self-efficacy, *forced belief* as opposed to unconscious self-efficacy, *naturally autonomic acquired beliefs based on experiences and/or learning*.

The lack of interference of personal experiences compared to patient representatives' responses resulted in a negative and objective dialogue. In contrast, patient representatives, though involved many personal experiences and understanding through social norms and common syntax, resulted in either a positive or negative dialogue, with the exception of patient representatives in Group D. Participants in Group D reported a significant variance between responses from NHS staff and patient representatives such that though no external cue was exposed and its COO was presumed, patient representatives were more neutral and displayed more negation than NHS staff. The dialogue of NHS staff members in Group D reported a more positive sentiment score that often detected negation between neutral and positive as the presumed information was understood as objective and expressed as controversial or acceptable with conditions.

Negative sentiments were also higher in patient representatives who expressed more emotional linguistics and tone through CA, which was further corroborated by behavioural and facial expression analysis. The syntax and lexical resources were more equipped for detection of features, tokens, and aspects of those uttered by patient representatives as opposed to NHS staff participants who used more scientific language and sophisticated syntax with less emotion and thus had less negation.

Generally, staff participants were not explicitly responsive to any external cues with negated impact compared to patient representatives who were explicitly responsive to both cues with varying degrees of impact on the overall perceptions and led to either a positive or negative sentiment.

7.3.4 Response Formation to External Cues

The speed of responses from staff participants in all four groups also varied in addition to the speed of responses from patient representatives. The average response completion time for one question by those in Groups A and C was approximately three minutes compared to the responses obtained from those in Groups B and D of approximately one minute. These completion times compared to patient representatives in Groups A and C was approximately 11 minutes compared to those in Groups B and D of approximately five minutes. The commonality of those in Groups A and C was the information about the innovations' COO which seem to conflate many responses across the different themes explored and reported. This correlation could illustrate the differences in risk aversion towards some innovations compared to staff participants as patient representatives were less risk averse than staff participants. Though staff participants were generally direct, structured and limited in their responses, those in Groups C demonstrated a sense of exploratory behaviour in that these participants asked more questions about the innovations' COO and the innovation's development to present date.

Those in Group D did not receive any information about the COO and mention of frugality, therefore a trend of being less critical or not providing much criticism was reported. The more information presented suggested an increased likelihood of criticism and alongside the design, risk and the innovation's overall intent was subject to scrutiny. Most patient representatives in Group A, though provided positive feedback about Sayeba's method, risk was discussed as a general concept as opposed to in conjunction with the innovation. This may have been attributed towards the limited information about the clinical effectiveness and trial data. On the other hand, responses from most in Group C reflected a reciprocal need to be assured, i.e., some participants criticised the COO for the lack of clinical data but whilst expressing themselves, needed a constant sense of reassurance or approval. This may have suggested that the participants themselves felt that their statements were controversial and provocative but felt comfortable and confident enough to express in the first instance, which may have been influenced by the setting or context of where the interviews were taking place e.g., the comfort and privacy of their own home as opposed to in a public domain.

7.3.5 COO Effect Through the TRD Model

Noteworthy, was the influence of the COO on responses about the innovations and its narrative. An example of this is that most patient representatives in Group A (exposed to both external cues), though acknowledged that Sayeba's method was an alternative because it used an unconventional material to treat PPH, its reference to being a FI was more acceptable than other innovations because of its COO influence. Here, Sayeba's method was seen more as a FI than other innovations presented because most participants felt that the use of a condom was "*cheap*", "*dangerous*" and "*expected from a country like Bangladesh*". When asked, most of these participants interpreted 'frugal innovation' as "*a cheap, temporary alternative*". Furthermore, they felt that the frugal part of the 'FI' context weighed significantly more than 'innovation' as participants generally felt that Sayeba's method was simply copied from previous options already being used in the HICs and the NHS and thus lacked any innovative creativity. This response and behaviour can somewhat be explained by the SCT as it demonstrates active and interacting influences of personal (expectations and attitudes – stereotyping, prejudice), behavioural (self-efficacy, practice – *or the lack of acceptance*) and environmental (social norms, influence on others and environment).

Patient representatives in Group A were generally more critical of the three innovations because it was this group where many participants rationalised with the use of such innovations, in that most participants envisaged themselves in a situation where the innovation could be used, i.e., one participant previously had a hernia repair and was due for another repair and thus could imagine the use of the MNM in their treatment. These participants coupled perceptions with previous experiences which allowed them to feel more involved in the innovation's plan for diffusion into HICs and were also more critical of the innovation as they saw themselves as 'service users of the innovation' in the current state.

The difference in responses could also be explained by the adjectives used to interpret 'frugal' or frugality and 'innovation'. The innovations presented to staff (one each according to the specific medical speciality) were described as not entirely new or novel despite the positive perception and some describing Sayeba's method as "*not needed*" and "*insufficient*". The general perception to innovation unless something is absolutely novel was perceived as an adjustment to current practice which could explain the monotonous, nebulous and restrictive and structured responses compared to many patient representatives who believed that the innovations presented were in some way innovative new approaches to healthcare and thus could explain the more abundant, elaborate and expressive response. The different constructs of the SCT model could explain the variations between

staff and patient representatives' responses and could suggest the foundations of such interpretations are correlated with how each participants perceived FI, COO and the overall innovation. An example of this correlation was when some patient representatives in Groups A and C would provide overall positive feedback about the innovations presented but felt it necessary to express some criticism about its COO, though the concern fell with the innovators e.g., the cost of clinical trials and regulatory approvals. The same participants shared concerns about the COO's ability to provide transparent scientific data and the overall development of innovation in regard to reputational status.

Responses from both NHS staff and patient representatives showed that the 'COO' and 'frugal' external cues posed as important and dictating variables that impacted the overall sentiment of the FI to be one of negative polarity which led to more criticism and overall rejection of its use. However, the 'COO' cue weighed significantly more on the negative sentiments than the 'frugal' cue for both sets of participants. Those who were not exposed to either cue or just the 'frugal' cue, had more of a positive sentiment, though this was an effect of implicit cognition and presumption.

Summary

The understanding of FI or at least its interpretation from those who were exposed to the cue could be explained by the personal and environmental constructs of the SCT such that features explicitly used to describe overall perceptions seemed to stem from their outlook based on social norms, attitudes, knowledge, and expectations formed through learned experiences and media forums. However, there are infiltration of behavioural attributes of the SCT on such perceptions because it takes the skills and practice to be able to form learned experiences or at least observed learning through others. Furthermore, implicit understanding of FI via the utterances of typically published synonymous characteristics suggested that the general perception of FI was aligned with cited literature but rather in a negative context as opposed to innovative adaptations. This was exacerbated through the lens of the COO in that support or endorsement from a HIC increases the positive perceptions of the FI in question and has the opposite effect when its presented to be developed from a LIC. Those who were not concerned with further clarification, suggested a sense of self-efficacy (behavioural), skill and practice itself such that participants felt that what they already knew or understood the information presented as already factual to base their perceptions. Through this narrative, the environmental attributes are present as it's a learned skill overtime which in turn is a cognitive feature forming knowledge, attitudes and expectations. With this previous experience, practice and acquired skillset, either cognitively or behaviourally, participants in Group A felt confident

in managing their expectations and were more vocal about criticising the FIs based on their perceptions about COO.

The degree of criticism was proportional to their affinity or animosity to the COO, such that if the COO was one seen as inferior, then the degree of criticism was higher and less subdued than those in Group D who only presumed the COO. Confidence works reciprocally with the behavioural construct which asserts a certain type of attitude within perceptions and are exacerbated in specific environments. The level of presumption versus factual facilitated the narrative of criticism and its subsequent perception of the FIs. Risk perceptions were based on these learned experiences and current emotions and is indicative of the presence of all three SCT constructs. Whilst the degree of criticism was higher and thorough among those in Group A, the need for reassurance from the interviewer was noticeable. The dynamics of free expressions by patient representatives exposed to both cues (Group A) followed by the need for reassurance could demonstrate the presence of environmental attributes such as acceptable social attitudes, and stereotypical behaviour, personal attributes such as the lack of skills and practice. This also demonstrated the infliction of self-efficacy in varying degree. Responses from those exposed to no external cues (Group D), demonstrated self-efficacy in a different dimension as expressions were assertive based on their beliefs at that point in time (not factual).

Staff participants across all Groups were less responsive to the external cues, if provided, and rather focused on the technical aspects of the FI. This may have been attributed to the disinterest in elements of affordability and accessibility and rather interest in key affective features such as those which would affect them such as useability, application, training, side effects and components. Though patient representatives are not directly affected by the costs of the FI, the perceptions of the FI are also represented by the cost, or its value, as expensive titles or components would provoke a superior brand or image. Staff participants often navigated the interview and asked questions about the more technical components of the FI, though some staff participants did not engage much which was associated with the time spent in their job position, medical speciality, employment environment or interest with medical innovation. Those in Group D were far less critical in general of the FI, which may have been attributed to less information presented or the place in which the interview took place (*discussed further in the reflexivity section*). Perceptions of staff participants across all Groups did not vary significantly.

Perhaps the differences in responses by both staff participants and patient representatives, from those exposed to eternal cues and those receiving none, can be attributed to the lack of importance

of the external cues because advance knowledge, attitudes and expectations (personal attributes) of the different features of the innovation and how that applies to their current practice or lifestyle. Behavioural attributes such as skills, practice and self-efficacy may have facilitated the limited response to the external cues. However, this was particularly more apparent as risk perceptions by patient representatives across all Groups and expectations of the FIs were based on perceptions on its associated COO. The COO served as a dependent variable of risk as it was constant in perceptions about various features with a particular importance on risk and it led to perceptions about the validity of clinical data and its design and useability. Such risk perceptions demonstrated the presence of all three SCT constructs acting in cognisant of each other. The medium- to low-risk innovation, Sayeba's method was rated as the riskiest due to its affiliated COO, allowing less experience staff to use it on patients and use of a condom compared to the most actual high-risk innovation MNM and less risky, ADCS. Participants who expressed Sayeba's method as high risk exerted some knowledge of innovation (personal) and the expectations for these innovations to be successful, though this knowledge stemmed from HICs which set the standard that Sayeba's method could not obtain based on various factors.

Though risk perceptions were not based solely on past experiences because on could develop such opinions through observed or vicarious learning, they could be understood through the lens of outcome expectations, self-efficacy and reinforcements through learned behaviours or past experiences. The acquired knowledge and skills shape the ability to perform a behaviour even through observation, which is often the processing of technical information that has been frequently reported in staff participants and those with a background in Higher Education. The self-reflection, forethought, self-efficacy, and reinforcements demonstrates that risk is not concrete and specific to the condition but varied according to different environments and patients, one that should be learned through experience and practice and not vicarious learning or observing. Though some individuals rated Sayeba's method as high risk due to its design, useability and COO, risk perceptions were also based on the lived experiences forming outcome expectations, attitudes, and knowledge about its perceived risk. There is some merit in the knowledge acquired through lived experiences to form practices of being the recipient of the innovation, subsequently shaping the outcome expectations.

Furthermore, younger patient representatives were less risk averse compared to older participants who were more concerned about the risks associated and the cost to the UK population. The variation in risk aversion was correlated with lived experiences and outcome expectations through self-efficacy. Those born and raised in LMICs and now live in HICs were less risk averse about innovations developed

in HICs than those conceived in LICs. This action and response itself demonstrate the active states of all three SCT constructs. Though all staff participants acknowledged the positive acquirement of regulatory approvals from known bodies in HICs, it did not limit or alter their perceptions of risk compared to patient representatives. These participants demonstrated self-efficacy, practice, skill, outcome expectations through experience over the influence of environmental attributes such as social norms and influence of colleagues' experience.

Personal attributes such as knowledge, skill, outcome expectations, attitudes, forethought capability frames the linguistics and narrative used in responses from all participants. The domains can also explain how perceptions are formed because it assesses the foundations of commentary. The lack of response to external cues by staff participants could be explained by the significant activity of personal and behavioural attributes in that their skill and knowledge facilitates not only the content of perceptions but its delivery being constructive and systematic. Personal attributes were active concurrently to behavioural attributes as responses about useability and risks were grounded with reference to previous experience, knowledge, attitudes which formed their ability to perform with similar alternatives showing skill, practice, and self-efficacy. We noticed some effect of symbolising capability as some staff members expressed wanting to try the innovation through potentially dangerous trial and error process of learning from experience. This would also inflict environmental attributes and the self-reflective capability (personal attribute) as they adjust to the working environment and social norms of current research.

In contrast, patient representatives expressed exploring risk and clinical evidence on others or gathered indirectly as opposed to their own experience. Though staff participants were more vocal about risk, the information gathered about risk provoked a more risk averse response from patient representatives. This demonstrated the variation in the activity of personal and behavioural attributes in addition to environmental for patient representatives. Overall, our results do suggest that the COO and frugality are important variables to examine when understanding and increasing acceptance of FI such that one must consider its value and need when presenting such cases to organisations and populations in a HIC. The cues placed great importance on how risk is perceived which was shown to drive a response of acceptance. When neither cues are presented, though it may increase acceptance due to absent information, the alluring characteristics may provoke one to assume its COO, perhaps incorrectly, and make decisions to accept without knowing why and it is then when one should consider its need when the overall criticism was lower than when presented with both cues which increased acceptance.

Summary of Trends Between Responses from Patient Representatives and NHS Staff Across All Groups

- Risk perceptions by staff participants was predominately based on acquired knowledge, training, practice that shapes its self-efficacy in contrast to patient representatives in which the same attributes are predominately facilitated by the processing of environmental factors.
- The lack of response to the 'frugal' cue from staff participants could also suggest that cost or affordability was not a concern further it evokes certain personal attributes or cognitive factors such as prioritising knowledge, attitudes to medical devices and patient safety and attitudes to healthcare were stronger than those at the organisational level e.g., procurement staff, who may prioritise cost over the useability of the innovation as they were not the direct or intended outcome/service recipient.
- Staff participants did not require a radical or novel innovation, they wanted simplicity, ease of use and high quantity of an effective innovation that was safe for both them and patients.
- Conversely, though staff participants did not significantly respond to the 'frugal' cue, patient representatives did, which provoked further assessment of the innovation and dampening of the innovation in general. The element of cost for patient representative signified the activity of social norms, practice of rejection, reinforcements through others, acceptance through others, attitudes, stereotypes, and *the lack of* knowledge about innovations from LICs.
- The difference in responses could also be explained by the adjectives used to interpret 'frugal' in that unless it involved a radical change, it was not novel and thus just an alternative to current options. Responses from patient representatives suggested that outcome expectations, and expectations of innovations used in HICs came at a radical expense coupled with high cost.
- Such aforementioned perceptions were based on the current attitudes, knowledge, practice, self-efficacy through experiences and social norms of what is acceptable in a country like the UK.
- The variations in perceptions about these innovations are predominately based on the contextual factors gained through experiences such that they form the behavioural and personal attributes which in turn shape how we process environmental attributes.

The next chapter addresses the gap in the existing literature, the premise of this study, and provides a summary of the key findings from each of the analytical chapters of this thesis (Chapters 4-7). These findings are the discussed regarding their contributions, implications for further research and policy making. The chapter will also provide an assessment of this study's strengths, limitations, and challenges.

Chapter 8: Discussion

FI are affordable products that meet the needs of resource-constrained consumers and aim to do more with less, whilst improving quality and increasing value and provisions. However, there are barriers to their acceptability, such as implicit negative perceptions towards the term frugality and toward innovations conceived in LICs. This thesis investigated the conceptualisation of FI in the context of a HIC like the UK and its potential for acceptance and diffusion by exploring the perceptions at the individual level within the NHS. During the first steps of this study, our research sought to identify gaps in the literature which was highlighted in our critical review exploring the different conceptualisations of FI irrespective of industrial and organisational sectors (Hindocha *et al*, 2020). We found there is a growing popularity of FI, numerous and diverse definitions that lacked a theoretical foundation and consequently led to a lack of a coherent conceptualisation that hinders research and adoption in practice. The aim of this review was to examine management, entrepreneurship, business, healthcare, and organisation studies literatures, explore the multiple definitions of FI that have appeared in the last two decades and examine the commonalities and differences of the various definitions.

Our critical review demonstrated a plethora of convoluted and synonymous definitions and interpretations of FI which increases with more research about FI. Notably, though initially outside the scope of the review, we found a significant trend in the country of publication, in that most publications were derived from HICs (*this will shed a significant importance to our research study*) which could help understand the value and source of interpretations about FI. Furthermore, it highlighted the presence of different frameworks to help steer and support the understanding of the FI and how one could use criteria to elucidate whether an innovation was frugal or not, though such frameworks often lacked a theoretical underpinning and/or grounded information and thus lacked coherence to specific constructs. Our results found over 20 definitions of FI to which only one was supported by a theoretical underpinning. Though it is important to note that a definition of FI does not necessarily require a grounded approach, it is important when sourcing its interpretation and underpinnings so that there is a common expectation of what FI is and how it is understood. After the consolidation of the definitions, we still found significant ambiguity around what constitutes a FI and how it is universally understood because it is particularly more challenging when its characteristics are also synonymous with other types of innovation.

Given FI is increasing in research and development within different industrial sectors and provided effective solutions and advantages, our research sought to understand what inhibits its acceptance and subsequent increase in successful diffusion in HICs. Furthermore, we aimed to investigate

whether the need to categorise an innovation as 'frugal' was important and if so whether the term 'frugal' provoked a response to the overall perception of it, and whether people accepted or rejected its use and whether and how this aligned with the practical and real-time interpretation of FI from a patient representative and NHS staff perspective. FI as a term was adopted by LICs because of its understanding and juxtaposition in HICs. For instance, FI is not understood as frugal in LICs but rather a generalised concept in the realm of innovation or everyday practice in different organisations and industrial sectors who continuously adapt to available resources as this is the so-called 'norm', but where this "issue" or challenge does not occur e.g., in HICs, it is merely a focus on pulling back and focusing on the simplicity and affordability of innovations.

During the global COVID-19 pandemic, the world witnessed and acknowledged a surge in innovations conceived in LICs who adapted far quicker than HICs and increased willingness to consider innovations developed in LMICs. However, this effect only became apparent in state of a global urgency, which begs the question, why is a LIC deemed more acceptable when there are limited options but not in everyday policy-making when it can alleviate the same objectives outlined in the NHS' LTP? Is this a behavioural effect or cognitive bias caused by LICs? Is acceptance contingent upon the specific countries? Irrespective of the chosen definition, FI is directly associated with a country of origin effect through the understanding of its synonymous characteristics such as adaptability, resource scarcity, affordability, and accessibility. Is the lack of diffusion of FI into a HIC influenced by its COO?

A key point is that despite the relevance and increasing interest of FI across all sectors, with particular focus on global health, there is no previous research exploring the perceptions of innovations conceived in a LICs, in a HIC context, with a particular focus on the NHS. Our research sought to address the gap of practical interpretations of FI and whether the need for its reference was important in the overall perception of the FI and its subsequent acceptance in the NHS. The primary objective of this research study was to explore how the cues of frugality and COO impact on patient representatives' and NHS staff perceptions of different FIs, *varying in invasiveness*, and how contextual characteristics can increase its acceptance for use and subsequent adoption using an acceptance model, *social cognitive theory (SCT)*. This was conducted by semi-structured interviews with both patient representatives (n=30) and NHS staff (n=30) across medical specialities that pertained to the FI examples e.g., the ADCS was discussed with those who currently worked in the realm of orthopaedics. We randomly allocated participants to one of four groups: (1) Group A – mentions both frugal and the COO, (2) Group B – mentions only frugal, (3) Group C – mentions only the COO and (4) Group D – does not mention frugal nor the COO. This research design enabled us to understand the dynamic and

interplay, if any, the term frugal and COO have on the perception of FI, specifically in healthcare that vary according to invasiveness, how contextual factors of the SCT can elucidate such perceptions and increase the acceptance and adoption of FI.

This section of the chapter begins with a summary of the key findings from the synthesis chapter of the thesis (Chapter 7). These findings are then discussed in terms of their contributions and implications for research into the acceptance and adoption of FI in a HIC like the UK with particular focus on the NHS. We will also provide recommendations, based on these findings, for managing and navigating the factors involved in the acceptance of FI from a patient representative and NHS staff perspective. The strengths of the thesis are considered in Section 8.3.1, challenges, and limitations of the SCT in qualitative innovation research are discussed in Sections 8.3.2 and 8.3.3 and suggestions are made for possible future research (Section 8.4). Our final chapter presents a concluding summary.

8.1 Summary of Key Findings

In this sub-section, we will discuss the three discerning trends highlighted in Chapter 8, (1) trends between Groups A (presence of both FI and COO cues) and D (absence of both FI and COO cues), (2) trends between invasiveness of innovations (MNM – most invasive, Sayeba's Method, ADCS – least invasive) and (3) trends between responses from patient representatives and NHS staff in all Groups, and its relevance to FI research, specifically regarding its perceived value and management and its implication for the NHS.

8.1.1 Trends Between Groups A and D

To align the research with the first objective, we explored and assessed the trends between those in Groups A (presence of both FI and COO cues) and D (absence of both FI and COO cues) to which we found a significant difference in the narrative of conversations and the degree of criticism. Whilst there were some common judgements and perceptions about Sayeba's method e.g., the reluctancy of accepting its use because it used a condom alternative which seemed unsafe and dangerous, the COO was spoken in conflation with the term 'frugal innovation', in that the existence of FI was a consequence of its COO. The COO was found to regularly occur during the different questions posed in the interview, which allowed a natural stepwise topic transition (Jefferson, 1984; Sacks, 1992) into perceptions about the COO on the overall FI without any further prompting and facilitation. This suggested that the COO was of particular importance to how the FI was perceived but also how the support of a HIC could increase its desirability factor granting the innovation more acceptable. Though

the importance of COO is not a novel discovery particularly when making decisions about healthcare, it is referred to as a cognitive cue, such that its involvement is a naturally occurring construct that is formed by a multifactorial response (Ostberg, 2011).

Sayeba's method was perceived to be the least desirable innovation among the three presented simply due to its COO and nature of equipment involved which represented their thoughts about the COO itself, *country affinity* (Adina et al., 2015). The COO seemed to exacerbate any negative feedback in replacement of positive feedback as it was discussed in conjunction and comparison to other innovations as opposed to staff members who simply only had Sayeba's method to refer to, who also tended to consistency compare it against the current practice, *Bakri Balloon*, also developed by a HIC. It was difficult to ascertain whether staff members were making comparisons to currently used devices based on the technical aspect or the COO itself as many of these expressions were conflated with each other. On the other hand, the staff responses in Group A were more constructive and systematic in that responses were structured according to level of priority and appropriateness. Notably, though participants in Group D could presume the COO, their overall perceptions did not vary significantly from those in Group A, though the narrative of perceptions was significantly different. This could suggest that stating the COO or the term 'frugal' invites thorough verbal criticism and openness to controversial thoughts rather than mollifying responses or implicitly encountering negative perceptions when exposed to such cues. The lack of utterance of the COO in responses by those in Group D suggested a reduced need for reassured behaviour compared to those in Group A as patient representatives would express negative perceptions about the COO and low-cost initiative whilst seeking assurance from the interviewer. Furthermore, our SA models found that the nuisances in Group A were also more negative than those in Group D. additionally, the tokens reported in Group D were more neutral than positive though the typical syntax may suggest positive outside of SA models. Thus our SA models found potential differences and variations in expressions based on everyday language and expressions.

8.1.2 Trends Between Invasiveness of Innovations

Though the MNM was deemed the most invasive innovation presented to participants, the relatively low-risk FI, Sayeba's method was deemed to be the riskiest to most participants across all groups simply due to its associated COO. The information about the COO served as a driver in evaluating the different surface more salient features of the innovation such as design, useability, cost, and materials, though the more constructive and personal features, risk, and clinical evidence, were subjected to a higher degree of evaluation based on the COO. The evaluation processing of COO on personal

attributes such as risk and clinical evidence, *directly associated with risk*, is corroborative of the research conducted by Hong and Wyer (1989) which found that the COO effect on cognitive processes involved in evaluation is consistent with the elaboration likelihood model (Petty and Cacioppo, 1986).

Fiske and Pavelchak (1986) found that individuals tend to correlate newly formed encounters with pre-existing stereotypes based on one or more salient features. As some participants expressed not being familiar with or previously hearing about innovations developed in Bangladesh, it can be suggested that the negative perceptions about Sayeba's method were mediated by preconformed stereotypes which may be indirectly related to the innovation itself and demonstrates the infliction and activity of the environmental attributes of the SCT coupled with behavioural (self-efficacy) and personal (attitudes and expectations). Though we found the interference of one's own cognitive processes in evaluation based on COO, this differs from the findings by (Fiske and Pavelchak, 1986), stating that individuals remain uninvolved and inflict unconscious bias stereotypes with 'category-based evaluation' and is not mediated by information about the actual innovation e.g., type of knowledge ("*completely dangerous*") or type of innovators' personality ("*not innovative at all*"), or race ("*unexpected for a Muslim-based country*"). The SA model exploring the invasiveness of an innovation on acceptability suggested that some features i.e., invasiveness (88.54%), accreditation (99.18%) and COO (83.88%), which are objective measures or outcomes, were expressed in a subjective manner.

In our study, both external cues increased the attention to features of the FIs that may have otherwise been ignored, deemed unimportant or less involved in the reality of accepting its use in their healthcare such as design, useability, and cost. Though risk is typically deemed important and involved in making informed decisions about healthcare, it was not evaluated based on its own concept but rather that of the COO's risk to the innovation development, inflicting an implicit unconscious bias of the COO in the overall acceptance. Whilst discussing and evaluating risk for the potential to improve health, it can also develop concerns among clinicians who feel that risk identification unravels fears, not useful for the patient and how patient's risk perceptions differ to an epidemiological one and may capitalise on commercial interest to drive sales (Huh and Cude, 2004; Nexøe et al., 2007; Skolbekken, 1998). Whilst an affiliation with a HIC increases the likelihood of acceptance, it still would be subjected to some level of scrutiny and criticism (reported in Group D with patient representatives), though less significant than patient representatives in Group A. This result was also corroborated by the SA model which showed Groups A, B and C rated invasiveness far higher for Sayeba's method than those in Group D which corresponded to a negative polarity score and thus negative sentiment. However, the

invasiveness for MNM was mixed between neutral and positive, despite the research team rating the FI as highly invasive due to its implantable nature. Similarly, this was expressed in the context of accreditation, clinical evidence and COO (Groups A and C only). On the other hand, those in Group D rated invasiveness for Sayeba's method as completely neutral whereas the ADCS and MNM were rated as positive. This may be because the perceptions in Group D were influenced by identifiable characteristics such as the name of the innovation resulting in a presumption based on prejudice and stereotype. Thus, ADCS (PR= 96.89%; NHS staff= 81.46%) and MNM (PR= 62.12%; NHS staff= 73.03%) were reported as having a higher average positive and neutral polarity score across all four Groups compared to Sayeba's method (PR= -86.09%; NHS staff= -90.77%).

8.1.3 Trends Between Responses from Patient Representatives and NHS Staff

The preconceptions about individual participation were mirrored in the narrative of responses particularly how each response was framed and navigated through their own level of comfort and exposure to personal experiences. This was demonstrated by the differences in responses by patient representatives who would often involve a level of personal or intimate knowledge about their past experiences compared to staff participants who typically express their perceptions in an ascriptive formula, a punctilious and conscientious manner facilitated by the groundings of their occupation. The understanding of the differences in expressions formed between staff and patient representatives could be explained by the SCT's TRD model to which our results and Chapter 8 demonstrated how each construct and individual domain could be used to interpret and understand a particular point of view within the general perception based on the contextual characteristics of the participant e.g., staff member. Our SA models for NHS staff participants indicated a higher overall neutral (35.79%) and negative polarity (-22.42%) and lower subjectivity classification (28.44%) compared to patient representatives across all Groups and all three FIs (10.34%; -25.46%; 87.93%). This is because much of their responses were based on factual information being presented and their own training and knowledge, reducing the counts of subjectivity and increasing objectivity. This passive and direct narrative often facilitated the interviews which projected a lower average negative sentiment score.

The structural notion of expressions between staff and patient representatives can demonstrate the impact and influence of the information presented and discussed in a time-specific approach. Staff participants across all four Groups provided perceptions in a systematic, monotonous, less exploratory, but more critical manner, in that staff were more concerned about and prioritised the technical information and its transparency over more abstract concepts such as design, cost and shared decision-making as often prioritised by patient representatives. The variation in structural

expression did not change among the different Groups which suggests that the information presented, and the involvement of external cues is processed in a systematic and constructive manner which could be further understood by the personal and behavioural attributes of the SCT. Furthermore, the formal narrative may have been chosen with a conscious bias approach such that the environment in which the interviews took place and the timing of the interviews suggested that most staff participants may not have been or felt comfortable enough to share their true opinions about the FIs presented or felt rushed to complete their participation due to their working schedules. This was further explored as two interviews with staff participants, one in Group A and another in Group C, took place in their residential environment and were found to be more expressive, personal and elaborate about the innovations' COO and frugality, though such perceptions were positive and such factors were deemed unimportant.

Blanchet and Blanchet (1994) suggested that specific environments do not act as a homogenous semantic space but rather arranged in working areas e.g., hospitals, operating rooms, patient rooms, each one with its particular features. Whilst the authors acknowledge that the interview itself can stipulate its own rules or 'communicative contract', the physical environment to which the staff are present, is likely to significantly influence the type of speech produced, particularly its context. Thus, though the typical environment and professional contextual factors of urgency and stress can become decisive factors in how perceptions are expressed, when the same individuals within the same setting are removed from professional contextual factors, expressions and perceptions may change. This can help support the understanding and discern the differences in speech among staff members and patient representatives. Furthermore, due the professional nature of their job role, staff members tend to act routinely and thus abide by a subconscious heuristic process, which uses cognitive strategies to resolve problems quickly and frugally that can often lead to failure of accurate assessments and complex processes. This in turn, may result in cognitive biases that can result in rushed judgements and perceptions, or harsh perceptions linked to clinical reasoning (Preisz, 2019). Additionally, the effect of the environment on cognitive bias can be demonstrated through participation bias as participants may deliver what they assume to response should be to somewhat evoke confirmatory bias. Staff participants did not show a significant influence of the COO effect on their preference or acceptance towards FI, compared to patient representatives who demonstrated that the COO effect is a systematic bias of acceptance in disfavour of FI.

8.2 Contributions and Implications of Findings

Our results found evidence of antipathy against specific countries according to the invasiveness and risk associated with specific FI and the actual FI itself. For instance, the design and useability of Sayeba's method initially provoked a positive response from those receiving both cues, however when discussing risk and clinical evidence, the initial response changed to a negative response once participants became more conscious and attentive to other aspects such as the COO and the frugality factor associated with the use of a condom. Responses from staff participants in our study demonstrated some implicit and explicit antipathy towards innovations conceived in LICs by focusing on identifying and applying so-called homegrown innovations into the NHS part of their LTP despite using FIs during a global pandemic. The global urgency and barriers to accessibility posed on the NHS represented an opportunity to "*rethink*" as the current innovative approaches in healthcare were not sustainable for professionals nor patients (Sarkar and Mateus, 2022).

An implication to the NHS could focus on collaborations with patient partners, community-led projects, and integrated boards such as those focusing on health inequalities. This would not only cater to many underrepresented patient groups but also evolve healthcare needs by focusing on what is needed as opposed to desired based on attractiveness. Furthermore, our findings demonstrated the need for staff to be involved when making decisions about what is used in their service delivery to all patients as it mainly affects them. The current process does not include NHS staff members when choosing to implement a medical innovation of any kind, though all participants felt the need for a representative to voice opinions and concerns about its use. These findings suggest that considering the perspectives of NHS staff aids in a smooth transition of FI in the NHS by not only implementing the perspectives of staff but also those of patient representatives. Though, most of our participants were positive about the future of FI in the NHS, there remains some scepticism about its financial issues, bureaucracy, and patient outcomes through some unconscious bias towards its COO. The LTP states that the regulatory approvals and clinical evidence is needed and considered from those that are frequently known and supported by popular institutions and organisations. Our findings suggest that the NHS could offer a trial or pilot process that is encouraged by staff members to then adapt or reshape to fit the context of the NHS with the integration of service users which will ultimately impact the outcomes of service recipients such as patient representatives. We suggest incorporating a practical recommendation culture, further training, and awareness towards FI in addressing the challenges set out in the LTP. Our findings also demonstrated the need for healthcare staff to address the role of locality bias in disparities in healthcare as the "not invented here syndrome" differs among hospitals in the NHS and may serve as a barrier for a more national implementation.

During the evolvement of country animosity and affinity, personality becomes a critical predictor of human attitudes and behaviour, (Hirsh and Dolderman, 2007), which can reciprocally be understood through the lens of the SCT. However, with personality forming perceptions of specific countries (Leonidou et al., 2019), there is a complete lack of evidence showing trends and associations between the degree of country animosity and LICs and vice versa with HICs, if any. Though, it can be understood that countries with controversial political and economic events can cause a state of antipathy (Klein et al., 1998), resistance towards validity of ideas and evidence, and can be embedded within certain personality traits in how such events are processed, perceived, and understood, there is a lack of evidence showing these associations within specific countries. Additionally, there is also a lack of research exploring whether such views carry through onto different mediums of products and services or whether they are specific to a certain item, service, or process.

According to Nesta (2023), "*good ideas can only have impact if they are taken up and used*" and acknowledges that there are barriers to adoption and spreading of innovations though they are not listed. Though the NHS Innovation Accelerator (NIA) programme, launched in 2015 by NHS England, supports healthcare professionals, small and medium enterprises (SMEs) and academic scale their innovations within the NHS and save costs, such innovations are developed and scaled only within England (Nesta, 2023). The programme also acknowledges that innovations can only provide an impact if they are implemented or adopted. Based on a continuous trend of developing, considering, and adopting homegrown innovations or those developed in other HICs, our results have demonstrated a culture of bias and stereotypes against innovations conceived in LICs. However, we acknowledge and as our results found, these outcomes may not be replicable through transferability and adaptation issues or even compared to in the UK due to many contextual factors such as differences in population, setting, training, education and more. It stresses the importance of adopting a collaborative approach when considering innovations from multilevel such that adaptation and transferability can be reshaped to fit the NHS context and piloted to ensure its success. However, this needs a more open approach. Though our study highlighted some facilitators, barriers, and influencers to the acceptance of FI in the NHS within perception analysis, we identified a hidden barrier, as not previous cited, of those positioned at the organisational level which ultimately control the consideration of FI for the NHS as healthcare professionals (so-called "gatekeepers") largely accepted the idea of FI and particularly the ADCS and MNM.

Furthermore, the NHS in the LTP highlighted the compulsory action to only consider innovations with rigorous clinical evidence from known regulatory bodies and associations from known organisations

and institutions such as NIHR, AHSN, Crick Institute and many more. This active notion implies that though previous research shows the advantages of FI, and now this evidence of acceptance towards FI with met contingences (as discussed in Chapter 7), the NHS expresses cognitive bias that still limit its consideration for implementation. Our results also found that FI is likely to be more acceptable and effective at the individual level and organisation level (based on previous research) if it is co-developed and/or endorsed or supported by a HIC as seen with the ADCS, which received almost full acceptance from all participants (Sarkar and Mateus, 2022). This may also include an ease of attainment when seeking regulatory approvals and CE markings. This also suggest that the NHS innovation accelerator programme ought to include innovators from LMICs working in healthcare that could offer new insights into FI and how they could address some of the challenges in the LTP with examples of practical solutions and adaptation methods as we acknowledge contextual differences.

The application of the SCT to this study contributed a novel breadth to the FI literature as it provided more than an anecdotal discussion and supported a conceptual interpretation to perceptions and behaviours. Our study offers a novel insight into how FI is perceived from an NHS staff and patient representative perspective. Furthermore, it contributes a theoretical and conceptual underpinning towards the barriers and facilitators that may mediate its diffusion. If healthcare professionals such as GPs, clinicians, surgeons and nurses represent the so-called “gatekeepers” and are mostly acceptive of the ideology of FI in the NHS, then it begs the question why has it not yet been implemented or even considered part of the NHS’ future plans. Additionally, though a plethora of evidence presents its proven effectiveness and safety without compromising quality, why has the NHS dismissed FI in its plan going forward despite adapting ideas from LMICs during the pandemic and only consider innovations that are developed in HICs with clinical evidence only from known regulatory bodies, suggesting that despite its effectiveness, if FI does not have accreditation or approval from a known body, its ineffective and rejected.

Additionally, our data analysis suggests that the SCT is a beneficial and effective conceptual approach to interpreting perceptions as it involves a multifaceted lens to identify common factors involved in its formation and how each can evoke a specific action or behaviour, e.g., acceptance. It also allows the user to rethink and redefine factors in an inductive process such that those not included in the main domains can be included in the interpretation. This theoretical navigation has never been used in the NHS capacity nor with its current staff members which is particularly important as perceptions are multidimensional including the perceptions about healthcare and risk and how they can differ when working in the hospital versus being a patient themselves alongside different medical

specialities. How these factors are determined, facilitates the creation of behaviours and its subsequent action overtime. Whilst we could not confirm nor test the SCT's advantage of predicting behaviours, its use still offers a critical and novel insight to understanding acceptability as a standalone concept and behaviour in healthcare, particularly how FI and COO are perceived together and in isolation alongside risk.

Furthermore, our study merges the perceptions of NHS staff and patient representatives which have typically been explored separately and thus we contribute by discussing the different narratives, barriers and influences that can improve or hinder the acceptability of FI in the NHS with a broader and relevant audience. Our study highlights the collaborative perspectives working across medical specialities to achieve a common goal of implementing safe and effective innovations that exert benefits for patients, staff, and the organisation. This collaborative perspective offers further importance as its acceptability poses a significant challenge in healthcare systems which are diverse across the world (Sarkar and Mateus, 2022). Perhaps the premise of the "*replicability problem*" and "*spread challenge*" is grounded on the importance and practical effect of adaptability which requires a collaborative approach of those using the FI and those receiving it alongside those making decisions to adopt it such as the NHS. However, as a prerequisite to exploring challenges to diffusion and adoption, our results provide evidence of an implication geared at understanding how FI can be integrated in healthcare from the starting point working in collaboration with staff and patient representatives, which would reciprocally reduce some challenges reported in our results and previous literature, particularly in HICs.

Our results corroborated the "*replicability problem*" and "*spread challenge*" identified by the Horton et al (2018) as many of our participants highlighted the notion of FI working for its COO as originally intended for and not for those it aims to scale into e.g., HICs. However, this perspective varied according to the type of FI presented and degree of invasiveness which subsequently affected risk perceptions. To our knowledge, no previous studies have explored the implications of risk on acceptance of FI nor acknowledged its impact on behavioural change within the scope of healthcare innovations particularly those from LICs. Thus, our results provide a novel opportunity to collate and polarise these findings and challenges to the adaptability problem to now fit the context of the NHS and in turn improve its diffusion and adoption using a collaborative approach. One significant challenge reported by Horton et al (2018) was exploring and shifting the organisational cultural that often hinders adoption. Our results found that though the idea of FI may be appealing and positive at first, there were biases towards its COO and validity of clinical evidence, which increased when

discussing specific attributes of the FI and its risks, such that the NHS' LTP outlines and focuses on innovations made in HICs with the support of frequently cited and popularised regulatory bodies. Findings from this study highlight what these issues are, how they can be resolved, who would be involved and its likelihood of acceptance.

Most previous studies exploring consumer animosity have focused on its application in the developed world (Amine, 2008; Areiza-Padilla et al., 2021; Campo and Alvarez, 2019; Nijssen and Douglas, 2011), leaving the exploration of such associations with LICs generally invisible. Areiza-Padilla et al (2021) believed that this trend is attributed to the political, economic, and military importance of HICs, compared to other developing or underdeveloped countries such that issues occurring in LICs are deemed less important or impactful than HICs. Evidence suggests that this adds to the view of animists of LICs and how each one is viewed in a general sense forming stereotypical views, often by third-party perception through vicarious or observational learning (Bandura, 1991b) or through past experiences or associations with that country, though it is often lead by a specific attribute. Han and Terpstra (1988), Hong and Wyer, (1989), Papadopoulos and Heslop (2014) showed that perceptions of a country influenced the evaluations of foreign products which formed perceptions of a product's attributes.

Our results showed some hesitancy towards acceptance of FI because it was deemed absent or "*lacklustre*" from specific COOs through the perceptions from various media forums. However, such perceptions also varied across countries classified under the same group e.g., LICs. A higher degree of animosity was shown to countries with a lack awareness of advancements and had a heightened awareness of negative publicity e.g., some participants felt that Sayeba's method and MNM were more dangerous and riskier to use in the NHS because they came from countries not typical of innovation development. This extended the distinction between one LIC from another in that India was seen as superior to Bangladesh simply because these participants had previously heard of innovation being developed in India or had experience something associated with India and not Bangladesh. This unfamiliarity took precedence in how perceptions of these countries are formed such that familiar stereotypes were used as "*fillers*" to judge unfamiliar attributes which typically takes place when people become overwhelmed with information or feel a detachment due to unfamiliarity (Maheswaran, 1994; Schaefer, 1997).

On the other hand, though country affinity is particularly high in HICs through patriotism (Ishii, 2009), nationalism (Shoham et al., 2006, 2016), cosmopolitism (Park and Yoon, 2017) and ethnocentrism

(Heiman and Just, 2021; Leonidou et al., 2019), some innovations particularly FIs do not encompass the same characteristics as ones frequently cited in HICs such as low-cost, affordable, or adaptable due to resource availability. For instance, in a HIC, FI is described as cost-effective despite being more expensive than those developed in LICs. Although the NHS acknowledges the importance of research and innovation to facilitate improved outcomes and efficiency and aims to increase the uptake of innovation to address such needs by ensuring local adoption and spread of proven innovations, working with AHSNs and NIHR (NHS, 2019), the same people who are service recipients (patients) and service users (NHS staff) expressed their confidence and acceptance of innovations developed in LICs providing they met the national standards of safety. This questions the real and practical hindrances involved in the diffusion of FIs into the NHS at an organisational level. Such biases and perceptions may be demonstrated by the assessment of the NHS' long-term objectives. The NHS aims to focus on local advancements and states only accepting evidence that is validated with rigour through known regulatory bodies and organisations (NHS, 2019).

There is an increasing corpus of evidence demonstrating the safety, efficacy, quality, feasibility, and effectivity of FI, whilst at times compared to existing alternatives and supported by known regulatory bodies e.g., the FDA, it continues to be dismissed and prioritises innovation conceived in HICs. Although, a review by Greenhalgh and colleagues (2004) identified various factors involved in driving adoption of innovation in health services, there remains a lack of evidence of successful uptake of FI and the factors involved in replicating the impact of an intervention as shown elsewhere, particularly through acceptance and subsequently adaptation (Horton et al., 2018).

Previous research from Agarwal and Teas (2001) and Aqueveque (2006) have shown that extrinsic cues such as price, brand or COO frequently pose as "*risk-relieving information*" (Oberecker and Diamantopoulos, 2011). Consumers may use these extrinsic cues to manage or lower their uncertainty or hesitancy about adverse consequences such as risk resulting from a purchase or use of a product. Thus, people choose familiar attributes through the evaluation of extrinsic cues over unfamiliar ones such that they tend to favour existing brands or products over new brand or unfamiliar ones as they are experienced with the perceived risk. Our results also corroborated this notion with the affinity towards a HIC such that any mention of a HIC e.g., support or endorsement with that of the ADCS, increased positive perceptions and had a lower perceived risk towards its use, rating the innovation as safe by most participants.

An extension of familiarity with the COO was also reported when participants rated the MNM innovation better than Sayeba's method though the level of invasiveness was significantly different (MNM, most invasive) and was primarily based on the COO, associations with the COO and clinical evidence obtained. Despite, India, and Bangladesh being constituted as "*out-groups*", we could see that the affinity towards India and HICs constituted a familiar option which directly influenced perceptions of risk and was consistent with the hypothesis tested in the Oberecker and Diamantopoulos (2011) study. India could be associated with some degree of innovation development and familiar context and environment through culture in the UK. Furthermore, our results were consistent with previous findings from the Oberecker et al (2008), which resulted in a negative relationship between products from the favoured country and perceived risk such that people tend to choose products from affinity countries when faced with other alternatives due to increased trust (Mitchell and Papavassiliou, 1999). This is association is due to the expected as affinity countries represent a 'positively valanced out-group or in-group' (Oberecker and Diamantopoulos, 2011).

Typically, foreign countries or LICs can be represented as "*out-groups*" in the conceptualisation of consumer ethnocentrism (Shimp and Sharma, 1987). However, in some contexts, particularly in this study, we found evidence of one of these so-called "*out-groups*", India, being included in one's "*in-group*", typically represented by HICs, in the case of consumer affinity (Shiv and Fedorikhin, 1999; Simons and Carey, 1998). Though some participants expressed concerns with the MNM with some rejecting its use altogether, specifically regarding the inclusion of the mesh material itself due to a recent controversy involving irreversible complications of vaginal meshes, the overall innovation received a generally positive review, which was attributed to its effectivity, success rate and familiar COO (those in Groups A and C). Though previous research (Oberecker et al., 2008) has shown that consumer ethnocentrism negatively influences foreign product evaluations (S. Sharma et al., 1994), increased risk perceptions (Khan and Lee, 2014) and reduced intentions to purchase foreign products (Durvasula et al., 1997), there is some assumption that affinity will have a positive impact with no influence of ethnocentrism predispositions (Oberecker and Diamantopoulos, 2011), which is corroborative of the results found in this study. This relationship suggests that participants may encounter cognitive discordance which challenges the ethnocentrism position, country affinity and risk perceptions (Festinger, 1957), which consistently changes overtime and can be explained through the application of the SCT's TRD model.

Furthermore, Erevelles (1998) suggested that behaviours are driven by affect and that personal or cognitive attributes alone may be insufficient in understanding intentions and decision-making. This

was supported by the position of the SCT model and Decision Theory as people often contravene their own principles, that are based cognitive perspectives, when making decisions such that one can change their outlook on a given innovation dependent on time, environment, and psychological factors (Kahneman and Tversky, 1979). Our study explored whether perceptions were influenced by subjected norms and outcome expectancies through the lens of the SCT model across the three constructs of the model. We found that many perceptions from patient representatives were influenced by social norms such that they shaped the subjective norms of what was deemed acceptable and the outcome expectations. Our results were shown to refute those reported in the Maher and Mady (2010), which explored the role and impact of anticipated emotions and subjective norms on consumer intentions regarding foreign products in light of negative political events. Here, the social pressures were deemed more importance and impactful in consumer's willingness to purchase foreign products compared to the anticipated emotions.

To our knowledge thus far, there are no studies exploring the differences in communication between patients and hospital staff regarding innovation or implementation of any product or service. Furthermore, studies which aim and explore such differences are primarily focused on the feedback of services received Aiken et al (2018) or healthcare providers perception and understanding of their patients' health beliefs and values compared to the actual beliefs as given by the patients (Kennedy et al., 2017), patient feedback response framework (Sheard et al., 2017), comparisons of survey responses on how real-time feedback can improve communication (Graham et al., 2018) and experience satisfaction (Dawson, 2018). Studies involving the application of the SCT in a healthcare context (Abdi et al., 2015; Dewar et al., 2012; Heydari et al., 2014; Moeini et al., 2019; Zhou and Fan, 2019), all primarily focused on obtaining responses from end-users or service recipients of the product or service in question. Given this collation of research, we found that no studies have explored perceptions of FI, including general innovation, adoption or implementation by healthcare providers and patients together as part of one study. This is particularly important as the NHS' LTP outlines objectives to leverage the skills, practices and experiences of healthcare providers and feedback from patients in enhancing current options and introducing new innovative approaches to tackle various constraints such as appointment times, clinicians to patient ratio, available beds, readmissions, follow-up, and budget cuts. To add to these growing issues, health inequalities, though often acknowledged, is rarely improved, which one can argue is the epitome of the development of FI.

Our results also showed some association between country animosity and specific innovations or their attributes. Similarly, with the lack of research in this area, no studies have explored the association

between country animosity and affinity to a specific classification of countries e.g., LICs, LMICs and HICs or culture, where it may have deep-rooted itself into stereotyping behaviours and colonisation, which has since transitioned into specs of health inequalities. This creates a so-called 'halo effect' within the realm of healthcare and the NHS' long-term objectives such that it states enhancing the future of healthcare through sourcing innovation locally with valued evidence (LTP). Whilst we can acknowledge the NHS' efforts to also boost local economies, it begs the question of whether the NHS itself shows signs of country animosity if it only seeks to localise efforts for advancements locally despite evidence showing that these traditional approaches have been far from sustainable. Our study is the first to our knowledge that shows evidence to suggest that though clinicians are often referred to as 'gatekeepers' and can be an asset towards driving the adoption of FI, they may be implicit in their actual hindrance despite evidence demonstrating effectivity and efficiency.

Furthermore, we also considered the alignment of responses from patient representatives who are service recipients, with staff members to demonstrate a level of acceptability of FI conceived in LICs for the NHS. Though the NHS shows efforts in triangulating the diffusion and development of innovations to those in HICs, reduce health inequalities and improve access to all, the same people who would use and receive the direct impact of the innovations are more likely to accept its use. Thus, we could argue that there is actual country animosity between the NHS and LICs, as they continue to dismiss the efforts of FI despite overwhelming evidence, which in itself is not deemed credible evidence (NHS, 2019). These actions implied by the objectives demonstrate a sense of potential positive attachment from ethnocentrism towards innovations and solutions being driven by the local community which can enhance the competitive power of local production and increases the behaviours towards accepting premium prices from 'local providers' (Kilders et al., 2021; Sharma et al., 1994; Van Loo et al., 2019; Wall and Heslop, 1986) as they continue to be more expensive alternatives to FI (Heiman and Just, 2021). Simultaneously, country animosity decreases the willingness or acceptance of goods from specific COO (Klein et al., 1998; Klein and Ettensoe, 1999; Riefler and Diamantopoulos, 2007).

According to Xin and Seo (2019), the higher the acceptance towards local solutions and innovations, the lower the acceptance of alternatives from specific COOs. This is effect is mirrored when high levels of hostility decrease the propensity to buy imported goods, hence increasing preference for local goods (Heiman and Just, 2021). Country animosity or triangulating the dependency on specific COOs such as HICs can reduce the acceptance either directly, without the interference of quality judgements or indirectly, by increasing the perceptions of product attributes e.g., risk (Dursun et al., 2019). The

NHS has projected a preference to only seeking innovation collaboration from credible sources and institutions including local suppliers, thus demonstrating both a direct and indirect form of animosity (Heiman and Just, 2021).

8.3 Strengths, Challenges and Limitations of this Study

The previous section highlighted the need to collect further evidence to support the development of acceptability research of FI. To inform future research projects, it is important to reflect on the strengths, challenges, and limitations of the current study.

8.3.1 Strengths of this Study

The first strength of this study was that it was the first to explore acceptability of FI in the context of the NHS at the individual level between current NHS staff and patient representatives who themselves are active patients. Our novel critical review (Hindocha et al., 2021) highlighted that whilst there is some importance in identifying the conceptualisation of FI and its associated characteristics to distinguish FI from other typologies, efforts were better focused on its comparison to incumbent alternatives in a way to standardise its conceptualisation and perhaps, even further, its definition. Similarly, to the concept of risk with its plethora of definitions and values, the core foundations and connotations contribute towards its universal understanding and application, to which the concept of FI seeks to do the same. With the increasing constraints imposed on the NHS in response to the growing population and its consequential complex morbidities, effective innovations that can improve and sustain the economic system in the UK are required now more so than ever.

Our second strength is that though innovation research has been widely explored in the realms of healthcare, they have been focused on the technological aspects of innovation and rarely the acceptance of innovations conceived from LMICs into a HIC, with none specifically exploring the context of the NHS. Thirdly, these studies did not involve the contributions of current staff participants and patients or patient representatives in one study. Thus, to our knowledge, the acceptance of non-technological FI in a healthcare system positioned in a HIC has never been explored. The perpetual understanding and implementation of such FIs starts at the core of its intention, *acceptance, or acceptability*. For an innovation to be understood, implemented, or adopted into any system, it must be acceptable which can be explored through perceptions. Fourthly, this study marks the first to explore perceptions of FIs, with varying invasiveness and its comparison to current incumbent alternatives used in the NHS by both current staff participants and patient representatives in the same study. Furthermore, the fifth strength was that this study's novelty continues in its application of the

SCT to understand perceptions of FI in the capacity of the NHS coupled with the use of qualitative semi-structured interviews as previous studies, though involved some qualitative data collection, are frequently focused on the quantitative interpretation of the SCT. Overall, not only has this research provided us with more clarity on FI, its interpretation, its desired characteristics, it has also made methodological advances in relation to how we understand FI and its dynamics by focusing on the micro, meso and macro and the social entrepreneurship (Bhatti, 2014).

Previous studies (Abdi et al., 2015; Dewar et al., 2012; Heydari et al., 2014; Moeini et al., 2019; Zhou and Fan, 2019), using the SCT to explore the acceptability of healthcare innovations primarily used either RCTs or mixed methods study design which involved the use of closed-ended questionnaires and surveys that were constructed according to the domains involved in the SCT model. These studies focused on feedback and responses from direct service recipients of the innovation. Such responses were moulded to the constructs of the SCT and its interpretations. Though this approach can help navigate and focus the interpretations accordingly to the SCT model, it limits the effect of external factors that the model does not include such as genetic predispositions, hormonal influences, and additional potential important drivers through the use of prompts and transitional speech. In contrast, our study is the first to our knowledge, that combines the strengths of the SCT, when exploring acceptance of healthcare innovations in the primary context of the NHS with not only the service recipients but also the service users, whilst mitigating the potential limitations of the SCT model through the use of an open-ended semi-structured questionnaire that was not constructed against the SCT constructs.

Although our study can be referred to as a small study (Britten, 1995; Sandelowski, 1996), we collected a large volume of data that involved 60 interviews (30 NHS staff and 30 patient representatives). The volume of interviews coupled with the open-ended approach provided a significant amount of granularity within responses such that analytical pluralism, *an application of more than one qualitative method used in one data analysis plan*, (TA and CA), was used alongside the SCT. This approach provided the opportunity of creating an objective-subjective interpretation and understanding of responses and expressions. However, we do acknowledge that these numbers do not reflect a representation of perceptions of these target groups in which a quantitative study design may have been able to achieve. Ratten (2019) suggested that the SCT could shed light on the role of marketing and how the use of specific phrases could drive the use of FI as it emphasises both internal and external factors involved in the SCT to understand perceptions of the innovation and its ultimate predictive behaviour. Therefore, the insights into these interactions from both target groups gained by the

application of the SCT and this study provides original contributions to the fields of acceptability and FI research in the context of a HIC's healthcare system. It also enabled a level of contextual understanding and how such perceptions may change over time and vary across different participants.

The sixth strength was the randomised allocation of participants to one of four Groups, which adds rigour to our interpretation of responses. With this randomisation, we were able to minimise any underlying association between the participants' responses to external cues and its absences. Furthermore, our study involved the exploration of contextual factors on perceptions and expressions such as category-based evaluations e.g., risk, COO, and frugality on innovations through the use of external cues. We purposefully selected FIs that varied in the degree of invasiveness as risk was found to be a contextual factor in acceptance in addition to the COO. Therefore, this study involved the exploration of the impact that these external cues could have on perception through utterances and examined the potential valence across Groups where external cues were present and absent. We provided an interpretation and understanding of responses through the use of the SCT in a qualitative approach using semi-structured interviews, which was also novel to this study.

Lastly, another strength was the application of SA to provide quantitative and objective rigour to the interpretation and application of the results. We used a natural language technique such as SA to extricate meaningful findings and present them numerically to explore the difference between the experimental conditions (four Groups). In addition to this, our qualitative interpretation through the application of TA, CA and SCT allowed for the exploration of interferences about the positivity, negativity and neutrality of respondents from their facial expressions, pauses, linguistic and body language in addition to their verbal responses.

8.3.2 Challenges of the Study

There were some difficulties in the analysis of perceptions whilst using the SCT model given that the majority of the previous studies using the SCT to explain predictive and health-promoting behaviours were typically quantitative and used closed questionnaires. Using an open-ended interview approach as opposed to previously used closed questionnaires allowed for thorough and diverse perceptions. Whilst the application of the SCT provided a significant positive contribution in helping understand the perceptions obtained in this study, its coding was challenging because of its qualitative application. Furthermore, whilst the SCT provided a thematic grounding and approach for interpretation and explanation of expressions, the modelling of themes was overarching in that we could not completely

ascertain and only suggest which construct of the SCT was most predominant and driver of the remaining constructs.

Though we recruited the proposed 30 NHS staff participants, this was significantly difficult to complete due to numerous reasons, including time constraints, requirement for further information, privacy, lack of incentive and unknown dismissal. Recruitment involved emailing internal networks within healthcare who matched the eligibility criteria. We contacted in total 87 current NHS staff members across different NHS networks, departments, and positions. The majority of our study advertisement via emails were dismissed stating that they either no longer worked for the NHS or were retired, politely rejected without further information, and did not receive a response. To mitigate the lack of engagement and recruitment, we reached out to our professional contacts within healthcare such as former colleagues, who were able to snowball the advertisement of our study. This increased the engagement of current NHS staff in our study, and we were able to recruit the full 30 proposed staff members. We amended our approach to inviting staff participants to our study based on the responses to our previous participation emails to include necessary information only and include a PIS and consent form in one email as opposed to another follow-up email. This helped reduce the time constraints imposed on staff in sending repeated emails and requests for more information.

Given the challenges of recruitment and the importance in involving NHS staff in our research, we sought to mitigate them through multiple strategies. These included contacting those who had already consented to participate in the study and asking them if their colleagues were interested in participating to somewhat act as “informal research champions” as it was a suggested enabler of research engagement (Gilbert et al., 2016). Another helpful element to improve recruitment of NHS staff was derived from discussions with our PPIE group who stated that the length of the interview was perhaps too long for staff to commit to and may provoke a dismissal or disengagement to the study. During this time, we had completed four interviews with NHS staff participants and evaluated the average completion time of 30 minutes. We acknowledged that time was a hinderance to engagement, and thus stated that though the study interviews were expected to last a maximum of 60-minutes as indicated in the staff PIS, it may be completed in less, which may be more appropriate for staff to participate as ‘well-designed time management’ was a suggested enabler of participation (French and Stavropoulou, 2016). Furthermore, we also emphasised that interviews could take place online at a time convenient for them and thus ensuring engagement mechanisms are as user-friendly and suitable as possible (Marjanovic et al., 2019). This approach increased engagement among staff participants because they could see that it was flexible according to their working schedule as with all of our interviews (including patient representatives).

Furthermore, two staff participants requested further information about the study and requested a copy of the ethics approval for their own research participation record keeping, which was also contingent upon their participation. Though, we encourage full transparency in research participation, part of our study involved randomisation to different groups whilst exposed to different external cues. Providing this information would have defeated the purpose of the study and its methodology, and thus the recruitment of the two staff participants had to be denied.

Overall, the experience of recruitment of current NHS staff and patient representatives was a positive one. Though, some staff participants frequently took part in research projects that would lean on their own professional and personal developmental objectives, cultural expectations, previous positive experience engaging in research, recruiting them in our study proved to be a significant challenge. This may have been attributed towards perhaps the most predominant barrier, the lack of time to engage in research. Other barriers may include lack of funding to support engagement, knowledge, skills, and confidence which may be associated with the lack of exposure to research and lack support from leadership or absence of professional network champions in research (Brereton et al., 2017; Lowrie et al., 2015; Rahman et al., 2011; Roberts et al., 2015; Tinkler et al., 2018). According to Marjanovic et al (2019), NHS staff should receive communication from research collaborators, support through training, mentorship and feedback and guidance from organisational policies that value research and make engagement feasible. Staff participants were not provided incentives for their participation unlike patient representatives. However, we acknowledged and value the importance of ground-level perceptions of NHS staff considering acceptance, adoption or implementation will directly impact them as “service users”.

The background and perceptions of ground-level NHS staff gives a direct understanding as we sought to obtain a fully versed and diverse perspective of FIs by those who would be directly involved with its potential use. Simply obtaining perceptions from patient representatives would have only provided one dimension to the true conception of FIs in the UK, but further, not including active NHS staff members would have dismissed the core perceptions from those who would be directly impacted by its potential implementation and its comparison to current alternatives. Healthcare professionals are commonly referred to as so-called ‘gatekeepers’ to which patients typically depend upon decisions proposed by their healthcare professional e.g., clinicians, consultants, GPs, and nurses. Therefore, NHS staff have much to offer to research about healthcare and their experience and insights can help in various ways such as developing research, trialling, analysis and dissemination. If we recommend that FIs are better compared to current incumbent alternatives, then we must seek to understand the

practicality of functions and perceptions from those who currently use it and thus must include the target population in our study.

8.3.3 Limitations of the Study

We acknowledge and understand research bias as important for determining the utility and interpretation of study results (Galdas, 2017). Firstly, we critically examined our role as researchers as 'potential bias' and 'researcher bias' in the epistemological and ontological positioning (see Section 3.11) and reflexivity section (see Section 3.12) where we examined the potential influences on the study design and interpretation and how these were limited and mitigated altogether. With this, there may be some limitations with selection bias through purposive sampling, participation bias, recall bias, cognitive bias, social acceptability bias and social desirable bias as reported in the Abdi et al (2015). We recognise some selection bias through our purposive sampling approach as patient representatives were primarily recruited from a public partner engagement platform, the Voice Network, to which certain sub-selected group of individuals sign up to participate because they are interested in participating in research studies. Though this may demonstrate a minimum understanding of research processes and our research area, it limits the engagement of those who do not possess the same level of health literacy or exposes constraints with language restrictions.

We must also highlight the possibility of various biases such as cognitive bias, participation bias, interviewer bias, recall bias and social acceptability bias as "*it is not possible for qualitative researchers to be totally objective, because total objectivity is not humanly possible*" (Ahern, 1999). As discussed in our reflexivity section, we mitigated subjectivity and bias by incorporating a form of bracketing which involved the structural processing of responses through the lens of the SCT but also by audio-recording the interviews, which was not conducted in previous studies using the SCT, to allow an accurate representation of responses that were coded using an informed systematic approach whilst in accordance with the definition of each construct. Using the SCT to explore perceptions of the healthcare innovations enabled the possibility to be both objective and subjective towards the responses allowing the interpretations to be fluid yet structural for consistency and standardisation. It also provided the opportunity to prompt further and deconstruct how expressions and responses are formed in an approach that channels back to external sources that are not directly involved within the SCT e.g., genetic conditions affecting how perceptions are formed and expressed.

The eligibility criteria in our study involved those who spoke fluent English. However, we must note that within the realms of COO research and engagement in research studies are barriers with

language. Previous research has shown that those who do not speak fluent English or have lower health literacy form perceptions significantly differently than those who fully understand the content and may vary in acceptance of FI. This limitation adds to the complex issue of segregation of cultures and the COO effect itself as it reveals the restrictions imposed on those with lower health literacy. Our results demonstrated that those born and raised in LICs and now reside in the UK, perceive health innovations more critically than those born and raised in the UK. Some of these perceptions expressed a social norm and influence on others to dissent against accepting FI in the UK. There were limitations to obtaining rigorous feedback about FI from those who do not speak English fluently as this could be a barrier to health inequalities associated with FI itself. Thus, selection bias of patient representatives may limit our interpretation and collation of comprehensive analysis of perceptions from those who lived experiences in LICs and now HICs.

A limitation in our study was the cross-sectional design in that the results obtained was from the target population at one specific time point, thus we had to examine the influence of exposures ("external cues") and assess the outcomes at the same time. Most studies using the SCT in acceptability research (Abdi et al., 2015; Dewar et al., 2012; Heydari et al., 2014; Moeini et al., 2019; Zhou and Fan, 2019), collected data ranging from two months to six months as it involved a quantitative or mixed method study design. These studies were able to examine the long-term effects of perceptions and follow-up to investigate whether it had changed over time and according to different factors. A cross-sectional study only provides a "snapshot" of a group of individuals Carlson and Morrison (2009) and because of this, results are often limiting when exploring behavioural change according to external factors. Furthermore, there is no prospective follow-up which would have corroborated our findings to real-time and accurate decision-making and health promoting behaviours of acceptance.

Some participants did express stating that it was difficult to accurately suggest their acceptance of the FI but in their current state of mind, they would, suggesting the subjectivity to change depending on different factors at a different time or circumstance. To this, another possible limitation may be that we did not solely explore perceptions from those actively diagnosed with a specific condition pertaining to the innovation being presented e.g., osteoporosis or arthritis when presenting the ADCS. Though this would have changed our ethics application and selection criteria, it may have limited our engagement with patient representatives. However, in our pool of participants, many did state an underlying condition that involved the possible use of one of the innovations presented.

Furthermore, it allowed for a more conclusive and comprehensive study of perceptions about pertinent and situational risk compared to perceived risks such that we could assess perceptions of

how some who needed treatment relatively soon varied from those who may need it in the future by weighing out different levels of risk and constructs involved within the SCT. Overall, as cross-sectional studies are fast and inexpensive to conduct, it was an appropriate and suitable design for generating information about the perceptions of the FI in healthcare and applying the SCT to understand the behaviours and expressions of perceptions.

Another possible limitation associated with the small sample size, was the limited number of sites from which participants were sampled from could limit the generalisability of our results. We included Imperial College Healthcare NHS Trust, Chelsea, and Westminster Hospital, AHSN, The George Institute and the NHS Confederation to recruit NHS staff. Despite our efforts to reach potential participants through these channels, we were limited in the selection of staff to engage in our research according to the medical specialities of the innovations chosen.

8.4 Future Research on Acceptability of FI

It is important to note that we are not claiming or suggesting that the SCT is predictive of people's behaviour, despite evidence demonstrating its effectivity. The core premise of the theory is to understand behaviours and how they are formed through its TRD model. Though the SCT stands as a model that can help form predictive behaviours based on the interpretation of constructs and the assessment of responses, this potential advantage may be suggested and claimed in longitudinal studies whereby the individual responses can demonstrate changes in behaviours and actions over a longer period of time whilst exposed to the initial observed variables. Given more time and resources such as a larger pool of participants across England, we could assess whether the initial responses change over time and whether exposure to the given cues and variables affect the initial perceptions according to time and medical conditions that may have been diagnosed to which makes the FI more personable.

A possible approach for future research would be to conduct a longitudinal study or a cohort study with the same participants to examine whether their initial perceptions changed over time in response to the SCT constructs, interactional changes as relationships change and its potential association to their health at that specific time as conditions change. For a prospective future study, our results should be followed up in a consent study, asking participants whether they would accept the initially evaluated FIs in their care as a matter of fact whilst disguising its actual use in their care or treatment. This would further validate our assessment of responses and the SCT's predictive nature of whether

perceived behaviours or decisions carry through with the action of acceptance. It is then we can develop substantiated plans and interventions to explore whether the role of acceptance could increase whilst mediating activated variables and further examine how the contingent variables could be monitored and adjusted to increase acceptance. Additionally, future studies could explore the impact of individual variables that were shown to influence acceptability, such as risk, accreditation, efficacy, clinical evidence, only COO and only frugality on the acceptability of FIs. Further to this, a prospective or follow-up study with the same participants (if opted in for follow-up) based on the results from this study, could propose a longitudinal design, exploring the acceptability and sentiments of FI at different time points such a six-months, 12-months, and 18 months. Some of the results suggested that the acceptability and attitudes may change if the innovation was deemed as "*useful*" and "*applicable*" to the respondent at the present time, given the available options. This could provide more accurate results into the acceptability of FI in the NHS but more specifically within individual care. Additionally, SA is crude and thus should be used in combination with another analytical method. There are several limitations with the type of SA used and its specific classification (Fang and Zhan, 2015; Liaqat et al., 2022; Wankhade et al., 2022).

Furthermore, prospective studies could also adopt a cross-over study design applying a wash-out period, to explore individual responses to the cues and compare them to the individuals themselves based on the descriptive and demographic data we collected. Using a similar design to one used by Harris et al (2015), a prospective study could present an innovation to a number of participants to which the country of origin has been changed from a LMIC to a HIC (baseline). The same innovation could then be presented again 12-months later to the same participants introducing its accurate COO. Collecting and comparing the perceptions of the FI whilst exposed to the cue whilst inaccurately stating the COO to then the correct COO, could illicit an impactful response. This would provide an isolation outcome approach to which one could measure the impact the COO alone has on the acceptability of a FI in the UK. In addition, we also suggest collection data on background characteristics of each participant e.g., degrees, ethnicity, age, sex and country of residence and country of birth.

Another possible inclusion for future research exploring the acceptability of FI is the importance of exploring the trend or behaviours of LICs adopting innovations conceived in HICs despites the challenges of affordability and their own research initiatives. Whilst some LICs may not be able to sustain the implementation or adoption of such innovations developed in HICs e.g., due to labour costs, accessibility to resources, infrastructure components, there remains a fascination of learning

from them and adapting such ideas to their own climate (Barlow, 2017; Howitt et al., 2012; Petrick and Juntiwasarakij, 2011). It is important to acknowledge and understand the growing domestic wealth of some LICs that now may be able to afford these innovations or its ideology to adaptation. Future studies can examine the trend of why ideas and innovations from HICs are still seen as superior over homegrown innovations like FI in LICs compared to homegrown innovations made in HICs. Though, there is not much information or research about this, its exploration can unlock a behavioural trend analysis that can be used for adaptation and marketing of FI.

Our findings showed that if specific attributes are fulfilled then most service users and recipients would be more inclined to accept FI in their care or service. Furthermore, it showed that innovations from specific LMICs are unacceptable in a HIC's healthcare system irrespective of successful outcomes and evidence, which suggests that the COO not only dampens the perspective of FI but deems its announcement as unnecessary as explicitly recorded by some participants. However, due to the lack of resources such as timing and funding of the PhD, our efforts were drawn to the individual level as this had not previously been explored in any capacity. An important avenue for research is to explore the perceptions of those who were actual service users and service recipients. The organisational level incorporates the system as a whole and involves the impact of individual and group behaviours on the system, so the exploration of the individual components i.e.., staff and patient representatives, can provide an outlook on how the organisation can be perceived, managed, and monitored effectively.

However, once obtaining this data as done so in this study, it is recommended that future studies explore how such individual components can impact the organisation and whether there are any similarities or differences in associations of the discerning trends and perceptions of FI. One may then be able to evaluate and identify barriers to its diffusion in the NHS and improve its implementation or adoption in the UK and how to address these barriers. Though our study focused on exploring acceptability of FI at the individual level among NHS staff and patient representatives, the initial intention of this study was to also include the organisational level and a broader systems approach. Our study presents an important emphasis on a system-wide perspective exploring perceptions and decision-making dynamics, through identifying and understand who the key decision makers are, their influence and perspective on adoption and how this can be improved.

We recommend that future research explore and apply a system-wide perspective of FI in healthcare exploring the external cues to those making the decisions of whether to accept and adopt innovations into the NHS. So, whilst this is a small-scale study and we offer insights into how FI is perceived at the

individual level within the NHS, there is a need to examine wide range of stakeholders and different NHS contexts. Our findings demonstrate that the so-called "gatekeepers" are those to only patients, but the "gatekeepers" themselves are patients with their own individual perspectives who look to those making decisions higher in the hierarchical positions. Further research should also explore the dynamics of frugality and determine how much is frugal enough if all innovations seek to lower costs and provide quality and effective solutions. Perhaps further researcher can explore a standardised approach to determining the value and success of FIs at the individual and organisational levels. Our results also found a double standard to adopt innovations from LMICs, as though the UK acknowledges ideas and developments from LMICs, despite its success and evidence, dismisses its opportunity to resolve the barriers and challenges currently imposed on the NHS as it seeks to only consider those from HICs.

We also considered the small sample size and the impact of each cue on the sentiment, perception, and acceptability of FI. A decrease in positivity implies an increase in negativity unless it's an increase in neutrality. We explored the positive rating as the primary outcome which is conducive to acceptability. We combined positive rates from Group A and compared them to those of Group D and calculate the effect size to base the sample size on this calculation.

We stipulate a p-value of 0.05 for statistical significance. We have two independent study Groups (A vs D), with a continuous variable (mean; μ) at a power set to 80% and confidence interval at 95%. We can see with our continuous variable, the average positivity of Group A across all three innovations is 36.96μ (Table 16). The average positivity of Group D across all three innovations is 66.75μ (Table 17). Calculations show that four people would be needed to show this difference is statistically significant (Table 18). Tables 19 to 33 shows the sample sizes needed to explore statistical significance between Groups A and D for both NHS staff and patient representatives. The greater the difference in means, the smaller the sample size needed to examine the effect or impact of cues on acceptability via a positive sentiment. This was calculated at the statistical significance at $p=<0.05$. We also considered the statistical significance and sample size for each individual innovation across Groups A and D for both patient representatives and NHS staff (Table 34).

Table 16: Mean Positivity for Patient Representatives in Group A (All Innovations)

Participant	Mean Positivity
1	43.11%
2	32.15%
3	56.87%

4	19.58%	
5	07.48%	
6	66.39%	
7	54.27%	
8	15.63%	
	36.96µ	mean
	20.15σ	SD
	36.935 ±13.965 (±37.81%)	SEM (CI = 95%)

Table 17: Mean Positivity for Patient Representatives in Group D (All Innovations)

Participant	Mean Positivity	
1	61.38%	
2	78.04%	
3	53.97%	
4	61.55%	
5	58.35%	
6	71.43%	
7	88.03%	
8	61.24%	
	66.75µ	mean
	10.74σ	SD
	66.7488 ±7.441 (±11.15%)	SEM (CI = 95%)

Table 18: Estimated Sample Size for Patient Representatives at 0.05 Probability (All Innovations)

Group A	36.96µ
Group D	66.75µ
Sample Size	4

Table 19: Mean Positivity for NHS Staff in Group A (All Innovations)

Participant	Mean Positivity	
1	46.37%	
2	35.29%	
3	38.21%	
	39.96µ	mean
	4.69σ	SD
	39.96 ±5.306 (±13.28%)	SEM (CI = 95%)

Table 20: Mean Positivity for NHS Staff in Group D (All Innovations)

Participant	Mean Positivity	
1	54.06%	
2	52.29%	
3	59.39%	
	53.25µ	mean
	5.31σ	SD
	53.25 ±3.678 (±6.91%)	SEM (CI = 95%)

Table 21: Estimated Sample Size for NHS Staff at 0.05 Probability (All Innovations)

Group A	39.96µ
Group D	53.25µ
Sample Size	18

Table 22: Mean Positivity for Patient Representatives in Group A – Sayeba's Method

Participant	Mean Positivity	
1	9.20%	
2	8.10%	
3	7.10%	
4	10.00%	
5	8.20%	
6	9.10%	
7	8.40%	
8	10.10%	
	8.78µ	mean
	0.95σ	SD
	8.775 ±0.661 (±7.53%)	SEM (CI = 95%)

Table 23: Mean Positivity for Patient Representatives in Group A - Mosquito Net Mesh

Participant	Mean Positivity	
1	85.31%	
2	76.78%	
3	96.57%	
4	84.85%	
5	77.39%	
6	95.83%	
7	89.27%	
8	93.64%	
	87.46µ	mean
	7.26σ	SD
	87.455 ±5.029 (±5.75%)	SEM (CI = 95%)

Table 24: Mean Positivity for Patient Representatives in Group A – Arbutus Drill Cover System

Participant	Mean Positivity	
1	96.40%	
2	96.92%	
3	94.31%	
4	96.19%	
5	89.56%	
6	98.79%	
7	97.49%	
8	98.74%	
	96.10μ	mean
	2.80σ	SD
	96.05 ±1.943 (±2.02%)	SEM (CI = 95%)

Table 25: Mean Positivity for Patient Representatives in Group D – Sayeba's Method

Participant	Mean Positivity	
1	89.11%	
2	75.14%	
3	86.81%	
4	89.65%	
5	82.79%	
6	86.57%	
7	84.54%	
8	95.69%	
	86.30μ	mean
	5.56σ	SD
	86.2875 ±3.855 (±4.47%)	SEM (CI = 95%)

Table 26: Mean Positivity for Patient Representatives in Group D - Mosquito Net Mesh

Participant	Mean Positivity	
1	96.88%	
2	93.89%	
3	88.79%	
4	75.44%	
5	89.63%	
6	94.69%	
7	94.59%	
8	97.33%	
	91.41μ	mean
	6.68σ	SD
	91.405 ±4.63 (±5.06%)	SEM (CI = 95%)

Table 27: Mean Positivity for Patient Representatives in Group D - Arbutus Drill Cover System

Participant	Mean Positivity	
1	97.19%	
2	98.64%	
3	98.43%	
4	96.41%	
5	97.24%	
6	97.27%	
7	98.31%	
8	95.41%	
	97.36µ	mean
	1.03σ	SD
	97.3625 ±0.712 (±0.73%)	SEM (CI = 95%)

Table 28: Mean Positivity for NHS Staff in Group A – Sayeba's Method

Participant	Mean Positivity	
1	2.55%	
2	2.93%	
3	3.39%	
	2.96µ	mean
	0.34σ	SD
	2.9567 ±0.389 (±13.14%)	SEM (CI = 95%)

Table 29: Mean Positivity for NHS Staff in Group A - Mosquito Net Mesh

Participant	Mean Positivity	
1	46.69%	
2	55.59%	
3	51.13%	
	51.14µ	mean
	3.63σ	SD
	51.14%	SEM (CI = 95%)

Table 30: Mean Positivity for NHS Staff in Group A - Arbutus Drill Cover System

Participant	Mean Positivity	
1	36.24%	
2	33.81%	
3	33.14%	
	34.40µ	mean
	1.33σ	SD
	34.3967 ±1.507 (±4.38%)	SEM (CI = 95%)

Table 31: Mean Positivity for NHS Staff in Group D - Sayeba's Method

Participant	Mean Positivity	
1	41.01%	
2	39.48%	
3	44.18%	
	41.56μ	mean
	1.96σ	SD
	41.5567 ±2.215 (±5.33%)	SEM (CI = 95%)

Table 32: Mean Positivity for NHS Staff in Group D - Mosquito Net Mesh

Participant	Mean Positivity	
1	56.73%	
2	57.25%	
3	57.70%	
	57.23μ	mean
	0.40σ	SD
	57.2267 ±0.449 (±0.78%)	SEM (CI = 95%)

Table 33: Mean Positivity for NHS Staff in Group D - Arbutus Drill Cover System

Participant	Mean Positivity	
1	55.61%	
2	51.62%	
3	46.68%	
	51.30μ	mean
	3.65σ	SD
	51.3033 ±4.133 (±8.06%)	SEM (CI = 95%)

Table 34: Estimated Sample Sizes for All Three Innovations for Patient Representatives (Groups A vs Group D) at 0.05 Probability

Patient Representatives	
Innovation	**Sample Size**
Sayeba's Method	0
Mosquito Net Mesh	202
Arbutus Drill Cover System	1978
NHS Staff	
Innovation	**Sample Size**
Sayeba's Method	2
Mosquito Net Mesh	84
Arbutus Drill Cover System	90

Chapter 9: Conclusion

Health systems in developed countries are under stress and FI have been put forward as one way to help deal with some of the challenges. This research explored the perceptions of FI and its COO, but furthermore, we explored how perceptions are grounded using the SCT to understand specific behaviours through theoretical constructs and domains attributed to acceptability. The application of the SCT allowed the analysis to go beyond the initial perceptions gathered in the interviews, deepening the conventional application of using quantitative design to assess a rather binary outcome. Within this study, we could attribute differences and similarities within responses across different target groups whilst exposed to specific information to gauge whether this influenced acceptance. This approach demonstrated that the behaviour of acceptance is a long-term everchanging construct and varies according to the time and environment of discussions and the core constructs of the SCT model. It was important to explore this research as FIs have long shown evidence of its effectiveness, efficiency, and its advantages to suit the needs of underserved people at a given time with limited resources but have struggled to be accepted in HICs despite sharing several systemic issues and challenges, with particular importance now in healthcare/NHS. The inherent uncertainty towards accepting the innovation in the UK was highlighted through qualifying language and explicit statements.

Though patient representatives and NHS staff participants shared an overall positive response towards the presented FI examples, the narratives and connotations used demonstrated a level of uncertainty – would their responses evoke the desired behaviour of acceptance had the innovation been nationally adopted (*would they object to its use if it had already been adopted*), contingent upon acquiring more information and approvals and would it change over time to a non-consensual use under different circumstances such as need or ethical values. Due to the limits imposed on the study design, this result was difficult to obtain. Our aim was also to explore facilitating barriers to the acceptance of FI and whether this changed according to the invasiveness of the innovation. We found that though risk was an important factor in shaping the initial perceptions of FI alongside the design, useability and clinical evidence, the most crucial factor was the COO effect on facilitating acceptance.

Participants evaluated risk according to the COO even as some did not explicitly receive the cue, as the COO may have been presumed through identifiable characteristics such as the name of the innovation and materials used. Though this resulted in less criticism than those who received the cue, the COO still mediates the overall perception of the innovation and thus subsequently its acceptance. These interviews with different target groups also provided the audience interpretation of the term

'frugal', which transitions in narrative depending on the field of study, to mean positive in the context of modern advancement and clever solutions or neutral in the context of good-enough for the time being or negative in the context of the COO and materials used e.g., condoms. While FI in literature across various sectors is typically referred to in a positive narrative, the 'frugal' part of it seems to dampen the overall perception which provoked more criticism and attention to the aspects that were used as alternatives or absent compared to their incumbent alternative, whilst 'innovation' increased positivity and circumvented such absences to be acceptable.

This questions whether the use of the term 'frugal' should continue to be used in such innovations if it limits the potential for its adoption in the UK, as our results demonstrate that without the term 'frugal', COO and identifiable characteristics, the outlook and importance of such innovations serves a great advantage and resolves many objectives outlined in the NHS' Long Term Plan. Whilst we cannot state how predictive these barriers were, our results support the influence of certain parameters through understanding behavioural responses on increasing or decreasing the level of acceptance of FI. Our result suggested that participants react more negatively to the COO compared to the term 'frugal'. This may be due to the subjective interpretation to frugality and the ongoing trend to save costs and adhere to simplicity, "gets the job done" notion. But with this, presents the narrative that removing information about the COO if it is a LMIC, increases acceptability or at least increases the openness and welcome new knowledge and information. The term frugal does not significantly impact the perception compared to the COO. With this, our results suggested that to market FI from the emerging world to the developed world and/or how to drive adoption of FIs within the western healthcare systems such as the NHS, the COO should not be mentioned. Our results suggested that the role of the COO cue weighs significantly more in mediating the acceptance of FI compared to the frugal cue as this can be seen as a new social norm and lifestyle change. The main differences between patient representatives and NHS staff was the dynamic of conversations and the requirement for clinical evidence and further testing for FI to be acceptable in the NHS. Staff were less reluctant to accept compared to patient representatives based on clinical evidence alone. However, when no cues were used, the general perception and acceptance was more positive though this was significant among patient representatives only.

Combining a theoretical acceptability model in the space of FI research in a healthcare context provided a real-life, detailed, in-depth description of the conceptualisation of FI and its mediating parameters influencing its acceptance. This thesis is the first step towards introducing acceptability research of FI to potentially shape its framing to increase the acceptance and subsequent adoption of

FI in HICs. The study is also first, to our knowledge, to provide supportive strategies for how to market FI to best increase its potential for adoption into HICs.

References

Abbott, T. E. F., Fowler, A. J., Dobbs, T. D., Harrison, E. M., Gillies, M. A., & Pearse, R. M. (2017). Frequency of surgical treatment and related hospital procedures in the UK: a national ecological study using hospital episode statistics. *British Journal of Anaesthesia*, *119*(2). https://doi.org/10.1093/bja/aex137

Abdi, J., Eftekhar, H., Mahmoodi, M., Shojayzadeh, D., Sadeghi, R., & Saber, M. (2015). Effect of the Intervention, Based on New Communication Technologies and the Social-Cognitive Theory, on the Weight Control of the Employees with Overweight and Obesity. *Journal of Research in Health Sciences*, *15*(4), 256–261.

Abraham, A., & Patro, S. (2014). 'Country-of-Origin' Effect and Consumer Decision-making. *Management and Labour Studies*, *39*(3), 309–318. https://doi.org/10.1177/0258042X15572408

Adams, J. (2002). *Risk*. Routledge.

Adebayo, B. (2020, March 20). *Senegal partners with UK lab to develop a hand-held coronavirus test kit*. CNN. https://edition.cnn.com/2020/03/12/africa/senegal-uk-coronavirus-rapid-test-kit/index.html

Adina, C., Gabriela, C., & Roxana-Denisa, S. (2015). Country-of-Origin Effects on Perceived Brand Positioning. *Procedia Economics and Finance*, *23*, 422–427. https://doi.org/10.1016/S2212-5671(15)00383-4

Afoakwa, E. O., Paterson, A., & Fowler, M. (2007). Factors influencing rheological and textural qualities in chocolate – a review. *Trends in Food Science & Technology*, *18*(6), 290–298. https://doi.org/10.1016/j.tifs.2007.02.002

Agarwal, B., Mittal, N., Bansal, P., & Garg, S. (2015). Sentiment Analysis Using Common-Sense and Context Information. *Computational Intelligence and Neuroscience*, *2015*, 1–9. https://doi.org/10.1155/2015/715730

Agarwal, N., & Brem, A. (2017). Frugal innovation-past, present, and future. *IEEE Engineering Management Review* , *45*(3), 37–41.

Agarwal, R., Anderson, C., Zarate, J., & Ward, C. (2013). If We Offer it, Will They Accept? Factors Affecting Patient Use Intentions of Personal Health Records and Secure Messaging. *Journal of Medical Internet Research*, *15*(2), e43. https://doi.org/10.2196/jmir.2243

Agarwal, S., & Teas, R. K. (2001). Perceived Value: Mediating Role of Perceived Risk. *Journal of Marketing Theory and Practice*, *9*(4), 1–14. https://doi.org/10.1080/10696679.2001.11501899

Agnihotri, A. (2015). Low-cost innovation in emerging markets. *Journal of Strategic Marketing*, *23*(5). https://doi.org/10.1080/0965254X.2014.970215

Ahern, K. J. (1999). Ten Tips for Reflexive Bracketing. *Qualitative Health Research*, *9*(3), 407–411. https://doi.org/10.1177/104973239900900309

Ahmad, M. H., Pathak, S., Clement, K. D., & Aly, E. H. (2019). Meta-analysis of the use of sterilized mosquito net mesh for inguinal hernia repair in less economically developed countries. *BJS Open*, *3*(4). https://doi.org/10.1002/bjs5.50147

Ahmed, F., Ahmed, N., Briggs, T. W. R., Pronovost, P. J., Shetty, D. P., Jha, A. K., & Govindarajan, V. (2017). Can reverse innovation catalyse better value health care? *The Lancet Global Health*, *5*(10). https://doi.org/10.1016/S2214-109X(17)30324-8

Aiken, L. H., Sloane, D. M., Ball, J., Bruyneel, L., Rafferty, A. M., & Griffiths, P. (2018). Patient satisfaction with hospital care and nurses in England: an observational study. *BMJ Open*, *8*(1), e019189. https://doi.org/10.1136/bmjopen-2017-019189

Ain, Q., Ali, M., Riaz, A., Noureen, A., Kamranz, M., Hayat, B., & Rehman, A. (2017). Sentiment Analysis Using Deep Learning Techniques: A Review. *International Journal of Advanced Computer Science and Applications*, *8*(6). https://doi.org/10.14569/IJACSA.2017.080657

Ajzen, I. (1985). From Intentions to Actions: A Theory of Planned Behavior. In *Action Control* (pp. 11–39). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-69746-3_2

Ajzen, I. (1989). Attitude structure and behavior. In A. Pratkanis, S. Breckler, & A. Greenwald (Eds.), *Attitude Structure and Function*. Erlbaum.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T

Ajzen, I. (2012). Martin Fishbein's Legacy. *The ANNALS of the American Academy of Political and Social Science*, *640*(1), 11–27. https://doi.org/10.1177/0002716211423363

Ajzen, I., & Albarracin, D. (2007). *Prediction and Change of Health Behavior* (I. Ajzen, D. Albarracin, & R. Hornik, Eds.). Lawrence Erlbaum Associates Publishers. https://doi.org/10.4324/9780203937082

Ajzen, I., Albarracin, D., & Hornik, R. (2007). *Prediction and Change of Health Behavior: Applying the Reasoned Action Approach*. Lawrence Erlbaum Associates Publishers.

Ajzen, I., & Fishbein, M. (1980). *Understanding Attitudes and Predicting Social Behavior*. Prentice-Hall.

Ajzen, I., & Madden, T. J. (1986). Prediction of goal-directed behavior: Attitudes, intentions, and perceived behavioral control. *Journal of Experimental Social Psychology*, *22*(5), 453–474. https://doi.org/10.1016/0022-1031(86)90045-4

Akhter, S., Begum, M., Kabir, Z., Rashid, M., Laila, T., & Zabeen, F. (2003). *Use of a Condom to Control Massive Postpartum Hemorrhage*. MedGenMed Ob/Gyn & Women's Health. https://www.medscape.com/viewarticle/459894

al Wattar, B., Tamblyn, J. A., Parry-Smith, W., Prior, M., & van der Nelson, H. (2017). Management of obstetric postpartum hemorrhage: a national service evaluation of current practice in the UK. *Risk Management and Healthcare Policy*, *Volume 10*. https://doi.org/10.2147/RMHP.S121737

Alam, A. Y. (2016). Steps in the Process of Risk Management in Healthcare. *Journal of Epidemiology and Preventive Medicine*, *02*(02). https://doi.org/10.19104/jepm.2016.118

Albarracín, D., Johnson, B. T., Fishbein, M., & Muellerleile, P. A. (2001). Theories of reasoned action and planned behavior as models of condom use: A meta-analysis. *Psychological Bulletin*, *127*(1), 142–161. https://doi.org/10.1037/0033-2909.127.1.142

Albert, M. (2019). Sustainable frugal innovation - The connection between frugal innovation and sustainability. *J Clean Prod*, *237*. https://doi.org/10.1016/j.jclepro.2019.117747

Al-Suqri, M. N., & Al-Kharusi, R. M. (2015). Ajzen and Fishbein's Theory of Reasoned Action (TRA) (1980). In *Information Seeking Behavior and Technology Adoption: Theories and Trends* (pp. 188–204). IGI Global. https://doi.org/10.4018/978-1-4666-8156-9.ch012

Al-Thubaity, A., Alqahtani, Q., & Aljandal, A. (2018). Sentiment lexicon for sentiment analysis of Saudi dialect tweets. *Procedia Computer Science*, *142*, 301–307. https://doi.org/10.1016/j.procs.2018.10.494

Amin, H., Abdul-Rahman, A.-R., & Abdul-Razak, D. (2016). Malaysian consumers' willingness to choose Islamic mortgage products. *International Journal of Bank Marketing*, *34*(6), 868–884. https://doi.org/10.1108/IJBM-06-2015-0099

Amine, L. S. (2008). Country-of-origin, animosity and consumer response: Marketing implications of anti-Americanism and Francophobia. *International Business Review*, *17*(4), 402–422. https://doi.org/10.1016/j.ibusrev.2008.02.013

Amine, L. S., Chao, M. C. H., & Arnold, M. J. (2005). Executive Insights: Exploring the Practical Effects of Country of Origin, Animosity, and Price–Quality Issues: Two Case Studies of Taiwan and Acer in China. *Journal of International Marketing*, *13*(2), 114–150. https://doi.org/10.1509/jimk.13.2.114.64855

Anger, H. A., Durocher, J., Dabash, R., Hassanein, N., Ononge, S., Burkhardt, G., Frye, L. J., Diop, A., Beye Diop, S. B. M., Darwish, E., Ramadan, M. C., Kayaga, J., Charles, D., Gaye, A., Eckardt, M., & Winikoff, B. (2021). Postpartum infection, pain and experiences with care among women treated for postpartum hemorrhage in three African countries: A cohort study of women managed with and without condom-catheter uterine balloon tamponade. *PLOS ONE*, *16*(2), e0245988. https://doi.org/10.1371/journal.pone.0245988

Angot, J., & Plé, L. (2015). Serving poor people in rich countries: the bottom-of-the-pyramid business model solution. *Journal of Business Strategy*, *36*(2). https://doi.org/10.1108/JBS-11-2013-0111

Ankel, S. (2020). *A construction expert broke down how China Built an Emergency Hospital to Treat Wuhan Coronavirus Patients in Just 10 Days*. Business Insider. https://www.businessinsider.com/how-china-managed-build-entirely-new-hospital-in-10-days-2020-2?r=US&IR=T

Aqueveque, C. (2006). Extrinsic cues and perceived risk: the influence of consumption situation. *Journal of Consumer Marketing*, *23*(5), 237–247. https://doi.org/10.1108/07363760610681646

Arbelaez Garces, G., Rakotondranaivo, A., & Bonjour, E. (2016). An acceptability estimation and analysis methodology based on Bayesian networks. *International Journal of Industrial Ergonomics*, *53*, 245–256. https://doi.org/10.1016/j.ergon.2016.02.005

Areiza-Padilla, J. A., Moise, M. S., & Manzi Puertas, M. A. (2021). Breaking the barriers of animosity: innovation in business models as a positioning strategy. *Heliyon*, *7*(7), e07545. https://doi.org/10.1016/j.heliyon.2021.e07545

Arshad, H., Radić, M., & Radić, D. (2018). Patterns of Frugal Innovation in Healthcare. *Technology Innovation Management Review*, *8*(4), 28–38.

Asghar, M. Z., Khan, A., Ahmad, S., Qasim, M., & Khan, I. A. (2017). Lexicon-enhanced sentiment analysis framework using rule-based classification scheme. *PLOS ONE*, *12*(2), e0171649. https://doi.org/10.1371/journal.pone.0171649

Asghar, M. Z., Sattar, A., Khan, A., Ali, A., Masud Kundi, F., & Ahmad, S. (2019). Creating sentiment lexicon for sentiment analysis in Urdu: The case of a resource-poor language. *Expert Systems*, *36*(3). https://doi.org/10.1111/exsy.12397

Assefa, Y., Gilks, C. F., van de Pas, R., Reid, S., Gete, D. G., & Van Damme, W. (2021). Reimagining global health systems for the 21st century: lessons from the COVID-19 pandemic. *BMJ Global Health*, *6*(4), e004882. https://doi.org/10.1136/bmjgh-2020-004882

Aubert, B. A., & Hamel, G. (2001). Adoption of smart cards in the medical sector: *Social Science & Medicine*, *53*(7), 879–894. https://doi.org/10.1016/S0277-9536(00)00388-9

Auerswald, E. H. (1987). Epistemological Confusion in Family Therapy and Research. *Family Process*, *26*(3), 317–330. https://doi.org/10.1111/j.1545-5300.1987.00317.x

Aven, T. (2012). The risk concept—historical and recent development trends. *Reliability Engineering & System Safety*, *99*, 33–44. https://doi.org/10.1016/j.ress.2011.11.006

Aven, T. (2016). Risk assessment and risk management: Review of recent advances on their foundation. *European Journal of Operational Research*, *253*(1), 1–13. https://doi.org/10.1016/j.ejor.2015.12.023

Badley, E. M., Canizares, M., MacKay, C., Mahomed, N. N., & Davis, A. M. (2013). Surgery or Consultation: A Population-Based Cohort Study of Use of Orthopaedic Surgeon Services. *PLoS ONE*, *8*(6). https://doi.org/10.1371/journal.pone.0065560

Bajaj, D., Oluwoye, J., & Lenard, D. (1997). An analysis of contractors' approaches to risk identification in New South Wales, Australia. *Construction Management and Economics*, *15*(4), 363–369. https://doi.org/10.1080/014461997372917

Bakker, A. B., Demerouti, E., & Sanz-Vergel, A. I. (2014). Burnout and Work Engagement: The JD–R Approach. *Annual Review of Organizational Psychology and Organizational Behavior*, *1*(1), 389–411. https://doi.org/10.1146/annurev-orgpsych-031413-091235

Balabanis, G., & Karpova, A. (2022). Cultural antecedents and consequences of luxury brand personalities. *European Journal of Marketing*, *56*(8), 2423–2454. https://doi.org/10.1108/EJM-03-2021-0215

Balabanis, G., & Siamagka, N.-T. (2017). Inconsistencies in the behavioural effects of consumer ethnocentrism. *International Marketing Review*, *34*(2), 166–182. https://doi.org/10.1108/IMR-03-2015-0057

Bandura, A. (1989a). Human agency in social cognitive theory. *American Psychologist*, *44*(9), 1175–1184. https://doi.org/10.1037/0003-066X.44.9.1175

Bandura, A. (1989b). Social Cognitive Theory. In R. Vasta (Ed.), *Annals of Child Development* (Vol. 6, pp. 1–60). Jessica Kingsley Publishers.

Bandura, A. (1991a). Social Cognitive Theory of Moral Thought and Action. In *Handbook of Moral Behavior and Development* (1st ed.). Psychology Press.

Bandura, A. (1991b). Social cognitive theory of self-regulation. *Organizational Behavior and Human Decision Processes*, *50*(2), 248–287. https://doi.org/10.1016/0749-5978(91)90022-L

Bandura, A. (2001a). Social Cognitive Theory: An Agentic Perspective. *Annual Review of Psychology*, *52*(1), 1–26. https://doi.org/10.1146/annurev.psych.52.1.1

Bandura, A. (2001b). Social Cognitive Theory of Mass Communication. *Media Psychology*, *3*(3), 265–299. https://doi.org/10.1207/S1532785XMEP0303_03

Bandura, A. (2002a). Selective Moral Disengagement in the Exercise of Moral Agency. *Journal of Moral Education*, *31*(2), 101–119. https://doi.org/10.1080/0305724022014322

Bandura, A. (2002b). Social Cognitive Theory in Cultural Context. *Applied Psychology*, *51*(2), 269–290. https://doi.org/10.1111/1464-0597.00092

Bandura, A. (2004). Health Promotion by Social Cognitive Means. *Health Education & Behavior*, *31*(2), 143–164. https://doi.org/10.1177/1090198104263660

Bandura, A., & National Institute of Mental Health. (1986). *Social foundations of thought and action: A social cognitive theory*. Prentice-Hall, Inc.

Banfield, A. (1982). *Unspeakable Sentences: Narration and Representation in the Language of Fiction*. Routledge & Kegan Paul Ltd.

Bargh, J. A., Schwader, K. L., Hailey, S. E., Dyer, R. L., & Boothby, E. J. (2012). Automaticity in social-cognitive processes. *Trends in Cognitive Sciences*, *16*(12), 593–605. https://doi.org/10.1016/j.tics.2012.10.002

Barlow, J. (2016). *Managing Innovation In Healthcare*. World Scientific Publishing Company.

Barlow, J. (2017). *Managing Innovation in Healthcare*. WORLD SCIENTIFIC (EUROPE). https://doi.org/10.1142/q0044

Bartley, T., & Egels-Zanden, N. (2015). Responsibility and neglect in global production networks: the uneven significance of codes of conduct in Indonesian factories. *Global Networks*, *15*(s1), S21–S44. https://doi.org/10.1111/glob.12086

Bartsch, E., Park, A. L., Pulver, A. J., Urquia, M. L., & Ray, J. G. (2015). Maternal and Paternal Birthplace and Risk of Stillbirth. *Journal of Obstetrics and Gynaecology Canada*, *37*(4), 314–323. https://doi.org/10.1016/S1701-2163(15)30281-4

Basu, R., Banerjee, P., & Sweeny, E. (2013). Frugal Innovation: Core Competencies to Address Global Sustainability. *Journal of Management for Global Sustainability*, *1*(2). https://doi.org/10.13185/JM2013.01204

Batson, V. D., & Yoder, L. H. (2012). Managerial coaching: a concept analysis. *Journal of Advanced Nursing*, *68*(7), 1658–1669. https://doi.org/10.1111/j.1365-2648.2011.05840.x

Baybutt, P. (2015). A critique of the Hazard and Operability (HAZOP) study. *Journal of Loss Prevention in the Process Industries*, *33*, 52–58. https://doi.org/10.1016/j.jlp.2014.11.010

Beard, J. H., Oresanya, L. B., Ohene-Yeboah, M., Dicker, R. A., & Harris, H. W. (2013). Characterizing the Global Burden of Surgical Disease: A Method to Estimate Inguinal Hernia Epidemiology in Ghana. *World Journal of Surgery*, *37*(3). https://doi.org/10.1007/s00268-012-1864-x

Becker, E., & Gibson, C. (1998). Fishbein and Ajzen's Theory of Reasoned Action: Accurate Prediction of Behavioral Intentions for Enrolling in Distance Education Courses. *Adult Education Quarterly*, *49*(1), 43–55. https://doi.org/10.1177/074171369804900105

Belas, J., Smrcka, L., Gavurova, B., & Dvorsky, J. (2018). The Impact of Social and Economic Factors in the Credit Risk Management of SME. *Technological and Economic Development of Economy*, *24*(3), 1215–1230. https://doi.org/10.3846/tede.2018.1968

Bell, S. F., Watkins, A., John, M., Macgillivray, E., Kitchen, T. L., James, D., Scarr, C., Bailey, C. M., Kelly, K. P., James, K., Stevens, J. L., Edey, T., Collis, R. E., & Collins, P. W. (2020). Incidence of postpartum haemorrhage defined by quantitative blood loss measurement: a national cohort. *BMC Pregnancy and Childbirth*, *20*(1). https://doi.org/10.1186/s12884-020-02971-3

Bencsik, A., Machová, R., & Tóth, Z. (2016). Cheap and clever – symbiosis of frugal innovation and knowledge management. *Problems and Perspectives in Management*, *14*(1). https://doi.org/10.21511/ppm.14(1).2016.10

Berka, P. (2020). Sentiment analysis using rule-based and case-based reasoning. *Journal of Intelligent Information Systems*, *55*(1), 51–66. https://doi.org/10.1007/s10844-019-00591-8

Bhattacharyya, O., Wu, D., Mossman, K., Hayden, L., Gill, P., Cheng, Y.-L., Daar, A., Soman, D., Synowiec, C., Taylor, A., Wong, J., von Zedtwitz, M., Zlotkin, S., Mitchell, W., & McGahan, A. (2017). Criteria to assess potential reverse innovations: opportunities for shared learning between high- and low-income countries. *Globalization and Health*, *13*(1). https://doi.org/10.1186/s12992-016-0225-1

Bhatti, Y. A. (2012). What is Frugal, What is Innovation? Towards a Theory of Frugal Innovation. *SSRN*. https://doi.org/10.2139/ssrn.2005910

Bhatti, Y. A. (2014). *Frugal innovation: social entrepreneurs' perceptions of innovation under institutional voids, resource scarcity and affordability constraints*. University of Oxford.

Bhatti, Y. A., Prime, M., Harris, M., Wadge, H., McQueen, J., Patel, H., Carter, A. W., Parston, G., & Darzi, A. (2017). The search for the holy grail: frugal innovation in healthcare from low-income

or middle-income countries for reverse innovation to developed countries. *BMJ Innovations*, *3*(4). https://doi.org/10.1136/bmjinnov-2016-000186

Bhatti, Y. A., & Ventresca, M. (2012). The Emerging Market for Frugal Innovation: Fad, Fashion, or Fit? *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2005983

Bhatti, Y., Basu, R., Barron, D., & Ventresca, M. J. (2018). *Frugal Innovation: Models, Means, Methods*. Cambridge University Press.

Bhatti, Y., Prabhu, J., & Harris, M. (2020). *Frugal Innovation for Today's and Tomorrow's Crises*. Stanford Social Innovation Review . https://ssir.org/articles/entry/frugal_innovation_for_todays_and_tomorrows_crises

Bhatti, Y., Taylor, A., Harris, M., Wadge, H., Escobar, E., Prime, M., Patel, H., Carter, A. W., Parston, G., Darzi, A. W., & Udayakumar, K. (2017). Global Lessons In Frugal Innovation To Improve Health Care Delivery In The United States. *Health Affairs*, *36*(11). https://doi.org/10.1377/hlthaff.2017.0480

Bhatti, Y., & Ventresca, M. (2013). How Can 'Frugal Innovation' Be Conceptualized? *SSRN*. https://doi.org/10.2139/ssrn.2203552

Bianchi, C., Bianco, M., Ardanche, M., & Schenck, M. (2017). Healthcare frugal innovation: A solving problem rationale under scarcity conditions. *Technology in Society*, *51*. https://doi.org/10.1016/j.techsoc.2017.08.001

Biber, D., and Finegan, E. (1989). Styles of stance in English: Lexical and grammatical marking of evidentiality and affect. *Text - Interdisciplinary Journal for the Study of Discourse*, *9*(1). https://doi.org/10.1515/text.1.1989.9.1.93

Bilkey, W. J., & Nes, E. (1982). Country-of-Origin Effects on Product Evaluations. *Journal of International Business Studies*, *13*(1), 89–100. https://doi.org/10.1057/palgrave.jibs.8490539

Birjali, M., Kasri, M., & Beni-Hssane, A. (2021). A comprehensive survey on sentiment analysis: Approaches, challenges and trends. *Knowledge-Based Systems*, *226*, 107134. https://doi.org/10.1016/j.knosys.2021.107134

Blanchet, G., & Blanchet, A. (1994). Interactional Effects of the Environment on Interviews. *European Journal of Psychology of Education*, *9*(1), 41–53. https://www.jstor.org/stable/23419984

Blinkenberg, J., Pahlavanyali, S., Hetlevik, Ø., Sandvik, H., & Hunskaar, S. (2019). General practitioners' and out-of-hours doctors' role as gatekeeper in emergency admissions to somatic hospitals in Norway: registry-based observational study. *BMC Health Services Research*, *19*(1), 568. https://doi.org/10.1186/s12913-019-4419-0

Bon-Gang, H. (2018). Methodology. In *Performance and Improvement of Green Construction Projects* (pp. 15–22). Elsevier. https://doi.org/10.1016/B978-0-12-815483-0.00003-X

Bonnabry, P. (2005). Use of a systematic risk analysis method to improve safety in the production of paediatric parenteral nutrition solutions. *Quality and Safety in Health Care*, *14*(2), 93–98. https://doi.org/10.1136/qshc.2003.007914

Bound, K., & Thornton, I. (2012). *Our Frugal Future: Lessons from India's Innovation System*.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Brem, A., & Wolfram, P. (2014). Research and development from the bottom up - introduction of terminologies for new product development in emerging markets. *Journal of Innovation and Entrepreneurship*, *3*(1). https://doi.org/10.1186/2192-5372-3-9

Brereton, L., Ingleton, C., Gardiner, C., Goyder, E., Mozygemba, K., Lysdahl, K. B., Tummers, M., Sacchini, D., Leppert, W., Blaževičienė, A., van der Wilt, G. J., Refolo, P., De Nicola, M., Chilcott,

J., & Oortwijn, W. (2017). Lay and professional stakeholder involvement in scoping palliative care issues: Methods used in seven European countries. *Palliative Medicine*, *31*(2), 181–192. https://doi.org/10.1177/0269216316649154

Briggs, T. (2012). *Getting it right first time: Improving the Quality of Orthopaedic Care within the National Health Service in England*. Healthcare Financial Management Association.

Brijs, K., Bloemer, J., & Kasper, H. (2011). Country-image discourse model: Unraveling meaning, structure, and function of country images. *Journal of Business Research*, *64*(12), 1259–1269. https://doi.org/10.1016/j.jbusres.2011.01.017

Britten, N. (1995). Qualitative Research: Qualitative interviews in medical research. *BMJ*, *311*(6999), 251–253. https://doi.org/10.1136/bmj.311.6999.251

Bruch, E., & Feinberg, F. (2017). Decision-Making Processes in Social Contexts. *Annual Review of Sociology*, *43*(1), 207–227. https://doi.org/10.1146/annurev-soc-060116-053622

Brulé, G., & Munier, F. (2021). *Happiness, Technology and Innovation*. Springer International Publishing. https://doi.org/10.1007/978-3-030-82685-7

Brun, W., & Teigen, K. H. (1988). Verbal probabilities: Ambiguous, context-dependent, or both? *Organizational Behavior and Human Decision Processes*, *41*(3), 390–404. https://doi.org/10.1016/0749-5978(88)90036-2

Brunsø, K., Scholderer, J., & Grunert, K. G. (2004). Testing relationships between values and food-related lifestyle: results from two European countries. *Appetite*, *43*(2), 195–205. https://doi.org/10.1016/j.appet.2004.05.001

Bryman, A. (2004). *Social Research Methods* (2nd ed.). Oxford University Press.

Burkell, J. (2004). What are the chances? Evaluating risk and benefit information in consumer health materials. *J Med Libr Assoc.*, *92*(2), 200–208.

Bybee, J., & Fleischman, S. (1995). *Modality in Grammar and Discourse*. John Benjamins Publishing.

Cameron, C. A., Roberts, C. L., Olive, E. C., Ford, J. B., & Fischer, W. E. (2006). Trends in postpartum haemorrhage. *Australian and New Zealand Journal of Public Health*, *30*(2). https://doi.org/10.1111/j.1467-842X.2006.tb00109.x

Campbell, S. (2005). Determining overall risk. *Journal of Risk Research*, *8*(7–8), 569–581. https://doi.org/10.1080/13669870500118329

Campo, S., & Alvarez, M. D. (2019). Animosity Toward a Country in the Context of Destinations as Tourism Products. *Journal of Hospitality & Tourism Research*, *43*(7), 1002–1024. https://doi.org/10.1177/1096348019840795

Cannavale, C., Claudio, L., & Simoni, M. (2021). How social innovations spread globally through the process of reverse innovation: a case-study from the South Korea. *Italian Journal of Marketing*, *2021*(4), 421–440. https://doi.org/10.1007/s43039-021-00027-8

Carlson, M. D. A., & Morrison, R. S. (2009). Study Design, Precision, and Validity in Observational Studies. *Journal of Palliative Medicine*, *12*(1), 77–82. https://doi.org/10.1089/jpm.2008.9690

Carroll, R. (2014). *Enterprise risk management: a framework for success; 2014*. American Society For Healthcare Risk Management. https://www.ashrm.org/sites/default/files/ashrm/ERM-White-Paper-8-29-14-FINAL.pdf

Cero, I., Luo, J., & Falligant, J. M. (2024). Lexicon-Based Sentiment Analysis in Behavioral Research. *Perspectives on Behavior Science*. https://doi.org/10.1007/s40614-023-00394-x

Chalothom, T., & Ellman, J. (2015). Simple Approaches of Sentiment Analysis via Ensemble Learning. In K. Kim (Ed.), *Information Science and Applications. Lecture Notes in Electrical Engineering* (Vol. 339, pp. 631–639). Springer. https://doi.org/10.1007/978-3-662-46578-3_74

Chandraharan, E., & Krishna, A. (2017). Diagnosis and management of postpartum haemorrhage. *BMJ*. https://doi.org/10.1136/bmj.j3875

Chang, I.-S., Wang, W., & Wu, J. (2019). To Strengthen the Practice of Ecological Civilization in China. *Sustainability*, *11*(17), 4661. https://doi.org/10.3390/su11174661

Chao, P., Papadopoulos, N., & Heslop, L. (1995). Product-Country Images: Impact and Role in International Marketing. *Journal of Marketing*, *59*(2), 115. https://doi.org/10.2307/1252079

Charles, R., Hood, B., Derosier, J. M., Gosbee, J. W., Li, Y., Caird, M. S., Biermann, J. S., & Hake, M. E. (2016). How to perform a root cause analysis for workup and future prevention of medical errors: a review. *Patient Safety in Surgery*, *10*(1), 20. https://doi.org/10.1186/s13037-016-0107-8

Chattalas, M., Kramer, T., & Takada, H. (2008). The impact of national stereotypes on the country of origin effect. *International Marketing Review*, *25*(1), 54–74. https://doi.org/10.1108/02651330810851881

Chen, C.-D., Fan, Y.-W., & Farn, C.-K. (2007). Predicting electronic toll collection service adoption: An integration of the technology acceptance model and the theory of planned behavior. *Transportation Research Part C: Emerging Technologies*, *15*(5), 300–311. https://doi.org/10.1016/j.trc.2007.04.004

Chen, R., Zhou, Y., Zhang, L., & Duan, X. (2019). Word-level sentiment analysis with reinforcement learning. *IOP Conference Series: Materials Science and Engineering*, *490*, 062063. https://doi.org/10.1088/1757-899X/490/6/062063

Christensen, C. (1997). *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail*. Harv Bus Rev.

Christensen, C. (2006). The Ongoing Process of Building a Theory of Disruption. *Journal of Product Innovation Management*, *23*(1). https://doi.org/10.1111/j.1540-5885.2005.00180.x

Christensen, C., & Raynor, M. (2003). *The Innovator's Solution: Creating and Sustaining Successful Growth* (1st ed.). Havard Business Review Press.

Christensen, C., Raynor, M. E., & Verlinden, M. (2001, November). *Skate to Where the Money Will Be*. Harv Bus Rev.

Chryssochoidis, G., Krystallis, A., & Perreas, P. (2007). Ethnocentric beliefs and country-of-origin (COO) effect. *European Journal of Marketing*, *41*(11/12), 1518–1544. https://doi.org/10.1108/03090560710821288

Clarke, M. G., Oppong, C., Simmermacher, R., Park, K., Kurzer, M., Vanotoo, L., & Kingsnorth, A. N. (2009). The use of sterilised polyester mosquito net mesh for inguinal hernia repair in Ghana. *Hernia*, *13*(2). https://doi.org/10.1007/s10029-008-0460-3

Claybourn, M. (2011). Relationships Between Moral Disengagement, Work Characteristics and Workplace Harassment. *Journal of Business Ethics*, *100*(2), 283–301. https://doi.org/10.1007/s10551-010-0680-1

Collins, B. (2018). *Adoption and spread of innovation in the NHS*. The King's Fund.

Conner, M., & Norman, P. (2015). *Predicting and Changing Health Behaviour: Research and Practice with Social Cognitive Models* (3rd ed.). McGraw-Hill Education.

Corcoran, K. J. (1991). Efficacy, "skills," reinforcement, and choice behavior. *American Psychologist*, *46*(2), 155–157. https://doi.org/10.1037/0003-066X.46.2.155

Cordell, V. V. (1993). Interaction Effects of Country of Origin with Branding, Price, and Perceived Performance Risk. *Journal of International Consumer Marketing*, *5*(2), 5–20. https://doi.org/10.1300/J046v05n02_02

Corsini, L., Dammicco, V., & Moultrie, J. (2020). Frugal innovation in a crisis: the digital fabrication maker response to COVID-19. *R&D Management*, *51*(2). https://doi.org/10.1111/radm.12446

Cotton, M., Henry, J., & Hasek, L. (2014). Value innovation: an important aspect of global surgical care. *Globalization and Health*, *10*(1). https://doi.org/10.1186/1744-8603-10-1

Crisp, N. (2010). *Turning the World Upside Down: The search for global health in the 21st Century*. CRC Press.

Crotty, M. (2003). *The foundation of social research: Meaning and perspective in the research process*. Sage Publications.

Dallera, G., Skopec, M., Battersby, C., Barlow, J., & Harris, M. (2022). Review of a frugal cooling mattress to induce therapeutic hypothermia for treatment of hypoxic-ischaemic encephalopathy in the UK NHS. *Globalization and Health*, *18*(1), 43. https://doi.org/10.1186/s12992-022-00833-5

Dalton, R. (2010). Operation Hernia mission to northern Ghana – a trainee's experience. *The Bulletin of the Royal College of Surgeons of England*, *92*(5). https://doi.org/10.1308/147363510X500663

Dang Vu, H. N., & Nielsen, M. R. (2022). Understanding determinants of the intention to buy rhino horn in Vietnam through the Theory of Planned Behaviour and the Theory of Interpersonal Behaviour. *Ecological Economics*, *195*, 107361. https://doi.org/10.1016/j.ecolecon.2022.107361

Dawar, N., & Parker, P. (1994). Marketing Universals: Consumers' Use of Brand Name, Price, Physical Appearance, and Retailer Reputation as Signals of Product Quality. *Journal of Marketing*, *58*(2), 81. https://doi.org/10.2307/1252271

Dawson, J. (2018). *Links between NHS staff experience and patient satisfaction: Analysis of surveys from 2014 and 2015*. NHS England. https://www.england.nhs.uk/wp-content/uploads/2018/02/links-between-nhs-staff-experience-and-patient-satisfaction-1.pdf

Day, M.-Y., & Lee, C.-C. (2016). Deep learning for financial sentiment analysis on finance news providers. *2016 IEEE/ACM International Conference on Advances in Social Networks Analysis and Mining (ASONAM)*, 1127–1134. https://doi.org/10.1109/ASONAM.2016.7752381

Dearing, J. W. (2009). Applying Diffusion of Innovation Theory to Intervention Development. *Research on Social Work Practice*, *19*(5), 503–518. https://doi.org/10.1177/1049731509335569

Dearing, J. W., & Cox, J. G. (2018). Diffusion Of Innovations Theory, Principles, And Practice. *Health Affairs*, *37*(2), 183–190. https://doi.org/10.1377/hlthaff.2017.1104

Dearing, J. W., Maibach, E. W., & Buller, D. B. (2006). A Convergent Diffusion and Social Marketing Approach for Disseminating Proven Approaches to Physical Activity Promotion. *American Journal of Preventive Medicine*, *31*(4), 11–23. https://doi.org/10.1016/j.amepre.2006.06.018

DeJonckheere, M., & Vaughn, L. M. (2019). Semistructured interviewing in primary care research: a balance of relationship and rigour. *Family Medicine and Community Health*, *7*(2), e000057. https://doi.org/10.1136/fmch-2018-000057

Delamothe, T. (2008). Founding principles. *BMJ*, *336*(7655), 1216–1218. https://doi.org/10.1136/bmj.39582.501192.94

Deng, L., Hinton, G., & Kingsbury, B. (2013). New types of deep neural network learning for speech recognition and related applications: an overview. *2013 IEEE International Conference on Acoustics, Speech and Signal Processing*, 8599–8603. https://doi.org/10.1109/ICASSP.2013.6639344

Dennis, E. A., Potter, K. L., Estabrooks, P. A., & Davy, B. M. (2012). Weight Gain Prevention for College Freshmen: Comparing Two Social Cognitive Theory-Based Interventions with and without Explicit Self-Regulation Training. *Journal of Obesity*, *2012*, 1–10. https://doi.org/10.1155/2012/803769

Department of Health. (2011a). *NHS Chief Executive's Review of Innovation in the NHS Summary of the responses to the Call for Evidence and Ideas*. Department of Health. https://webarchive.nationalarchives.gov.uk/ukgwa/20130107013731/http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_131299

Department of Health & Social Care. (2021). *Guidance: The NHS Constitution for England*. NHS.

Department of Health, N. I. & E. D. I. and S. I. (2011b). *Innovation Health and Wealth: Accelerating Adoption and Diffusion in the NHS*.

Department of Health, NHS Improvement and Efficiency Directorate, & Innovation and Service Improvement. (2011). *Innovation, Health and Wealth: Accelerating Adoption and Diffusion in the NHS*. Department of Health.

DePasse, J. W., & Lee, P. T. (2013). A model for 'reverse innovation' in health care. *Globalization and Health*, *9*(1). https://doi.org/10.1186/1744-8603-9-40

DeRosier, J., Stalhandske, E., Bagian, J. P., & Nudell, T. (2002). Using Health Care Failure Mode and Effect Analysis™: The VA National Center for Patient Safety's Prospective Risk Analysis System. *The Joint Commission Journal on Quality Improvement*, *28*(5), 248–267. https://doi.org/10.1016/S1070-3241(02)28025-6

Devika, M. D., Sunitha, C., & Ganesh, A. (2016). Sentiment Analysis: A Comparative Study on Different Approaches. *Procedia Computer Science*, *87*, 44–49. https://doi.org/10.1016/j.procs.2016.05.124

Dewar, D. L., Lubans, D. R., Plotnikoff, R. C., & Morgan, P. J. (2012). Development and evaluation of social cognitive measures related to adolescent dietary behaviors. *International Journal of Behavioral Nutrition and Physical Activity*, *9*(1), 36. https://doi.org/10.1186/1479-5868-9-36

Dibley, A., & Baker, S. (2001). Uncovering the links between brand choice and personal values among young British and Spanish girls. *Journal of Consumer Behaviour*, *1*(1), 77–93. https://doi.org/10.1002/cb.55

Dichter, E. (1962). *The world customer*. Spotlight On Advertising Appeals Abroad. https://doi.org/10.1002/tie.5060040415

Dillard, J., & Pfau, M. (2002). *The Persuasion Handbook: Developments in Theory and Practice* (J. Dillard & L. Shen, Eds.; 2nd ed.). Sage Publications Inc.

Dillion, A., & Morris, M. (1996). User Acceptance of Information Technology: Theories and Models. In M. Williams (Ed.), *Annual Review of Information Science and Technology* (pp. 3–32). Information Today. https://www.researchgate.net/profile/Andrew-Dillon-5/publication/277983543_User_Acceptance_of_Information_Technology_Theories_and_Models/links/5593eb3008ae16f493efb6fb/User-Acceptance-of-Information-Technology-Theories-and-Models.pdf

Dingfelder, H. E., & Mandell, D. S. (2011). Bridging the Research-to-Practice Gap in Autism Intervention: An Application of Diffusion of Innovation Theory. *Journal of Autism and Developmental Disorders*, *41*(5), 597–609. https://doi.org/10.1007/s10803-010-1081-0

Dirksen, C. D., Beets, G. L., Go, P. M. N. Y. H., Geisler, F. E. A., Baeten, C. G. M. I., & Kootstra, G. (2003). Bassini repair compared with laparoscopic repair for primary inguinal hernia: a randomised controlled trial. *European Journal of Surgery*, *164*(6). https://doi.org/10.1080/110241598750004256

Dishman, R. K., Dunn, A. L., Sallis, J. F., Vandenberg, R. J., & Pratt, C. A. (2010). Social-Cognitive Correlates of Physical Activity in a Multi-Ethnic Cohort of Middle-School Girls: Two-year

Prospective Study. *Journal of Pediatric Psychology*, *35*(2), 188–198. https://doi.org/10.1093/jpepsy/jsp042

Dludhlu, N. I., Pretorius, J. H. C., & van Wyngaard, C. J. (2017). Risk evaluation in project management implementation: The case of infrastructural development projects. *2017 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM)*, 1743–1747. https://doi.org/10.1109/IEEM.2017.8290190

Dollard, J., & Miller, N. E. (1941). *Social Learning and Imitation*. Yale University Press.

Donovan, R., & Henley, N. (2010). *Principles and Practice of Social Marketing: An International Perspective*. Cambridge University Press.

Dursun, İ., Kabadayi, E., Ceylan, K., & Koksal, C. (2019). Russian Consumers Responses to Turkish Products: Exploring the Roles of Country Image, Consumer Ethnocentrism, and Animosity. *Business and Economics Research Journal*, *10*(2), 499–515. https://doi.org/10.20409/berj.2019.182

Durvasula, S., Andrews, J. C., & Netemeyer, R. G. (1997). A Cross-Cultural Comparison of Consumer Ethnocentrism in the United States and Russia. *Journal of International Consumer Marketing*, *9*(4), 73–93. https://doi.org/10.1300/J046v09n04_05

Dwivedi, R. K., Aggarwal, M., Keshari, S. Kr., & Kumar, A. (2019). Sentiment Analysis and Feature Extraction Using Rule-Based Model (RBM). In S. Bhattacharyya, A. Hassanien, D. Gupta, A. Khanna, & I. Pan (Eds.), *nternational Conference on Innovative Computing and Communications* (pp. 57–63). https://doi.org/10.1007/978-981-13-2354-6_7

Ejnavarzala, H. (2019). Epistemology–Ontology Relations in Social Research: A Review. *Sociological Bulletin*, *68*(1), 94–104. https://doi.org/10.1177/0038022918819369

Erev, I., & Cohen, B. L. (1990). Verbal versus numerical probabilities: Efficiency, biases, and the preference paradox. *Organizational Behavior and Human Decision Processes*, *45*(1), 1–18. https://doi.org/10.1016/0749-5978(90)90002-Q

Erevelles, S. (1998). The Role of Affect in Marketing. *Journal of Business Research*, *42*(3), 199–215. https://doi.org/10.1016/S0148-2963(97)00118-5

Erickson, G. M., Johansson, J. K., & Chao, P. (1984). Image Variables in Multi-Attribute Product Evaluations: Country-of-Origin Effects. *Journal of Consumer Research*, *11*(2), 694. https://doi.org/10.1086/209005

Etzioni, D. A., Liu, J. H., Maggard, M. A., & Ko, C. Y. (2003). The Aging Population and Its Impact on the Surgery Workforce. *Annals of Surgery*, *238*(2). https://doi.org/10.1097/01.SLA.0000081085.98792.3d

EU Commission Staff Working Paper. (2010). *Risk Assessment and Mapping Guidelines for Disaster Management*. https://ec.europa.eu/echo/files/about/COMM_PDF_SEC_2010_1626_F_staff_working_document_en.pdf

Faiella, G., Parand, A., Franklin, B. D., Chana, P., Cesarelli, M., Stanton, N. A., & Sevdalis, N. (2018). Expanding healthcare failure mode and effect analysis: A composite proactive risk analysis approach. *Reliability Engineering & System Safety*, *169*, 117–126. https://doi.org/10.1016/j.ress.2017.08.003

Fanelli, S., Salvatore, F. P., De Pascale, G., & Faccilongo, N. (2020). Insights for the future of health system partnerships in low- and middle-income countries: a systematic literature review. *BMC Health Services Research*, *20*(1), 571. https://doi.org/10.1186/s12913-020-05435-8

Fang, X., & Zhan, J. (2015). Sentiment analysis using product review data. *Journal of Big Data*, *2*(1), 5. https://doi.org/10.1186/s40537-015-0015-2

Farra, N., Challita, E., Assi, R. A., & Hajj, H. (2010). Sentence-Level and Document-Level Sentiment Mining for Arabic Texts. *2010 IEEE International Conference on Data Mining Workshops*, 1114–1119. https://doi.org/10.1109/ICDMW.2010.95

Festinger, L. (1957). *A Theory of Cognitive Dissonance*. Stanford University Press.

Fischer, B., Guerrero, M., Guimón, J., & Schaeffer, P. R. (2021). Knowledge transfer for frugal innovation: where do entrepreneurial universities stand? *Journal of Knowledge Management*, *25*(2), 360–379. https://doi.org/10.1108/JKM-01-2020-0040

Fischer, P. M., & Zeugner-Roth, K. P. (2017). Disentangling country-of-origin effects: the interplay of product ethnicity, national identity, and consumer ethnocentrism. *Marketing Letters*, *28*(2), 189–204. https://doi.org/10.1007/s11002-016-9400-7

Fishbein, M. (1967). *Readings in attitude theory and measurement*. Wiley.

Fishbein, M. (2008). A Reasoned Action Approach to Health Promotion. *Medical Decision Making*, *28*(6), 834–844. https://doi.org/10.1177/0272989X08326092

Fishbein, M. (2009). An integrative model for behavioral prediction and its application to health promotion. In R. DiClemente, R. Crosby, & M. Kegler (Eds.), *Emerging theories in health promotion practice and research* (pp. 215–234). Jossey-Bass/Wiley.

Fishbein, M., & Ajzen, I. (1975). *Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research*. Addison-Wesley.

Fishbein, M., & Ajzen, I. (2011). *Predicting and Changing Behavior The Reasoned Action Approach*. Taylor & Francis.

Fiske, S., & Pavelchak, M. (1986). Category Based Versus Piecemeal Based Affective Responses: Developments in Schema-Triggered Affect. In R. Sorrentino & E. Higgins (Eds.), *Handbook of Motivation and Cognition: Foundations of Social Behavior* (pp. 167–203). Guilford Press.

Flage, R., Aven, T., Zio, E., & Baraldi, P. (2014). Concerns, Challenges, and Directions of Development for the Issue of Representing Uncertainty in Risk Assessment. *Risk Analysis*, *34*(7), 1196–1207. https://doi.org/10.1111/risa.12247

Ford, J. B., Roberts, C. L., Simpson, J. M., Vaughan, J., & Cameron, C. A. (2007). Increased postpartum hemorrhage rates in Australia. *International Journal of Gynecology & Obstetrics*, *98*(3). https://doi.org/10.1016/j.ijgo.2007.03.011

Forrest, C. B. (2003). Primary care in the United States: Primary care gatekeeping and referrals: effective filter or failed experiment? *BMJ*, *326*(7391), 692–695. https://doi.org/10.1136/bmj.326.7391.692

Foscht, T., Maloles, C., Swoboda, B., Morschett, D., & Sinha, I. (2008). The impact of culture on brand perceptions: a six-nation study. *Journal of Product & Brand Management*, *17*(3), 131–142. https://doi.org/10.1108/10610420810875052

Fox, G., & Connolly, R. (2018). Mobile health technology adoption across generations: Narrowing the digital divide. *Information Systems Journal*, *28*(6), 995–1019. https://doi.org/10.1111/isj.12179

French, C., & Stavropoulou, C. (2016). Specialist nurses' perceptions of inviting patients to participate in clinical research studies: a qualitative descriptive study of barriers and facilitators. *BMC Medical Research Methodology*, *16*(1), 96. https://doi.org/10.1186/s12874-016-0204-5

Freudenberg, S., Sano, D., Ouangré, E., Weiss, C., & Wilhelm, T. J. (2006). Commercial Mesh versus Nylon Mosquito Net for Hernia Repair. A Randomized Double-blind Study in Burkina Faso. *World Journal of Surgery*, *30*(10). https://doi.org/10.1007/s00268-006-0108-3

Fuller, S. (2002). *Social Epistemology* (2nd ed.). Indiana University Press.

Furue, N., & Washid, Y. (2014). Conception of the Inductive Reverse Innovation by developed-country multinational enterprises. *Proceedings of PICMET '14 Conference: Portland International Center for Management of Engineering and Technology; Infrastructure and Service Integration*, 900–906. https://ieeexplore.ieee.org/document/6921127

Gadiesh, O., Leung, P., & Vestring, T. (2007). The Battle for China's Good-Enough Market. *Harv Bus Rev*.

Gagnon, M.-P., Godin, G., Gagné, C., Fortin, J.-P., Lamothe, L., Reinharz, D., & Cloutier, A. (2003). An adaptation of the theory of interpersonal behaviour to the study of telemedicine adoption by physicians. *International Journal of Medical Informatics*, *71*(2–3), 103–115. https://doi.org/10.1016/S1386-5056(03)00094-7

Galdas, P. (2017). Revisiting Bias in Qualitative Research. *International Journal of Qualitative Methods*, *16*(1), 160940691774899. https://doi.org/10.1177/1609406917748992

Gamon, M. (2004). Sentiment classification on customer feedback data: noisy data, large feature vectors, and the role of linguistic analysis. *Proceedings of International Conference on Computational Linguistics*.

Gan, Y., Li, W., Cao, S., Dong, X., Li, L., Mkandawire, N., Chen, Y., Herath, C., Song, X., Yin, X., Yang, T., Li, J., Deng, J., & Lu, Z. (2016). Patients' Willingness on Community Health Centers as Gatekeepers and Associated Factors in Shenzhen, China. *Medicine*, *95*(14), e3261. https://doi.org/10.1097/MD.0000000000003261

Garcia, R., & Calantonea, R. (2002). A critical look at technological innovation typology and innovativeness terminology: a literature review. *Journal of Product Innovation Management*, *19*(2), 110–132. https://doi.org/10.1016/S0737-6782(01)00132-1

Garcia-Ruiz, P., & Rodriguez-Lluesma, C. (2014). Consumption Practices: A Virtue Ethics Approach. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2556388

Garrido, M. V., Zentner, A., & Busse, R. (2011). The effects of gatekeeping: A systematic review of the literature. *Scandinavian Journal of Primary Health Care*, *29*(1), 28–38. https://doi.org/10.3109/02813432.2010.537015

Gartlehner, G., Hansen, R., Nissman, D., Lohr, K., & Carey, T. (2006). Criteria for Distinguishing Effectiveness From Efficacy Trials in Systematic Reviews. *Agency for Healthcare Research and Quality (US), Rockville (MD)*.

Gerhold, M., & Horton, T. (2023). *Innovation is being squeezed out of the NHS*. The Health Foundation. https://www.health.org.uk/news-and-comment/blogs/innovation-is-being-squeezed-out-of-the-nhs

Gilbert, A., Steel, J., Rachel, D., & Jaggi, A. (2016). Identifying barriers and facilitators to engaging in clinical research within an NHS Therapies Department: results of a listening exercise. *Physiotherapy*, *102*, e179. https://doi.org/10.1016/j.physio.2016.10.214

Glanz, K., Rimer, B., & Lewis, F. (2002). *Health Behaviour and Health Education: Theory, Research and Practice*. Jossey-Bass.

Gluckman, P. (2016). *Making decisions in the face of uncertainty: Understanding risk*. https://www.apothecaries.org/wp-content/uploads/2019/02/Ethics-and-Risk_Part-1.pdf

Godin, G., Bélanger-Gravel, A., Eccles, M., & Grimshaw, J. (2008). Healthcare professionals' intentions and behaviours: A systematic review of studies based on social cognitive theories. *Implementation Science*, *3*(1), 36. https://doi.org/10.1186/1748-5908-3-36

Gogoi, M., & Hazarika, M. (2017). Application of Programme Evaluation and Review Technique (PERT) in Educational Management. *Asian Journal of Research in Social Sciences and Humanities*, *7*(10), 155. https://doi.org/10.5958/2249-7315.2017.00492.0

Gómez-Rodríguez, C., Alonso-Alonso, I., & Vilares, D. (2019). How important is syntactic parsing accuracy? An empirical evaluation on rule-based sentiment analysis. *Artificial Intelligence Review*, *52*(3), 2081–2097. https://doi.org/10.1007/s10462-017-9584-0

Goodwin, C., & Heritage, J. (1990). Conversation Analysis. *Annual Review of Anthropology*, *19*(1). https://doi.org/10.1146/annurev.an.19.100190.001435

Govindarajan, V. (2012). *Health Care for 1% of the Cost*. Harvard Business Review. https://hbr.org/2012/04/saving-and-improving-lives-for

Govindarajan, V., & Manikutty, S. (2010). *What Poor Countries Can Teach Rich Ones About Health Care*. Harvard Business Review. https://hbr.org/2010/04/how-poor-countries-can-help-so

Govindarajan, V., & Ramamurti, R. (2011). Reverse innovation, emerging markets, and global strategy. *Global Strategy Journal*, *1*(3–4). https://doi.org/10.1002/gsj.23

Govindarajan, V., & Trimble, C. (2009, September 30). *Is Reverse Innovation Like Disruptive Innovation?* Harv Bus Rev.

Graham, C., Käsbauer, S., Cooper, R., King, J., Sizmur, S., Jenkinson, C., & Kelly, L. (2018). An evaluation of a near real-time survey for improving patients' experiences of the relational aspects of care: a mixed-methods evaluation. *Health Services and Delivery Research*, *6*(15), 1–174. https://doi.org/10.3310/hsdr06150

Greenhalgh, T., Robert, G., Macfarlane, F., Bate, P., & Kyriakidou, O. (2004). Diffusion of Innovations in Service Organizations: Systematic Review and Recommendations. *The Milbank Quarterly*, *82*(4), 581–629. https://doi.org/10.1111/j.0887-378X.2004.00325.x

Grimshaw, J. M., Eccles, M. P., Walker, A. E., & Thomas, R. E. (2002). Changing physicians' behavior: What works and thoughts on getting more things to work. *Journal of Continuing Education in the Health Professions*, *22*(4), 237–243. https://doi.org/10.1002/chp.1340220408

Grol, R., & Wensing, M. (2004). What drives change? Barriers to and incentives for achieving evidence-based practice. *Medical Journal of Australia*, *180*(S6). https://doi.org/10.5694/j.1326-5377.2004.tb05948.x

Grover, A., Caulfield, P., & Roehrich, K. (2014). Frugal innovation in healthcare and its applicability to developed markets. *British Academy of Management*, 1–57.

Gul, M., & Ak, M. F. (2018). A comparative outline for quantifying risk ratings in occupational health and safety risk assessment. *Journal of Cleaner Production*, *196*, 653–664. https://doi.org/10.1016/j.jclepro.2018.06.106

Gupta, R., Pandit, A., Nirjar, A., & Gupta, P. (2013). Husk Power Systems: Bringing Light to Rural India and Tapping Fortune at the Bottom of the Pyramid. *Asian Journal of Management Cases*, *10*(2), 129–143. https://doi.org/10.1177/0972820113493690

Gupta, V. (2011). Corporate Response to Global Financial Crisis: A Knowledge-Based Model. *Global Economy Journal*, *11*(2). https://doi.org/10.2202/1524-5861.1706

Habibi, F., Taghipour Birgani, O., Koppelaar, H., & Radenović, S. (2018). Using fuzzy logic to improve the project time and cost estimation based on Project Evaluation and Review Technique (PERT). *Journal of Project Management*, 183–196. https://doi.org/10.5267/j.jpm.2018.4.002

Habimana, O., Li, Y., Li, R., Gu, X., & Yu, G. (2020). Sentiment analysis using deep learning approaches: an overview. *Science China Information Sciences*, *63*(1), 111102. https://doi.org/10.1007/s11432-018-9941-6

Hadengue, M., de Marcellis-Warin, N., & Warin, T. (2017). Reverse innovation: a systematic literature review. *International Journal of Emerging Markets*, *12*(2). https://doi.org/10.1108/IJoEM-12-2015-0272

Hagley, G., Mills, P. D., Watts, B. v, & Wu, A. W. (2019). Review of alternatives to root cause analysis: developing a robust system for incident report analysis. *BMJ Open Quality*, *8*(3), e000646. https://doi.org/10.1136/bmjoq-2019-000646

Hallam, J. S., & Petosa, R. (2004). The Long-Term Impact of a Four-Session Work-Site Intervention on Selected Social Cognitive Theory Variables Linked to Adult Exercise Adherence. *Health Education & Behavior*, *31*(1), 88–100. https://doi.org/10.1177/1090198103259164

Han, C. M. (1989). Country Image: Halo or Summary Construct? *Journal of Marketing Research*, *26*(2), 222. https://doi.org/10.2307/3172608

Han, C. M., & Terpstra, V. (1988). Country-of-Origin Effects for Uni-National and Bi-National Products. *Journal of International Business Studies*, *19*(2), 235–255. https://doi.org/10.1057/palgrave.jibs.8490379

Hardeman, W., Sutton, S., Griffin, S., Johnston, M., White, A., Wareham, N. J., & Kinmonth, A. L. (2005). A causal modelling approach to the development of theory-based behaviour change programmes for trial evaluation. *Health Education Research*, *20*(6), 676–687. https://doi.org/10.1093/her/cyh022

Harmeling, C. M., Magnusson, P., & Singh, N. (2015). Beyond anger: A deeper look at consumer animosity. *Journal of International Business Studies*, *46*(6), 676–693. https://doi.org/10.1057/jibs.2014.74

Harmeling, C. M., Moffett, J. W., Arnold, M. J., & Carlson, B. D. (2017). Toward a theory of customer engagement marketing. *Journal of the Academy of Marketing Science*, *45*(3), 312–335. https://doi.org/10.1007/s11747-016-0509-2

Harris, M., Bhatti, Y., Buckley, J., & Sharma, D. (2020). Fast and frugal innovations in response to the COVID-19 pandemic. *Nature Medicine*, *26*(6). https://doi.org/10.1038/s41591-020-0889-1

Harris, M., Bhatti, Y., & Darzi, A. (2016). Does the Country of Origin Matter in Health Care Innovation Diffusion? *JAMA*, *315*(11). https://doi.org/10.1001/jama.2016.0483

Harris, M., Marti, J., Watt, H., Bhatti, Y., Macinko, J., & Darzi, A. W. (2017). Explicit Bias Toward High-Income-Country Research: A Randomized, Blinded, Crossover Experiment Of English Clinicians. *Health Affairs*, *36*(11), 1997–2004. https://doi.org/10.1377/hlthaff.2017.0773

Harris, M., Weisberger, E., Silver, D., Dadwal, V., & Macinko, J. (2016). That's not how the learning works – the paradox of Reverse Innovation: a qualitative study. *Globalization and Health*, *12*(1). https://doi.org/10.1186/s12992-016-0175-7

Harris, M., Weisberger, E., Silver, D., & Macinko, J. (2015). 'They hear "Africa" and they think that there can't be any good services' – perceived context in cross-national learning: a qualitative study of the barriers to Reverse Innovation. *Globalization and Health*, *11*(1), 45. https://doi.org/10.1186/s12992-015-0130-z

Harrison, R. L., Granja, C., & Leroy, C. (2010). *Introduction to Monte Carlo Simulation*. 17–21. https://doi.org/10.1063/1.3295638

Hayman, R. (2002). Uterine compression sutures: surgical management of postpartum hemorrhage. *Obstetrics & Gynecology*, *99*(3). https://doi.org/10.1016/S0029-7844(01)01643-X

He, Y. (2012). Incorporating Sentiment Prior Knowledge for Weakly Supervised Sentiment Analysis. *ACM Transactions on Asian Language Information Processing*, *11*(2), 1–19. https://doi.org/10.1145/2184436.2184437

Heckmann, I. (2016). A New Definition of Supply Chain Risk. In *Towards Supply Chain Risk Analytics* (pp. 43–75). Springer Fachmedien Wiesbaden. https://doi.org/10.1007/978-3-658-14870-6_3

Heckmann, I., Comes, T., & Nickel, S. (2015). A critical review on supply chain risk – Definition, measure and modeling. *Omega*, *52*, 119–132. https://doi.org/10.1016/j.omega.2014.10.004

Heiman, A., & Just, D. R. (2021). Nationalism in the produce aisle: Using country of origin labels to stir patriotism and animosity. *Q Open*, *1*(1). https://doi.org/10.1093/qopen/qoaa012

Heller, L. J., Skinner, C. S., Tomiyama, A. J., Epel, E. S., Hall, P. A., Allan, J., LaCaille, L., Randall, A. K., Bodenmann, G., Li-Tsang, C. W. P., Sinclair, K., Creek, J., Baumann, L. C., Karel, A., Andersson, G., Hanewinkel, R., Morgenstern, M., Puska, P., Bucks, R. S., … Denollet, J. (2013). Theory of Reasoned Action. In *Encyclopedia of Behavioral Medicine* (pp. 1964–1967). Springer New York. https://doi.org/10.1007/978-1-4419-1005-9_1619

Hennessy, M., Bleakley, A., Fishbein, M., Brown, L., DiClemente, R., Romer, D., Valois, R., Vanable, P. A., Carey, M. P., & Salazar, L. (2010). Differentiating Between Precursor and Control Variables When Analyzing Reasoned Action Theories. *AIDS and Behavior*, *14*(1), 225–236. https://doi.org/10.1007/s10461-009-9560-z

Herche, J. (1992). A note on the predictive validity of the CETSCALE. *Journal of the Academy of Marketing Science*, *20*(3), 261–264. https://doi.org/10.1007/BF02723413

Herstatt, C., & Tiwari, R. (2020). Opportunities of frugality in the post-corona era. *International Journal of Technology Management*, *83*(1/2/3). https://doi.org/10.1504/IJTM.2020.109276

Heydari, A., Dashtgard, A., & Moghadam, Z. (2014). The effect of Bandura's social cognitive theory implementation on addiction quitting of clients referred to addiction quitting clinics. *Iran J Nurs Midwifery Res*, *19*(1), 19–23.

Hindocha, C. N., Antonacci, G., Barlow, J., & Harris, M. (2021). Defining frugal innovation: a critical review. *BMJ Innovations*, *7*(4), 647–656. https://doi.org/10.1136/bmjinnov-2021-000830

Hirsh, J. B., & Dolderman, D. (2007). Personality predictors of Consumerism and Environmentalism: A preliminary study. *Personality and Individual Differences*, *43*(6), 1583–1593. https://doi.org/10.1016/j.paid.2007.04.015

Hoffman, F. O., & Hammonds, J. S. (1994). Propagation of Uncertainty in Risk Assessments: The Need to Distinguish Between Uncertainty Due to Lack of Knowledge and Uncertainty Due to Variability. *Risk Analysis*, *14*(5), 707–712. https://doi.org/10.1111/j.1539-6924.1994.tb00281.x

Holt, E., & Chapman Brown, H. (1931). *Animal Drive and Learning Processes: An Essay toward Radical Empiricism*. H. Holt and Company.

Hong, S.-T., & Wyer, Jr. , R. S. (1989). Effects of Country-of-Origin and Product-Attribute Information on Product Evaluation: An Information Processing Perspective. *Journal of Consumer Research*, *16*(2), 175. https://doi.org/10.1086/209206

Horton, T., Illingworth, J., & Warbuton, W. (2018, September). *The Spread Challenge*. The Health Foundation. https://reader.health.org.uk/the-spread-challenge

Hossain, M. (2016). Frugal Innovation: A Systematic Literature Review. *SSRN*. https://doi.org/10.2139/ssrn.2768254

Hossain, M. (2018). Frugal innovation: A review and research agenda. *J Clean Prod*, *182*. https://doi.org/10.1016/j.jclepro.2018.02.091

Hossain, M. (2020). Frugal innovation: Conception, development, diffusion, and outcome. *J Clean Prod*, *262*. https://doi.org/10.1016/j.jclepro.2020.121456

Hossain, M., Simula, H., & Halme, M. (2016). Can frugal go global? Diffusion patterns of frugal innovations. *Technology in Society*, *46*. https://doi.org/10.1016/j.techsoc.2016.04.005

Hota, H. S., Sharma, D. K., & Verma, N. (2021). Lexicon-based sentiment analysis using Twitter data. *Data Science for COVID-19*, 275–295. https://doi.org/10.1016/B978-0-12-824536-1.00015-0

Hough, C. (2020). *Different Types Of Innovation in Business: Why One Size Doesn't Fit All*. Idea Drop.

Howitt, P., Darzi, A., Yang, G.-Z., Ashrafian, H., Atun, R., Barlow, J., Blakemore, A., Bull, A. M., Car, J., Conteh, L., Cooke, G. S., Ford, N., Gregson, S. A., Kerr, K., King, D., Kulendran, M., Malkin, R. A., Majeed, A., Matlin, S., … Wilson, E. (2012). Technologies for global health. *The Lancet*, *380*(9840), 507–535. https://doi.org/10.1016/S0140-6736(12)61127-1

Hughes, C. M. L., Baber, C., Bienkiewicz, M., Worthington, A., Hazell, A., & Hermsdörfer, J. (2015). The application of SHERPA (Systematic Human Error Reduction and Prediction Approach) in the development of compensatory cognitive rehabilitation strategies for stroke patients with left and right brain damage. *Ergonomics*, *58*(1), 75–95. https://doi.org/10.1080/00140139.2014.957735

Huh, J., & Cude, B. (2004). Is the Information "Fair and Balanced" in Direct-to-Consumer Prescription Drug Websites? *Journal of Health Communication*, *9*(6), 529–540. https://doi.org/10.1080/10810730490882667

Hussein, D. M. E.-D. M. (2018). A survey on sentiment analysis challenges. *Journal of King Saud University - Engineering Sciences*, *30*(4), 330–338. https://doi.org/10.1016/j.jksues.2016.04.002

Hyllegard, K. H., Yan, R.-N., Ogle, J. P., & Lee, K.-H. (2012). Socially Responsible Labeling. *Clothing and Textiles Research Journal*, *30*(1), 51–66. https://doi.org/10.1177/0887302X11433500

Ibrahim, A., Knox, K., Rundle-Thiele, S., & Arli, D. (2018). Segmenting a Water Use Market. *Social Marketing Quarterly*, *24*(1), 3–17. https://doi.org/10.1177/1524500417741277

Immelt, J. R., Govindarajan, V., & Trimble, C. (2009, October). *How GE Is Disrupting Itself*. Harv Bus Rev.

Imtiaz, M., Munsi, A., Nayan, D., & Dei, S. (2014). Systematic Human Error Reduction and Prediction Approach while Drilling. *International Journal of Scientific and Engineering Research*, *5*(12), 808–812.

India Today. (2020). *Coronavirus: Vodka Company to Make 24 Tons of Hand Sanitisers*. India Today.

Insch, G. S., & McBride, J. B. (2004). The impact of country-of-origin cues on consumer perceptions of product quality. *Journal of Business Research*, *57*(3), 256–265. https://doi.org/10.1016/S0148-2963(02)00323-5

Ishii, K. (2009). Nationalistic Sentiments of Chinese Consumers: The Effects and Determinants of Animosity and Consumer Ethnocentrism. *Journal of International Consumer Marketing*, *21*(4), 299–308. https://doi.org/10.1080/08961530802282232

Issa, H., Townsend, W., & Harris, M. (2021). Benefiting the NHS through innovation: how to ensure international health partnerships are genuinely reciprocal. *BMJ Global Health*, *6*(Suppl 6), e004936. https://doi.org/10.1136/bmjgh-2021-004936

Issock Issock, P. B., Roberts-Lombard, M., & Mpinganjira, M. (2020). Understanding household waste separation in South Africa. *Management of Environmental Quality: An International Journal*, *31*(3), 530–547. https://doi.org/10.1108/MEQ-08-2019-0181

Jaakkola, E., & Renko, M. (2007). Critical innovation characteristics influencing the acceptability of a new pharmaceutical product format. *Journal of Marketing Management*, *23*(3–4), 327–346. https://doi.org/10.1362/026725707X196404

James, N., & Busher, H. (2009). *Online Interviewing*. SAGE Publications.

Jamieson, M. K., Govaart, G. H., & Pownall, M. (2023). Reflexivity in quantitative research: A rationale and beginner's guide. *Social and Personality Psychology Compass*, *17*(4). https://doi.org/10.1111/spc3.12735

Jang, Y., & Yoo, H. (2012). Self-management programs based on the social cognitive theory for Koreans with chronic disease: A systematic review. *Contemporary Nurse*, *40*(2), 147–159. https://doi.org/10.5172/conu.2012.40.2.147

Jefferson, G. (1984). On Stepwise Transition from Talk about a Trouble to Inappropriately Next-Positioned Matters. In M. Atkinson & J. Heritage (Eds.), *Structures of Social Action: Studies in Conversation Analysis* (pp. 191–222). Cambridge University Press.

Jenkins, J. T., & O'Dwyer, P. J. (2008). Inguinal hernias. *BMJ*, *336*(7638). https://doi.org/10.1136/bmj.39450.428275.AD

Joint Australian New Zealand International Standard. (2009). *Australian/New Zealand Standard, Risk Management – Principles and Guidelines.* https://www.isa.org.jm/files/files/documents/asnzs_31000_2009.pdf

Joseph, K., Rouleau, J., Kramer, M., Young, D., Liston, R., & Baskett, T. (2007). Investigation of an increase in postpartum haemorrhage in Canada. *BJOG: An International Journal of Obstetrics & Gynaecology*, *114*(6). https://doi.org/10.1111/j.1471-0528.2007.01316.x

Joshi, N., & Itkat, S. (2014). A Survey on Feature Level Sentiment Analysis. *International Journal of Computer Science and Information Technologies*, *5*(4), 5422–5425.

Josiassen, A. (2011). Consumer Disidentification and Its Effects on Domestic Product Purchases: An Empirical Investigation in the Netherlands. *Journal of Marketing*, *75*, 124–140.

Juric, B., & Worsley, A. (1998). Consumers' attitudes towards imported food products. *Food Quality and Preference*, *9*(6), 431–441. https://doi.org/10.1016/S0950-3293(98)00027-5

Kahneman, D., & Tversky, A. (1979). On the interpretation of intuitive probability: A reply to Jonathan Cohen. *Cognition*, *7*(4), 409–411. https://doi.org/10.1016/0010-0277(79)90024-6

Kalchbrenner, N., Grefenstette, E., & Blunsom, P. (2014). A Convolutional Neural Network for Modelling Sentences. *Proceedings of the 52nd Annual Meeting of the Association for Computational Linguistics (Volume 1: Long Papers)*, 655–665. https://doi.org/10.3115/v1/P14-1062

Kaplan, S., & Garrick, B. J. (1981). On The Quantitative Definition of Risk. *Risk Analysis*, *1*(1), 11–27. https://doi.org/10.1111/j.1539-6924.1981.tb01350.x

Karnani, A. (2007). The Mirage of Marketing to the Bottom of the Pyramid: How the Private Sector Help Alleviate Poverty. *California Management Review*, *6*, 582–584.

Kaynak, E., Kucukemiroglu, O., & Hyder, A. S. (2000). Consumers' country-of-origin (COO) perceptions of imported products in a homogenous less-developed country. *European Journal of Marketing*, *34*(9/10), 1221–1241. https://doi.org/10.1108/03090560010342610

Keeney, B. (1983). *Aesthetics of Change*. Guilford Press.

Keller, K., Apéria, T., & Georgson, M. (2011). *Strategic brand management - A European perspective* (2nd ed.). Pearson Education Limited.

Kemshall, H., & Wilkinson, B. (2011). Introduction. In H. Kemshall & B. Wilkinson (Eds.), *Good Practice in Assessing Risk Current Knowledge, Issues and Approaches* (Vol. 3, pp. 1–5). Jessica Kingsley Publishers.

Kennedy, B., Rehman, M., Johnson, W., Magee, M., Leonard, R., & Katzmarzyk, P. (2017). Healthcare Providers versus Patients' Understanding of Health Beliefs and Values. *Patient Experience Journal*, *4*(3), 29–37.

Kerbouche, M., Lakhdar, A., Belminoun, A., & Guenouni, H. (2012). The Country of Origin and the Consumer Behavior - How to Improve Chinese Products Brands? *Mediterranean Journal of Social Sciences*, *3*(11). 10.5901/mjss.2012.v3n11p551

Khan, M. A., & Lee, M. S. W. (2014). Prepurchase Determinants of Brand Avoidance: The Moderating Role of Country-of-Origin Familiarity. *Journal of Global Marketing*, *27*(5), 329–343. https://doi.org/10.1080/08911762.2014.932879

Khan, R. (2016a). How Frugal Innovation Promotes Social Sustainability. *Sustainability*, *8*(10). https://doi.org/10.3390/su8101034

Khan, R. (2016b). How Frugal Innovation Promotes Social Sustainability. *Sustainability*, *8*(10), 1034. https://doi.org/10.3390/su8101034

Khan, R., & Melkas, H. (2020). The social dimension of frugal innovation. *International Journal of Technology Management*, *83*(1/2/3), 160. https://doi.org/10.1504/IJTM.2020.109234

Khan, Z. (2023). The Emerging Challenges and Strengths of the National Health Services: A Physician Perspective. *Cureus*. https://doi.org/10.7759/cureus.38617

Khoo, C. S., & Johnkhan, S. B. (2018). Lexicon-based sentiment analysis: Comparative evaluation of six sentiment lexicons. *Journal of Information Science*, *44*(4), 491–511. https://doi.org/10.1177/0165551517703514

Khunti, K., Griffiths, A., Majeed, A., Nagpaul, C., & Rao, M. (2021). Assessing risk for healthcare workers during the covid-19 pandemic. *BMJ*, n602. https://doi.org/10.1136/bmj.n602

Kilders, V., Caputo, V., & Liverpool-Tasie, L. S. O. (2021). Consumer ethnocentric behavior and food choices in developing countries: The case of Nigeria. *Food Policy*, *99*, 101973. https://doi.org/10.1016/j.foodpol.2020.101973

Kim, Y. (2014). Convolutional Neural Networks for Sentence Classification. *Proceedings of the 2014 Conference on Empirical Methods in Natural Language Processing (EMNLP)*, 1746–1751. https://doi.org/10.3115/v1/D14-1181

Kingiri, A. N., & Fu, X. (2020). Understanding the diffusion and adoption of digital finance innovation in emerging economies: M-Pesa money mobile transfer service in Kenya. *Innovation and Development*, *10*(1), 67–87. https://doi.org/10.1080/2157930X.2019.1570695

Kingsnorth, A. N., Clarke, M. G., & Shillcutt, S. D. (2009). Public Health and Policy Issues of Hernia Surgery in Africa. *World Journal of Surgery*, *33*(6). https://doi.org/10.1007/s00268-009-9964-y

Kiss, A., Corona, D., & Kiss, O. (2012). The Use of Mosquito-Net Cloths as Prosthesis in Inguinal Hernia Repair: An Experience in Southern Sudan. *Surgical Science*, *03*(03). https://doi.org/10.4236/ss.2012.33030

Klein, J. G., & Ettensoe, R. (1999). Consumer Animosity and Consumer Ethnocentrism. *Journal of International Consumer Marketing*, *11*(4), 5–24. https://doi.org/10.1300/J046v11n04_02

Klein, J. G., Ettenson, R., & Morris, M. D. (1998). The Animosity Model of Foreign Product Purchase: An Empirical Test in the People's Republic of China. *Journal of Marketing*, *62*(1), 89–100. https://doi.org/10.1177/002224299806200108

Klein, R., & Maybin, J. (2012). *Thinking about Rationing*. The King's Fund. https://www.kingsfund.org.uk/sites/default/files/field/field_publication_file/Thinking-about-rationing-the-kings-fund-may-2012.pdf

Knight, G. A., & Calantone, R. J. (2000). A flexible model of consumer country-of-origin perceptions. *International Marketing Review*, *17*(2), 127–145. https://doi.org/10.1108/02651330010322615

Knight, M., Callaghan, W. M., Berg, C., Alexander, S., Bouvier-Colle, M.-H., Ford, J. B., Joseph, K., Lewis, G., Liston, R. M., Roberts, C. L., Oats, J., & Walker, J. (2009). Trends in postpartum hemorrhage

in high resource countries: a review and recommendations from the International Postpartum Hemorrhage Collaborative Group. *BMC Pregnancy and Childbirth*, *9*(1). https://doi.org/10.1186/1471-2393-9-55

Knorringa, P., Peša, I., Leliveld, A., & van Beers, C. (2016). Frugal Innovation and Development: Aides or Adversaries? *The European Journal of Development Research*, *28*(2). https://doi.org/10.1057/ejdr.2016.3

Koerich, G. V., & Cancellier, E. (2019). Frugal Innovation: origins, evolution and future perspectives. *Cadernos EBAPE.BR*, *17*(4). https://doi.org/10.1590/1679-395174424x

Kong, A., Barnett, G. O., Mosteller, F., & Youtz, C. (1986). How Medical Professionals Evaluate Expressions of Probability. *New England Journal of Medicine*, *315*(12), 740–744. https://doi.org/10.1056/NEJM198609183151206

Krieger, M. G. M., Wenham, C., Nacif Pimenta, D., Nkya, T. E., Schall, B., Nunes, A. C., De Menezes, A., & Lotta, G. (2021). How do community health workers institutionalise: An analysis of Brazil's CHW programme. *Global Public Health*. https://doi.org/10.1080/17441692.2021.1940236

Kroll, H., & Gabriel, M. (2020). Frugal innovation in, by and for Europe. *International Journal of Technology Management*, *83*(1/2/3), 34. https://doi.org/10.1504/IJTM.2020.109230

Kuipers, P., Humphreys, J. S., Wakerman, J., Wells, R., Jones, J., & Entwistle, P. (2008). Collaborative review of pilot projects to inform policy: A methodological remedy for pilotitis? *Australia and New Zealand Health Policy*, *5*(1), 17. https://doi.org/10.1186/1743-8462-5-17

Kuipers, T. (2001). *Structures in Science: Heuristic Patterns Based on Cognitive Structures An Advanced Textbook in Neo-Classical Philosophy of Science*. Kluwer Academic Publishers.

Kumar, N., & Puranam, P. (2012). Frugal engineering: an emerging innovation paradigm. *Ivey Business Journal*, *76*(2).

Kuo, A. (2014). Creating Social Value through Frugal Innovation. In *In. Entrepreneurship in Asia Social Enterprise, Network and Grassroots Case Studies (Japanese Management and International Studies)* (pp. 53–66). World Scientific Publishing Company.

Kuo, A., & Ng, S. (2016). Frugal innovation: A strategy for emerging market penetration and beyond. International Journal of Accounting & Business Management. *International Journal of Accounting & Business Management*, *4*(2).

Kurland, N. B. (1995). Ethical Intentions and the Theories of Reasoned Action and Planned Behavior. *Journal of Applied Social Psychology*, *25*(4), 297–313. https://doi.org/10.1111/j.1559-1816.1995.tb02393.x

Lampert, S. I., & Jaffe, E. D. (1998). A dynamic approach to country-of-origin effect. *European Journal of Marketing*, *32*(1/2), 61–78. https://doi.org/10.1108/03090569810197471

Lan, M., Tan, C., Su, J., & Lu, Y. (2009). Supervised and Traditional Term Weighting Methods for Automatic Text Categorization. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, *31*(4), 721–735. https://doi.org/10.1109/TPAMI.2008.110

Laricchia, F. (2023, May 16). *Apple - statistics & facts*. Statista. https://www.statista.com/topics/847/apple/#topicOverview

Laroche, M., Papadopoulos, N., Heslop, L. A., & Mourali, M. (2005). The influence of country image structure on consumer evaluations of foreign products. *International Marketing Review*, *22*(1), 96–115. https://doi.org/10.1108/02651330510581190

Leadbeater, C. (2014). *The Frugal Innovator: Creating Change on a Shoestring Budget* (1st ed.). Palgrave Macmillian.

Leão, A. L. M. de S., & Mello, S. C. B. de. (2007). The means-end approach to understanding customer values of a on-line newspaper. *BAR - Brazilian Administration Review*, *4*(1), 1–20. https://doi.org/10.1590/S1807-76922007000100002

Leavy, B. (2011). Vijay Govindarajan: innovation coach to the developed and developing world. *Strategy & Leadership*, *39*(5), 4–12. https://doi.org/10.1108/10878571111161471

Lee, J. K., & Lee, W.-N. (2009). Country-of-Origin Effects on Consumer Product Evaluation and Purchase Intention: The Role of Objective Versus Subjective Knowledge. *Journal of International Consumer Marketing*, *21*(2), 137–151. https://doi.org/10.1080/08961530802153722

Lehoux, P., & Silva, H. (2019). Transforming Disciplinary Traditions Comment on "Problems and Promises of Health Technologies: The Role of Early Health Economic Modeling." *International Journal of Health Policy and Management*. https://doi.org/10.15171/ijhpm.2019.130

Lent, R. W., Miller, M. J., Smith, P. E., Watford, B. A., Hui, K., & Lim, R. H. (2015). Social cognitive model of adjustment to engineering majors: Longitudinal test across gender and race/ethnicity. *Journal of Vocational Behavior*, *86*, 77–85. https://doi.org/10.1016/j.jvb.2014.11.004

Leonidou, L., Kvasova, O., Christodoulides, P., & Tokar, S. (2019). Personality Traits, Consumer Animosity, and Foreign Product Avoidance: The Moderating Role of Individual Cultural Characteristics. *Journal of International Marketing*, *27*(2), 76–96. https://www.jstor.org/stable/26979282

Levänen, J., Hossain, M., Lyytinen, T., Hyvärinen, A., Numminen, S., & Halme, M. (2015). Implications of Frugal Innovations on Sustainable Development: Evaluating Water and Energy Innovations. *Sustainability*, *8*(1), 4. https://doi.org/10.3390/su8010004

Li, H., Zhang, Y. (Anthea), & Lyles, M. (2013). Knowledge Spillovers, Search, and Creation in China's Emerging Market. *Management and Organization Review*, *9*(3), 395–412. https://doi.org/10.1111/more.12036

Li, T., He, T., Tan, X., Yang, S., Li, J., Peng, Z., Li, H., Song, X., Wu, Q., Yang, F., & Xing, Y. (2009). Prevalence of Age-Related Cataract in High-Selenium Areas of China. *Biological Trace Element Research*, *128*(1). https://doi.org/10.1007/s12011-008-8248-y

Li, W., & Monroe, K. (1992). The Role of Country of Origin Information on Buyers' Product Evaluation: An In-Depth Interview Approach. *Enhancing Knowledge Development*, *3*, 274–280.

Liaqat, M. I., Awais Hassan, M., Shoaib, M., Khurshid, S. K., & Shamseldin, M. A. (2022). Sentiment analysis techniques, challenges, and opportunities: Urdu language-based analytical study. *PeerJ Computer Science*, *8*, e1032. https://doi.org/10.7717/peerj-cs.1032

Lien, A. S.-Y., & Jiang, Y.-D. (2017). Integration of diffusion of innovation theory into diabetes care. *Journal of Diabetes Investigation*, *8*(3), 259–260. https://doi.org/10.1111/jdi.12568

Liker, J. K., & Sindi, A. A. (1997). User acceptance of expert systems: a test of the theory of reasoned action. *Journal of Engineering and Technology Management*, *14*(2), 147–173. https://doi.org/10.1016/S0923-4748(97)00008-8

Ling, P., Geng, C., Menghou, Z., & Chunya, L. (2014). *What Do Seller Manipulations of Online Product Reviews Mean to Consumers?* (HKIBS Working Paper Series 070-1314).

Liu, B. (2012). *Sentiment Analysis and Opinion Mining*. Springer International Publishing. https://doi.org/10.1007/978-3-031-02145-9

Liu, B. (2020). *Sentiment Analysis: Mining Opinions, Sentiments, and Emotions* (2nd ed.). Cambridge University Press.

Liu, C., Yu, F., Xu, Y., Li, J., Guan, Z., Sun, M., Liu, C., He, F., & Chen, D. (2021). Prevalence and risk factors of severe postpartum hemorrhage: a retrospective cohort study. *BMC Pregnancy and Childbirth*, *21*(1). https://doi.org/10.1186/s12884-021-03818-1

Liu, H.-C., You, X.-Y., Tsung, F., & Ji, P. (2018). An improved approach for failure mode and effect analysis involving large group of experts: An application to the healthcare field. *Quality Engineering*, *30*(4), 762–775. https://doi.org/10.1080/08982112.2018.1448089

Lobb, A. E., & Mazzocchi, M. (2007). Domestically produced food: Consumer perceptions of origin, safety and the issue of trust. *Food Economics - Acta Agriculturae Scandinavica, Section C*, *4*(1), 3–12. https://doi.org/10.1080/16507540701192485

Lowrie, R., Morrison, G., Lees, R., Grant, C. H., Johnson, C., MacLean, F., Semple, Y., Thomson, A., Harrison, H., Mullen, A. B., Lannigan, N., & Macdonald, S. (2015). Research is 'a step into the unknown': an exploration of pharmacists' perceptions of factors impacting on research participation in the NHS. *BMJ Open*, *5*(12), e009180. https://doi.org/10.1136/bmjopen-2015-009180

Lowry, P. B., Zhang, J., & Wu, T. (2017). Nature or nurture? A meta-analysis of the factors that maximize the prediction of digital piracy by using social cognitive theory as a framework. *Computers in Human Behavior*, *68*, 104–120. https://doi.org/10.1016/j.chb.2016.11.015

Luomala, H. T. (2007). Exploring the role of food origin as a source of meanings for consumers and as a determinant of consumers' actual food choices. *Journal of Business Research*, *60*(2), 122–129. https://doi.org/10.1016/j.jbusres.2006.10.010

Lyu, T., Chen, H., & Guo, Y. (2023). Investigating innovation diffusion, social influence, and personal inner forces to understand people's participation in online e-waste recycling. *Journal of Retailing and Consumer Services*, *73*, 103366. https://doi.org/10.1016/j.jretconser.2023.103366

Madden, T. J., Ellen, P. S., & Ajzen, I. (1992). A Comparison of the Theory of Planned Behavior and the Theory of Reasoned Action. *Personality and Social Psychology Bulletin*, *18*(1), 3–9. https://doi.org/10.1177/0146167292181001

Maher, A. A., & Mady, S. (2010). Animosity, subjective norms, and anticipated emotions during an international crisis. *International Marketing Review*, *27*(6), 630–651. https://doi.org/10.1108/02651331011088263

Maheswaran, D. (1994). Country of Origin as a Stereotype: Effects of Consumer Expertise and Attribute Strength on Product Evaluations. *Journal of Consumer Research*, *21*(2), 354. https://doi.org/10.1086/209403

Malodia, S., Gupta, S., & Jaiswal, A. K. (2020). Reverse innovation: a conceptual framework. *Journal of the Academy of Marketing Science*, *48*(5). https://doi.org/10.1007/s11747-019-00703-4

Manrai, L. A., Lascu, D.-N., & Manrai, A. K. (1998). Interactive effects of country of origin and product category on product evaluations. *International Business Review*, *7*(6), 591–615. https://doi.org/10.1016/S0969-5931(98)00026-2

Marjanovic, S., Ball, S., Harshfield, A., Dimova, S., Prideaux, R., Carpenter, A., Punch, D., & Simmons, R. (2019). *Involving NHS staff in research*. The Healthcare Improvement Studies Institute. https://www.thisinstitute.cam.ac.uk/wp-content/uploads/2019/02/Involving-NHS-Staff-In-Research.pdf

Martin, I. M., & Eroglu, S. (1993). Measuring a multi-dimensional construct: Country image. *Journal of Business Research*, *28*(3), 191–210. https://doi.org/10.1016/0148-2963(93)90047-S

Martin, J. R., & White, P. R. R. (2005). *The Language of Evaluation: Appraisal in English*. Palgrave Macmillan.

Martin-Delgado, J., Martínez-García, A., Aranaz, J. M., Valencia-Martín, J. L., & Mira, J. J. (2020). How Much of Root Cause Analysis Translates into Improved Patient Safety: A Systematic Review. *Medical Principles and Practice*, *29*(6), 524–531. https://doi.org/10.1159/000508677

Matthew, J., Spencer, G., & Andrea, Z. (2015). Potential applications of sentiment analysis in educational research and practice – Is SITE the friendliest conference? In D. Slykhuis & G. Marks (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference*.

Maynard, M., & Purvis, J. (1994). Methods, Practice and Epistemology: The Debate about Feminism and Research. In *Researching Women's Lives From A Feminist Perspective* (1st ed.). Routledge.

Meagher, K. (2018). Cannibalizing the Informal Economy: Frugal Innovation and Economic Inclusion in Africa. *The European Journal of Development Research*, *30*(1), 17–33. https://doi.org/10.1057/s41287-017-0113-4

Medhat, W., Hassan, A., & Korashy, H. (2014). Sentiment analysis algorithms and applications: A survey. *Ain Shams Engineering Journal*, *5*(4), 1093–1113. https://doi.org/10.1016/j.asej.2014.04.011

Meena, A., & Prabhakar, T. (2007). Sentence Level Sentiment Analysis in the Presence of Conjuncts Using Linguistic Analysis. *Advances in Information Retrieval*, 573–580. https://doi.org/10.1007/978-3-540-71496-5_53

Mehboob Shaikh, I., & Amin, H. (2023). Customers' willingness to choose family takaful: extending the theory of interpersonal behaviour. *Journal of Islamic Accounting and Business Research*. https://doi.org/10.1108/JIABR-04-2022-0113

Mehta, P., & Pandya, S. (2020). A Review On Sentiment Analysis Methodologies, Practices And Applications . *International Journal of Scientific & Technology Research*, *9*(2), 601–609.

Merriam SB. (2009). *Qualitative research: A Guide to design and implementation*. Jossey-Bass.

Mesnil, G., Mikolov, T., Ranzato, M., & Bengio, Y. (2014). *Ensemble of Generative and Discriminative Techniques for Sentiment Analysis of Movie Reviews*.

Meyer, S. B., & Lunnay, B. (2013). The Application of Abductive and Retroductive Inference for the Design and Analysis of Theory-Driven Sociological Research. *Sociological Research Online*, *18*(1), 86–96. https://doi.org/10.5153/sro.2819

Michie, S. (2005). Making psychological theory useful for implementing evidence based practice: a consensus approach. *Quality and Safety in Health Care*, *14*(1), 26–33. https://doi.org/10.1136/qshc.2004.011155

Michie, S., Hardeman, W., Fanshawe, T., Prevost, A. T., Taylor, L., & Kinmonth, A. L. (2008). Investigating theoretical explanations for behaviour change: the case study of ProActive. *Psychology & Health*, *23*(1), 25–39. https://doi.org/10.1080/08870440701670588

Mikolov, T., Chen, K., Corrado, G., & Dean, J. (2013). Efficient Estimation of Word Representations in Vector Space. *CoRR*.

Min, S., So, K. K. F., & Jeong, M. (2019). Consumer adoption of the Uber mobile application: Insights from diffusion of innovation theory and technology acceptance model. *Journal of Travel & Tourism Marketing*, *36*(7), 770–783. https://doi.org/10.1080/10548408.2018.1507866

Mishev, K., Gjorgjevikj, A., Vodenska, I., Chitkushev, L. T., & Trajanov, D. (2020). Evaluation of Sentiment Analysis in Finance: From Lexicons to Transformers. *IEEE Access*, *8*, 131662–131682. https://doi.org/10.1109/ACCESS.2020.3009626

Mishra, N., Agrawal, S., Gulabani, K., & Shrivastava, C. (2016). Use of an Innovative Condom Balloon Tamponade in Postpartum Haemorrhage: A Report. *The Journal of Obstetrics and Gynecology of India*, *66*(1). https://doi.org/10.1007/s13224-015-0818-2

Mitchell, V., & Papavassiliou, V. (1999). Marketing causes and implications of consumer confusion. *Journal of Product & Brand Management*, *8*(4), 319–342. https://doi.org/10.1108/10610429910284300

Moeini, B., Bashirian, S., Soltanian, A., Ghaleiha, A., & Taheri, M. (2019). Examining the Effectiveness of a Web-Based Intervention for Depressive Symptoms in Female Adolescents: Applying Social Cognitive Theory. *J Res Health Sci*, *19*(3).

Montano, D., & Kasprzyk, D. (2015). Theory of Reasoned Action, Theory of Planned Behavior, and the Integrated Behavioral Model. In K. Glanz, B. Rimer, & K. Viswanath (Eds.), *Health Behavior: Theory, Research, and Practice* (pp. 95–124). Jossey-Bass/Wiley.

Montoyo, A., Martínez-Barco, P., & Balahur, A. (2012). Subjectivity and sentiment analysis: An overview of the current state of the area and envisaged developments. *Decision Support Systems*, *53*(4), 675–679. https://doi.org/10.1016/j.dss.2012.05.022

Moody, G. D., & Siponen, M. (2013). Using the theory of interpersonal behavior to explain non-work-related personal use of the Internet at work. *Information & Management*, *50*(6), 322–335. https://doi.org/10.1016/j.im.2013.04.005

Moore, C. (2015). Moral disengagement. *Current Opinion in Psychology*, *6*, 199–204. https://doi.org/10.1016/j.copsyc.2015.07.018

Moore, G. C., & Benbasat, I. (1996). Integrating Diffusion of Innovations and Theory of Reasoned Action models to predict utilization of information technology by end-users. In *Diffusion and Adoption of Information Technology* (pp. 132–146). Springer US. https://doi.org/10.1007/978-0-387-34982-4_10

Morgan, N., Pritchard, A., & Pride, R. (2004). *Destination branding: Creating the unique destination proposition* (2nd ed.). Butterworth-Heinemann.

Moussa, M. E., Mohamed, E. H., & Haggag, M. H. (2020). A generic lexicon-based framework for sentiment analysis. *International Journal of Computers and Applications*, *42*(5), 463–473. https://doi.org/10.1080/1206212X.2018.1483813

Mukumbang, F. C. (2021). Retroductive Theorizing: A Contribution of Critical Realism to Mixed Methods Research. *Journal of Mixed Methods Research*, *17*(1), 93–114. https://doi.org/10.1177/15586898211049847

Munteanu, C., & Pagalea, A. (2014). Brands as a Mean of Consumer Self-expression and Desired Personal Lifestyle. *Procedia - Social and Behavioral Sciences*, *109*, 103–107. https://doi.org/10.1016/j.sbspro.2013.12.427

Nabi, R. L., & Clark, S. (2008). Exploring the Limits of Social Cognitive Theory: Why Negatively Reinforced Behaviors on TV May Be Modeled Anyway. *Journal of Communication*, *58*(3), 407–427. https://doi.org/10.1111/j.1460-2466.2008.00392.x

Nagamanjula, R., & Pethalakshmi, A. (2020). A novel framework based on bi-objective optimization and LAN2FIS for Twitter sentiment analysis. *Social Network Analysis and Mining*, *10*(1), 34. https://doi.org/10.1007/s13278-020-00648-5

Nagashima, A. (1970). A Comparison of Japanese and U.S. Attitudes toward Foreign Products. *Journal of Marketing*, *34*(1), 68–74. https://doi.org/10.1177/002224297003400115

Nagashima, A. (1977). A Comparative “Made in” Product Image Survey among Japanese Businessmen. *Journal of Marketing*, *41*(3), 95. https://doi.org/10.2307/1250943

Najimi, A., & Ghaffari, M. (2013). Promoting fruit and vegetable consumption among students: a randomized controlled trial based on social cognitive theory. *Journal of the Pakistan Medical Association*, *63*(10).

Namperumalsamy, P. (2020). Maintaining quality in community eye care – The Aravind model. *Indian Journal of Ophthalmology*, *68*(2). https://doi.org/10.4103/ijo.IJO_41_20

Nandi, T. (2020). *See pics: Indian Railways Coaches Converted to Isolation Wards for Coronavirus Patients.* Livemint. https://www.livemint.com/news/india/see-pics-indian-railways-coaches-converted-to-isolation-wards-for-coronavirus-patients-11585573012954.html

Nandwani, P., & Verma, R. (2021). A review on sentiment analysis and emotion detection from text. *Social Network Analysis and Mining*, *11*(1), 81. https://doi.org/10.1007/s13278-021-00776-6

Narayana Health. (2023). *NH Cares*. https://www.narayanahealth.org/diseases

Nari Kahle, H., Dubiel, A., Ernst, H., & Prabhu, J. (2013). The democratizing effects of frugal innovation. *Journal of Indian Business Research*, *5*(4). https://doi.org/10.1108/JIBR-01-2013-0008

Naveen, N., & Srinath, R. (2014). A Comparative Study Between Modified Bassini's Repair and Lichtenstein Mesh Repair of Inguinal Hernias in Rural Population. *J Clin Diagn Res*, *8*(2), 88–91. https://doi.org/10.7860/JCDR/2014/7431.4016

Nes, E. B., Yelkur, R., & Silkoset, R. (2014). Consumer affinity for foreign countries: Construct development, buying behavior consequences and animosity contrasts. *International Business Review*, *23*(4), 774–784. https://doi.org/10.1016/j.ibusrev.2013.11.009

Nesta. (2023). *NHS Innovation Accelerator*. Nesta.

Neviarouskaya, A., Prendinger, H., & Ishizuka, M. (2011). SentiFul: A Lexicon for Sentiment Analysis. *IEEE Transactions on Affective Computing*, *2*(1), 22–36. https://doi.org/10.1109/T-AFFC.2011.1

Nexøe, J., Halvorsen, P. A., & Kristiansen, I. S. (2007). Review Article: Critiques of the risk concept — valid or not? *Scandinavian Journal of Public Health*, *35*(6), 648–654. https://doi.org/10.1080/14034940701418897

NHS. (2016). *NHS Five Year Forward View*. NHS. https://www.england.nhs.uk/wp-content/uploads/2016/05/fyfv-tech-note-090516.pdf

NHS. (2019). *The NHS Long Term Plan*. NHS. https://www.longtermplan.nhs.uk/wp-content/uploads/2019/01/nhs-long-term-plan-june-2019.pdf

NHS Barts Health. (2020). *NHS Nightingale London Hospital.* Barts Health. https://www.bartshealth.nhs.uk/nightingale

NHS England. (2013). *The NHS Belongs to the People*. NHS England. https://www.england.nhs.uk/wp-content/uploads/2013/07/nhs-belongs.pdf

NHS England. (2014). *Five Year Forward View*. NHS England.

NHS England. (2023a). *Innovation and Technology Payment*. NHS England. https://www.england.nhs.uk/aac/what-we-do/innovation-for-healthcare-inequalities-programme/innovation-and-technology-payment/

NHS England. (2023b). *Innovation for Healthcare Inequalities Programme*. NHS England. https://www.england.nhs.uk/aac/what-we-do/innovation-for-healthcare-inequalities-programme/

NHS Health Education England. (2023). *NHS England Global Health Partnerships*. NHS Health Education England. https://global.hee.nhs.uk/

NICE. (2004). *Laparoscopic surgery for inguinal hernia repair [TA83]*. https://www.nice.org.uk/Guidance/TA83

Nijssen, E. J., & Douglas, S. P. (2011). Consumer World-Mindedness and Attitudes toward Product Positioning in Advertising: An Examination of Global versus Foreign versus Local Positioning. *Journal of International Marketing*, *19*(3), 113–133. https://doi.org/10.1509/jimk.19.3.113

Nilsen, P., Roback, K., Broström, A., & Ellström, P.-E. (2012). Creatures of habit: accounting for the role of habit in implementation research on clinical behaviour change. *Implementation Science*, *7*(1), 53. https://doi.org/10.1186/1748-5908-7-53

Nisbett, R. E., & Wilson, T. D. (1977). The halo effect: Evidence for unconscious alteration of judgments. *Journal of Personality and Social Psychology*, *35*(4), 250–256. https://doi.org/10.1037/0022-3514.35.4.250

Noblit, G., & Engel, J. (1999). Chapter 2: The Holistic Injunction: An Ideal and a Moral Imperative for Qualitative Research. *Counterpoints Particularities: Collected Essays on Ethnography and Education* , *44*, 53–60. https://www.jstor.org/stable/42975554

Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic Analysis. *International Journal of Qualitative Methods*, *16*(1), 160940691773384. https://doi.org/10.1177/1609406917733847

Numminen, S., & Lund, P. D. (2017). Frugal energy innovations for developing countries – a framework. *Global Challenges*, *1*(1), 9–19. https://doi.org/10.1002/gch2.1012

Oberecker, E., & Diamantopoulos, A. (2011). Consumers' Emotional Bonds with Foreign Countries: Does Consumer Affinity Affect Behavioral Intentions? *Journal of International Marketing*, *19*(2), 45–72. 10.2307/41304394

Oberecker, E. M., Riefler, P., & Diamantopoulos, A. (2008). The Consumer Affinity Construct: Conceptualization, Qualitative Investigation, and Research Agenda. *Journal of International Marketing*, *16*(3), 23–56. https://doi.org/10.1509/jimk.16.3.23

Obermiller, C., & Spangenberg, E. (1989). Exploring the Effects of Country of Origin Labels: an Information Processing Framework. *Advances in Consumer Research*, *16*, 454–459.

Öhman, E. (2021). The Validity of Lexicon-based Sentiment Analysis in Interdisciplinary Research. *Proceedings of the Workshop on Natural Language Processing for Digital Humanities*, 7–12.

Olufadewa, I., Adesina, M., & Ayorinde, T. (2021). Global health in low-income and middle-income countries: a framework for action. *The Lancet Global Health*, *9*(7), e899–e900. https://doi.org/10.1016/S2214-109X(21)00143-1

Onyenwe, I., Nwagbo, S., Mbeledogu, N., & Onyedinma, E. (2020). The impact of political party/candidate on the election results from a sentiment analysis perspective using #AnambraDecides2017 tweets. *Social Network Analysis and Mining*, *10*(1), 55. https://doi.org/10.1007/s13278-020-00667-2

Oribabor, F., Amao, O., Akanni, S., & Fatudimu, S. (2015). The use of nontreated mosquito-net mesh cloth for a tension free inguinal hernia repair: Our experience. *Nigerian Journal of Surgery*, *21*(1). https://doi.org/10.4103/1117-6806.152726

Orth, U. R., & Firbasová, Z. (2003). The role of consumer ethnocentrism in food product evaluation. *Agribusiness*, *19*(2), 137–153. https://doi.org/10.1002/agr.10051

Osbourne, J. A., & Clarke, M. (2008). Factors Motivating the Acceptance of New Information and Communication Technologies in UK Healthcare. In *Information Communication Technologies* (pp. 1036–1046). IGI Global. https://doi.org/10.4018/978-1-59904-949-6.ch069

Ostberg, J. (2011). The Mythological Aspects of Country-of-Origin: The Case of the Swedishness of Swedish Fashion. *Journal of Global Fashion Marketing*, *2*(4), 223–234. https://doi.org/10.1080/20932685.2011.10593100

Ostraszewska, Z., & Tylec, A. (2015). Reverse innovation – how it works. *International Journal of Business and Management*, *III*(1). https://doi.org/10.20472/BM.2015.3.1.004

Otieno, O. C., Liyala, S., Odongo, B. C., & Abeka, S. (2016). Theory of Reasoned Action as an Underpinning to Technological Innovation Adoption Studies. *World Journal of Computer Application and Technology*, *4*(1), 1–7. https://doi.org/10.13189/wjcat.2016.040101

Otter, V., Prechtel, B., & Theuvsen, L. (2018). Country of Origin Effect for Food Products from Developing and Transition Countries: A PLS Analysis of German Consumers' Perception. *Journal of International Food & Agribusiness Marketing*, *30*(4), 355–381. https://doi.org/10.1080/08974438.2018.1449695

Ouyang, X., Zhou, P., Li, C. H., & Liu, L. (2015). Sentiment Analysis Using Convolutional Neural Network. *2015 IEEE International Conference on Computer and Information Technology; Ubiquitous Computing and Communications; Dependable, Autonomic and Secure Computing; Pervasive Intelligence and Computing*, 2359–2364. https://doi.org/10.1109/CIT/IUCC/DASC/PICOM.2015.349

Oxford Reference. (2023a). *Overview: Attitude*. Oxford Reference. https://www.oxfordreference.com/display/10.1093/oi/authority.20110803095433168#:~:text=The%20way%20in%20which%20a,how%20they%20behave%20towards%20them.

Oxford Reference. (2023b). *Overview: Belief*. Oxford Reference.

Oxford Reference. (2023c). *Overview: Intention*. Oxford Reference. https://www.oxfordreference.com/display/10.1093/oi/authority.20110803100006205#:~:text=N.,(for%20example%2C%20murder).

Ozgediz, D., Jamison, D., Cherian, M., & McQueen, K. (2008). The burden of surgical conditions and access to surgical care in low- and middle-income countries. *Bulletin of the World Health Organization*, *86*(8), 646–647. https://doi.org/10.2471/BLT.07.050435

Palm, E., Seubert, C., & Glaser, J. (2020). Understanding Employee Motivation for Work-to-Nonwork Integration Behavior: a Reasoned Action Approach. *Journal of Business and Psychology*, *35*(5), 683–696. https://doi.org/10.1007/s10869-019-09648-5

Pang, B., & Lee, L. (2008). Opinion Mining and Sentiment Analysis. *Foundations and Trends® in Information Retrieval*, *2*(1–2), 1–135. https://doi.org/10.1561/1500000011

Pansera, M. (2018). Frugal or Fair? The Unfulfilled Promises of Frugal Innovation. *Technology Innovation Management Review*, *8*(4). https://doi.org/10.22215/timreview/1148

Pansera, M., & Sarkar, S. (2016). Crafting Sustainable Development Solutions: Frugal Innovations of Grassroots Entrepreneurs. *Sustainability*, *8*(1). https://doi.org/10.3390/su8010051

Papadopoulos, N., Banna, A. El, & Murphy, S. A. (2017). Old Country Passions: An International Examination of Country Image, Animosity, and Affinity among Ethnic Consumers. *Journal of International Marketing*, *25*(3), 61–82. https://doi.org/10.1509/jim.16.0077

Papadopoulos, N., Elliot, S., & De Nisco, A. (2013). From 'made-in'' to "product-country images'' and 'place branding'': a journey through research time and space.'"' *MERCATI E COMPETITIVITÀ*, *2*, 37–57. https://doi.org/10.3280/MC2013-002003

Papadopoulos, N., & Heslop, L. A. (2014). *Product-Country Images*. Routledge. https://doi.org/10.4324/9781315863931

Park, J. E., & Yoon, S.-J. (2017). Antecedents of consumer animosity and the role of product involvement on purchase intentions. *American Journal of Business*, *32*(1), 42–57. https://doi.org/10.1108/AJB-08-2016-0028

Park, M.-B., & Ranabhat, C. L. (2022). COVID-19 trends, public restrictions policies and vaccination status by economic ranking of countries: a longitudinal study from 110 countries. *Archives of Public Health*, *80*(1), 197. https://doi.org/10.1186/s13690-022-00936-w

Pascarella, G., Rossi, M., Montella, E., Capasso, A., de Feo, G., Botti, G., Nardone, A., Montuori, P., Triassi, M., D'Auria, S., & Morabito, A. (2021). Risk Analysis in Healthcare Organizations: Methodological Framework and Critical Variables. *Risk Management and Healthcare Policy*, *Volume 14*, 2897–2911. https://doi.org/10.2147/RMHP.S309098

Payne, J. W. (1982). Contingent decision behavior. *Psychological Bulletin*, *92*(2), 382–402. https://doi.org/10.1037/0033-2909.92.2.382

Pee, L. G., Woon, I. M. Y., & Kankanhalli, A. (2008). Explaining non-work-related computing in the workplace: A comparison of alternative models. *Information & Management*, *45*(2), 120–130. https://doi.org/10.1016/j.im.2008.01.004

Peerally, M. F., Carr, S., Waring, J., & Dixon-Woods, M. (2016). The problem with root cause analysis. *BMJ Quality & Safety*, bmjqs-2016-005511. https://doi.org/10.1136/bmjqs-2016-005511

Peng, M., Zhang, Q., Jiang, Y., & Huang, X. (2018). Cross-Domain Sentiment Classification with Target Domain Specific Information. *Proceedings of the 56th Annual Meeting of the Association for Computational Linguistics (Volume 1: Long Papers)*, 2505–2513. https://doi.org/10.18653/v1/P18-1233

Petosa, R. L., Suminski, R., & Hortz, B. (2003). Predicting Vigorous Physical Activity Using Social Cognitive Theory. *American Journal of Health Behavior*, *27*(4), 301–310. https://doi.org/10.5993/AJHB.27.4.2

Petrick, I. J., & Juntiwasarakij, S. (2011). The Rise of the Rest: Hotbeds of Innovation in Emerging Markets. *Research-Technology Management*, *54*(4), 24–29. https://doi.org/10.5437/08956308X5404009

Phau, I., & Chao, P. (2008). Country-of-origin: state of the art review for international marketing strategy and practice. *International Marketing Review*, *25*(4). https://doi.org/10.1108/imr.2008.03625daa.001

Piron, F. (2000). Consumers' perceptions of the country-of-origin effect on purchasing intentions of (in)conspicuous products. *Journal of Consumer Marketing*, *17*(4), 308–321. https://doi.org/10.1108/07363760010335330

Piryani, R., Gupta, V., Singh, V. K., & Ghose, U. (2017). A Linguistic Rule-Based Approach for Aspect-Level Sentiment Analysis of Movie Reviews. In S. Bhatia, K. Mishra, S. Tiwari, & V. Singh (Eds.), *Advances in Computer and Computational Sciences* (Vol. 553, pp. 201–209). Springer. https://doi.org/10.1007/978-981-10-3770-2_19

Pisoni, A., Michelini, L., & Martignoni, G. (2018). Frugal approach to innovation: State of the art and future perspectives. *J Clean Prod*, *171*. https://doi.org/10.1016/j.jclepro.2017.09.248

Plotnikoff, R. C., Lubans, D. R., Penfold, C. M., & Courneya, K. S. (2014). Testing the utility of three social-cognitive models for predicting objective and self-report physical activity in adults with type 2 diabetes. *British Journal of Health Psychology*, *19*(2), 329–346. https://doi.org/10.1111/bjhp.12085

Podoshen, J. (2009). Distressing events and future purchase decisions: Jewish consumers and the Holocaust. *Journal of Consumer Marketing*, *26*(4), 263–276. https://doi.org/10.1108/07363760910965864

Poh Chuin, T., & Mohamad, O. (2012). Young Malaysians' chocolate brand familiarity: the effect of brand's country of origin and consumer consumption level. *Business Strategy Series*, *13*(1), 13–20. https://doi.org/10.1108/17515631211194580

Pourrazavi, S., Allahverdipour, H., Jafarabadi, M. A., & Matlabi, H. (2014). A socio-cognitive inquiry of excessive mobile phone use. *Asian Journal of Psychiatry*, *10*, 84–89. https://doi.org/10.1016/j.ajp.2014.02.009

Prabhu, G. N., & Gupta, S. (2014). Heuristics of frugal service innovations. *IEEE*, 3309–3312.

Prabhu, J. (2017). Frugal innovation: doing more with less for more. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, *375*(2095). https://doi.org/10.1098/rsta.2016.0372

Prabowo, R., & Thelwall, M. (2009). Sentiment analysis: A combined approach. *Journal of Informetrics*, *3*(2), 143–157. https://doi.org/10.1016/j.joi.2009.01.003

Prahalad, C. K. (2006). *The Fortune at the Bottom of the Pyramid*. Pearson Education Inc.

Prahalad, C. K. (2012). Bottom of the Pyramid as a Source of Breakthrough Innovations. *Journal of Product Innovation Management*, *29*(1). https://doi.org/10.1111/j.1540-5885.2011.00874.x

Prahalad, C. K., & Mashelkar, R. A. (2010). *Innovation's Holy Grail*. Harvard Business Review.

Preisz, A. (2019). Fast and slow thinking; and the problem of conflating clinical reasoning and ethical deliberation in acute decision-making. *Journal of Paediatrics and Child Health*, *55*(6), 621–624. https://doi.org/10.1111/jpc.14447

Prime, M., Attaelmanan, I., Imbuldeniya, A., Harris, M., Darzi, A., & Bhatti, Y. (2018). From Malawi to Middlesex: the case of the Arbutus Drill Cover System as an example of the cost-saving potential of frugal innovations for the UK NHS. *BMJ Innovations*, *4*(2). https://doi.org/10.1136/bmjinnov-2017-000233

Profeta, A., Balling, R., & Roosen, J. (2012). The relevance of origin information at the point of sale. *Food Quality and Preference*, *26*(1), 1–11. https://doi.org/10.1016/j.foodqual.2012.03.001

Project Management Institute (PMI). (2013). *A Guide to the Project Management Body of Knowledge (PMBOK Guide)* (5th ed.). Project Management Institute.

Prussia, G. E., & Kinicki, A. J. (1996). A motivational investigation of group effectiveness using social-cognitive theory. *Journal of Applied Psychology*, *81*(2), 187–198. https://doi.org/10.1037/0021-9010.81.2.187

Radjou, N., & Prabhu, J. (2014). *What Frugal Innovators Do*. Harv Bus Rev.

Radjou, N., Prabhu, J., & Ahuja, S. (2012a). *Jugaad Innovation: Think Frugal, be Flexible, Generate Breakthrough Growth*. Wiley Publishing.

Radjou, N., Prabhu, J., & Ahuja, S. (2012b). The CEO's Frugal Innovation Agenda. *Harvard Business Review*.

Rah, J.-E., Manger, R. P., Yock, A. D., & Kim, G.-Y. (2016). A comparison of two prospective risk analysis methods: Traditional FMEA and a modified healthcare FMEA. *Medical Physics*, *43*(12), 6347–6353. https://doi.org/10.1118/1.4966129

Rahimi, N., & Jetter, A. (2015). Explaining health technology adoption: Past, present, future. *2015 Portland International Conference on Management of Engineering and Technology (PICMET)*, 2465–2495. https://doi.org/10.1109/PICMET.2015.7273030

Rahman, S., Majumder, A., Shaban, S., Rahman, N., Ahmed, S. M., Abdulrahman, K., & Dsouza. (2011). Physician participation in clinical research and trials: issues and approaches. *Advances in Medical Education and Practice*, 85. https://doi.org/10.2147/AMEP.S14103

Ranathunga, G. A. (2014). Post partum haemorrhage, severe acute maternal morbidity and the condom catheter uterine tamponade. *Sri Lanka Journal of Obstetrics and Gynaecology*, *35*(4). https://doi.org/10.4038/sljog.v35i4.6582

Rao, B. C. (2013). How disruptive is frugal? *Technology in Society*, *35*(1). https://doi.org/10.1016/j.techsoc.2013.03.003

Rao, B. C. (2014). Alleviating Poverty in the Twenty-First Century Through Frugal Innovations. *Challenge*, *57*(3). https://doi.org/10.2753/0577-5132570302

Rashid, M. S. (2017). Weakening the Effect of Unfavorable Country of Origin: A Process- and Parameter-Associated Theoretical Framework. *Journal of Global Marketing*, *30*(2), 87–98. https://doi.org/10.1080/08911762.2016.1226450

Ratten, V. (2011). Social Cognitive Theory in Mobile Banking Innovations. *International Journal of E-Business Research*, *7*(1), 39–51. https://doi.org/10.4018/jebr.2011010103

Ratten, V. (2015). International Consumer Attitudes Toward Cloud Computing: A Social Cognitive Theory and Technology Acceptance Model Perspective. *Thunderbird International Business Review*, *57*(3), 217–228. https://doi.org/10.1002/tie.21692

Ratten, V. (2019). *Frugal Innovation* (1st ed.). Routledge. https://doi.org/10.4324/9780429455803

Rawwas, M. Y. A., Rajendran, K. N., & Wuehrer, G. A. (1996). The influence of worldmindedness and nationalism on consumer evaluation of domestic and foreign products. *International Marketing Review*, *13*(2), 20–38. https://doi.org/10.1108/02651339610115746

Ray, P. K., & Ray, S. (2010). Resource-Constrained Innovation for Emerging Economies: The Case of the Indian Telecommunications Industry. *IEEE Transactions on Engineering Management*, *57*(1). https://doi.org/10.1109/TEM.2009.2033044

Reis, L. P., Fernandes, J. M., & Armellini, F. (2021). Leveraging a Process-Oriented Perspective on Frugal Innovation Through the Linkage of Lean Product Development (LPD) Practices and Waste. *International Journal of Innovation and Technology Management*, *18*(07). https://doi.org/10.1142/S0219877021300044

Renault, B. Y., Agumba, J. N., & Ansary, N. (2016). A Theoretical Review of Risk Identification: Perspective of Construction Industry. *5th Applied Research Conference in Africa (ARCA 2016)*, 773–782.

Resnik, D. B. (2005). Eliminating the daily life risks standard from the definition of minimal risk. *Journal of Medical Ethics*, *31*(1), 35–38. https://doi.org/10.1136/jme.2004.010470

Rezvani, S., Shenyari, G., Dehkordi, G., Salehi, M., Nahid, N., & Soleimani, S. (2012). Country of Origin: A Study over Perspective of Intrinsic and Extrinsic Cues on Consumers` Purchase Decision. *Business Management Dynamics*, *1*(11), 68–75. https://www.bmdynamics.com/issue_pdf/bmd110225-68-75.pdf

Richman, B., Udayakumar, K., Mitchell, W., & Schulman, A. (2008). Lessons from India in Organizational Innovation: A Tale of Two Heart Hospitals. *Health Affairs*, *27*(5), 1260–1270.

Riefler, P., & Diamantopoulos, A. (2007). Consumer animosity: a literature review and a reconsideration of its measurement. *International Marketing Review*, *24*(1), 87–119. https://doi.org/10.1108/02651330710727204

Roberts, R., Perry, N., Phillips, A., Richardson, D., & Soni, S. (2015). Clinical research should be a priority in the NHS – but what do genito-urinary medicine clinic staff think? *International Journal of STD & AIDS*, *26*(2), 107–112. https://doi.org/10.1177/0956462414531241

Robson, C. (2002). *Real World Research: A Resource for Social Scientists and Practitioner-Researchers* (2nd ed.). Blackwell Publishers Ltd.

Rogers, E. (2003). *Diffusion of Innovations* (5th ed.). Free Press.

Rogers, E. (2010). *Diffusion of Innovations* (4th ed.). Simon and Schuster.

Rosca, E., Arnold, M., & Bendul, J. C. (2017). Business models for sustainable innovation – an empirical analysis of frugal products and services. *J Clean Prod*, *162*. https://doi.org/10.1016/j.jclepro.2016.02.050

Roth, K. P., & Diamantopoulos, A. (2009). Advancing the country image construct. *Journal of Business Research*, *62*(7), 726–740. https://doi.org/10.1016/j.jbusres.2008.05.014

Royer, P. (2000). Risk Management: The Undiscovered Dimension of Project Management. *Project Management Journal*, *31*(1), 6–13. https://doi.org/10.1177/875697280003100103

Rudell, F. (2006). Shopping With a Social Conscience: Consumer Attitudes Toward Sweatshop Labor. *Clothing and Textiles Research Journal*, *24*(4). https://doi.org/10.1177/0887302X06293063

Russell, S. V., Young, C. W., Unsworth, K. L., & Robinson, C. (2017). Bringing habits and emotions into food waste behaviour. *Resources, Conservation and Recycling*, *125*, 107–114. https://doi.org/10.1016/j.resconrec.2017.06.007

Ryan, R. (2019). *The Oxford Handbook of Human Motivation* (2nd ed.). Oxford University Press.

Sackey, S., & Kim, B.-S. (2019). Schedule Risk Analysis using a Proposed Modified Variance and Mean of the Original Program Evaluation and Review Technique Model. *KSCE Journal of Civil Engineering*, *23*(4), 1484–1492. https://doi.org/10.1007/s12205-019-1826-z

Sacks, H. (1992). *Lectures on conversation* (G. Jefferson, Ed.; Vol. 2). Blackwell.

Sacks, H., Schegloff, E. A., & Jefferson, G. (1974). A Simplest Systematics for the Organization of Turn-Taking for Conversation. *Language*, *50*(4), 696. https://doi.org/10.2307/412243

Samiee, S. (2011). Resolving the impasse regarding research on the origins of products and brands. *International Marketing Review*, *28*(5), 473–485. https://doi.org/10.1108/02651331111167598

Samiee, S., Shimp, T. A., & Sharma, S. (2005). Brand origin recognition accuracy: its antecedents and consumers' cognitive limitations. *Journal of International Business Studies*, *36*(4), 379–397. https://doi.org/10.1057/palgrave.jibs.8400145

Sandelowski, M. (1996). One is the liveliest number: The case orientation of qualitative research. *Research in Nursing & Health*, *19*(6), 525–529. https://doi.org/10.1002/(SICI)1098-240X(199612)19:6<525::AID-NUR8>3.0.CO;2-Q

Sarkar, S., & Mateus, S. (2022). Value creation using minimal resources – A meta-synthesis of frugal innovation. *Technological Forecasting and Social Change*, *179*, 121612. https://doi.org/10.1016/j.techfore.2022.121612

Sarver, V. (1983). Ajzen and Fishbein's "Theory of Reasoned Action": A Critical Assessment. *Journal for the Theory of Social Behaviour*, *13*(2), 155–164. https://doi.org/10.1111/j.1468-5914.1983.tb00469.x

Say, L., Chou, D., Gemmill, A., Tunçalp, Ö., Moller, A.-B., Daniels, J., Gülmezoglu, A. M., Temmerman, M., & Alkema, L. (2014). Global causes of maternal death: a WHO systematic analysis. *The Lancet Global Health*, *2*(6). https://doi.org/10.1016/S2214-109X(14)70227-X

Scarbrough, H., & Kyratsis, Y. (2022). From spreading to embedding innovation in health care: Implications for theory and practice. *Health Care Management Review*, *47*(3), 236–244. https://doi.org/10.1097/HMR.0000000000000323

Schaefer, A. (1997). Do demographics have an impact on country of origin effects? *Journal of Marketing Management*, *13*(8), 813–834. https://doi.org/10.1080/0267257X.1997.9964513

Schooler, R. D. (1965). Product Bias in the Central American Common Market. *Journal of Marketing Research*, *2*(4), 394. https://doi.org/10.2307/3149486

Schunk, D. H. (1989). Social Cognitive Theory and Self-Regulated Learning. In *Springer Series in Cognitive Development* (pp. 83–110). https://doi.org/10.1007/978-1-4612-3618-4_4

Schwandt, T. (2001). *Dictionary of qualitative inquiry*. Sage Publications.

Sekhon, M., Cartwright, M., & Francis, J. J. (2017). Acceptability of healthcare interventions: an overview of reviews and development of a theoretical framework. *BMC Health Services Research*, *17*(1), 88. https://doi.org/10.1186/s12913-017-2031-8

Serrano-Gomez, L., & Munoz-Hernandez, J. I. (2019). Monte Carlo approach to fuzzy AHP risk analysis in renewable energy construction projects. *PLOS ONE*, *14*(6), e0215943. https://doi.org/10.1371/journal.pone.0215943

Shahid, M. S., Hossain, M., Shahid, S., & Anwar, T. (2023). Frugal innovation as a source of sustainable entrepreneurship to tackle social and environmental challenges. *Journal of Cleaner Production*, *406*, 137050. https://doi.org/10.1016/j.jclepro.2023.137050

Shapiro, J. (2010). The NHS: the story so far (1948–2010). *Clinical Medicine*, *10*(4), 336–338. https://doi.org/10.7861/clinmedicine.10-4-336

Sharma, A., & Iyer, G. R. (2012). Resource-constrained product development: Implications for green marketing and green supply chains. *Industrial Marketing Management*, *41*(4). https://doi.org/10.1016/j.indmarman.2012.04.007

Sharma, D., & Cotton, M. (2021). Reverse innovation in health: Good but not good enough to be standard of care? *Tropical Doctor*, *51*(2). https://doi.org/10.1177/0049475521994353

Sharma, D., Harris, M., Agrawal, V., & Agarwal, P. (2021). Plea for standardised reporting of frugal innovations. *BMJ Innovations*, *7*(4), 642–646. https://doi.org/10.1136/bmjinnov-2021-000710

Sharma, S., Shimp, T. A., & Shin, J. (1994). Consumer Ethnocentrism: A Test of Antecedents and Moderators. *Journal of the Academy of Marketing Science*, *23*(1), 26–37. https://doi.org/10.1177/0092070395231004

Shayo, E. H., Norheim, O. F., Mboera, L. E. G., Byskov, J., Maluka, S., Kamuzora, P., & Blystad, A. (2012). Challenges to fair decision-making processes in the context of health care services: a qualitative assessment from Tanzania. *International Journal for Equity in Health*, *11*(1), 30. https://doi.org/10.1186/1475-9276-11-30

Sheard, L., Marsh, C., O'Hara, J., Armitage, G., Wright, J., & Lawton, R. (2017). The Patient Feedback Response Framework – Understanding why UK hospital staff find it difficult to make improvements based on patient feedback: A qualitative study. *Social Science & Medicine*, *178*, 19–27. https://doi.org/10.1016/j.socscimed.2017.02.005

Shimp, T. A., & Sharma, S. (1987). Consumer Ethnocentrism: Construction and Validation of the CETSCALE. *Journal of Marketing Research*, *24*(3), 280–289. https://doi.org/10.1177/002224378702400304

Shirsat, V. S., Jagdale, R. S., & Deshmukh, S. N. (2019). Sentence Level Sentiment Identification and Calculation from News Articles Using Machine Learning Techniques. In *Computing, Communication and Signal Processing* (pp. 371–376). Springer. https://doi.org/10.1007/978-981-13-1513-8_39

Shiv, B., & Fedorikhin, A. (1999). Heart and Mind in Conflict: the Interplay of Affect and Cognition in Consumer Decision Making. *Journal of Consumer Research*, *26*(3), 278–292. https://doi.org/10.1086/209563

Shoham, A., Davidow, M., Klein, J., & Ruvio, A. (2006). Animosity on the Home Front: The Intifada in Israel and Its Impact on Consumer Behavior. *Journal of International Marketing*, *14*(3), 92–114.

Shoham, A., Gavish, Y., & Rose, G. M. (2016). Consequences of Consumer Animosity: A Meta-Analytic Integration. *Journal of International Consumer Marketing*, *28*(3), 185–200. https://doi.org/10.1080/08961530.2015.1116040

Shugan, S. M. (1980). The Cost of Thinking. *Journal of Consumer Research*, *7*(2), 99. https://doi.org/10.1086/208799

Simons, J., & Carey, K. B. (1998). A Structural Analysis of Attitudes toward Alcohol and Marijuana Use. *Personality and Social Psychology Bulletin*, *24*(7), 727–735. https://doi.org/10.1177/0146167298247005

Simula, H., Hossain, M., & Halme, M. (2015). Frugal and Reverse Innovations Quo Vadis? *SSRN*. https://doi.org/10.2139/ssrn.2678861

Singh, M., Jakhar, A. K., & Pandey, S. (2021). Sentiment analysis on the impact of coronavirus in social life using the BERT model. *Social Network Analysis and Mining*, *11*(1), 33. https://doi.org/10.1007/s13278-021-00737-z

Singh, V. K., Piryani, R., Uddin, A., & Waila, P. (2013). Sentiment analysis of movie reviews: A new feature-based heuristic for aspect-level sentiment classification. *2013 International Mutli-Conference on Automation, Computing, Communication, Control and Compressed Sensing (IMac4s)*, 712–717. https://doi.org/10.1109/iMac4s.2013.6526500

Singh, V., Singh, G., Rastogi, P., & Deswal, D. (2018). Sentiment Analysis Using Lexicon Based Approach. *2018 Fifth International Conference on Parallel, Distributed and Grid Computing (PDGC)*, 13–18. https://doi.org/10.1109/PDGC.2018.8745971

Skolbekken, J. A. (1998). Communicating the risk reduction achieved by cholesterol reducing drugs. *BMJ*, *316*(7149), 1956–1958. https://doi.org/10.1136/bmj.316.7149.1956

Skopec, M., Grillo, A., Kureshi, A., Bhatti, Y., & Harris, M. (2021). Double standards in healthcare innovations: the case of mosquito net mesh for hernia repair. *BMJ Innovations*, *7*(2). https://doi.org/10.1136/bmjinnov-2020-000535

Skopec, M., Harris, M., & Issa, H. (2022, June). *Innovation in the NHS Through Bi-Directional Learning*. Tropical Health and Education Trust. https://www.thet.org/wp-content/uploads/2022/08/Innovation-in-the-NHS-Imperial-THET-for-HEE-July-22-v3-01.08.22-1.pdf

Skopec, M., Issa, H., & Harris, M. (2019). Delivering cost effective healthcare through reverse innovation. *BMJ*. https://doi.org/10.1136/bmj.l6205

Smith-McLallen, A., & Fishbein, M. (2008). Predictors of intentions to perform six cancer-related behaviours: Roles for injunctive and descriptive norms. *Psychology, Health & Medicine*, *13*(4), 389–401. https://doi.org/10.1080/13548500701842933

Snowdon, A. W., Bassi, H., Scarffe, A. D., & Smith, A. D. (2015). Reverse innovation: an opportunity for strengthening health systems. *Globalization and Health*, *11*(1). https://doi.org/10.1186/s12992-015-0088-x

Soni, P., & Krishnan, R. T. (2014). Frugal innovation: aligning theory, practice, and public policy. *Journal of Indian Business Research*, *6*(1). https://doi.org/10.1108/JIBR-03-2013-0025

Šotić, A., & Rajić, R. (2015). The Review of the Definition of Risk. *Online Journal of Applied Knowledge Management*, *3*(3), 17–26.

Sripa, P., Hayhoe, B., Garg, P., Majeed, A., & Greenfield, G. (2019). Impact of GP gatekeeping on quality of care, and health outcomes, use, and expenditure: a systematic review. *British Journal of General Practice*, *69*(682), e294–e303. https://doi.org/10.3399/bjgp19X702209

Stein, J. C. (1995). Prices and Trading Volume in the Housing Market: A Model with Down-Payment Effects. *The Quarterly Journal of Economics*, *110*(2), 379–406. https://doi.org/10.2307/2118444

Stephenson, B. M., & Kingsnorth, A. N. (2011). Inguinal hernioplasty using mosquito net mesh in low income countries: an alternative and cost effective prosthesis. *BMJ*, *343*(dec15 1). https://doi.org/10.1136/bmj.d7448

Sumner, L. (1996). *Welfare, Happiness, and Ethics*. Oxford University Press.

Swift, J. S. (1999). Cultural closeness as a facet of cultural affinity. *International Marketing Review*, *16*(3), 182–201. https://doi.org/10.1108/02651339910274684

Taboada, M. (2016). Sentiment Analysis: An Overview from Linguistics. *Annual Review of Linguistics*, *2*(1), 325–347. https://doi.org/10.1146/annurev-linguistics-011415-040518

Taboada, M., Brooke, J., Tofiloski, M., Voll, K., & Stede, M. (2011). Lexicon-Based Methods for Sentiment Analysis. *Computational Linguistics*, *37*(2), 267–307. https://doi.org/10.1162/COLI_a_00049

Taherdoost, H. (2018). A review of technology acceptance and adoption models and theories. *Procedia Manufacturing*, *22*, 960–967. https://doi.org/10.1016/j.promfg.2018.03.137

Taherdoost, H., & Masrom, M. (2009). An examination of smart card technology acceptance using adoption model. *Proceedings of the ITI 2009 31st International Conference on Information Technology Interfaces*, 329–334. https://doi.org/10.1109/ITI.2009.5196103

Tai, K., Socher, R., & Manning, C. (2015). Improved Semantic Representations From Tree-Structured Long Short-Term Memory Networks. *ArXiv*.

Tang, W., Qiang, M., Duffield, C. F., Young, D. M., & Lu, Y. (2007). Risk Management in the Chinese Construction Industry. *Journal of Construction Engineering and Management*, *133*(12), 944–956. https://doi.org/10.1061/(ASCE)0733-9364(2007)133:12(944)

Taylor, A., Escobar, E., & Udayakumar, K. (2017). *Expanding Access to Low-Cost, High-Quality Tertiary Care*. The Commonwealth Fund. https://www.commonwealthfund.org/publications/case-study/2017/nov/expanding-access-low-cost-high-quality-tertiary-care#4

Tchankova, L. (2002). Risk identification – basic stage in risk management. *Environmental Management and Health*, *13*(3), 290–297. https://doi.org/10.1108/09566160210431088

Teuber, R. (2010). Geographical Indications of Origin as a Tool of Product Differentiation: The Case of Coffee. *Journal of International Food & Agribusiness Marketing*, *22*(3–4), 277–298. https://doi.org/10.1080/08974431003641612

Thakor, M. V., & Lavack, A. M. (2003). Effect of perceived brand origin associations on consumer perceptions of quality. *Journal of Product & Brand Management*, *12*(6), 394–407. https://doi.org/10.1108/10610420310498821

The Economist. (2010, June). *In praise of techno-austerity*. https://www.economist.com/leaders/2010/06/10/in-praise-of-techno-austerity

Tinkler, L., Smith, V., Yiannakou, Y., & Robinson, L. (2018). Professional identity and the Clinical Research Nurse: A qualitative study exploring issues having an impact on participant recruitment in research. *Journal of Advanced Nursing*, *74*(2), 318–328. https://doi.org/10.1111/jan.13409

Tiwari, R., Fischer, L., & Kalogerakis, K. (2016). Frugal Innovation in Scholarly and Social Discourse: An Assessment of Trends and Potential Societal Implications. *Joint Working Paper of Fraunhofer MOEZ Leipzig and Hamburg University of Technology in the BMBF-ITA Project*, 2–28.

Tiwari, R., Fischer, L., & Kalogerakis, K. (2017). Frugal innovation in Germany: A qualitative analysis of potential socio-economic impacts. *S, Working Paper, No. 96, Hamburg University of Technology (TUHH), Institute for Technology and Innovation Management (TIM)*, 2–24.

Tiwari, R., & Herstatt, C. (2013). “Too good” to succeed? Why not just try “good enough”! Some deliberations on the prospects of frugal innovations. *Working Paper, No. 76, Hamburg University of Technology (TUHH), Institute for Technology and Innovation Management (TIM)*.

Tong, R. (2001). An Operational System for Detecting and Tracking Opinions in On-Line Discussion. *Proceedings of SIGIR Workshop on Operational Text Classification*.

Tongaonkar, R., Reddy, B., Mehta, V., Singh, N., & Shivade, S. (2003). Preliminary Multicentric Trial of Cheap Indigenous Mosquito-Net Cloth for Tension-free Hernia Repair. *Indian Journal of Surgery*, *65*(1), 89–95. https://tspace.library.utoronto.ca/handle/1807/24057

Tornatzky, L. G., & Klein, K. J. (1982). Innovation characteristics and innovation adoption-implementation: A meta-analysis of findings. *IEEE Transactions on Engineering Management*, *EM-29*(1), 28–45. https://doi.org/10.1109/TEM.1982.6447463

Traugott, E. (2010). (Inter) subjectivity and (inter) subjectification: A reassessment. In K. Davidse, L. Vandelanotte, & H. Cuyckens (Eds.), *Subjectification, Intersubjectification and Grammaticalization* (pp. 29–61). Walter de Gruyter.

Traugott, E. C. (1995). Subjectification in grammaticalisation. In *Subjectivity and Subjectivisation* (pp. 31–54). Cambridge University Press. https://doi.org/10.1017/CBO9780511554469.003

Triandis, H. (1977). *Interpersonal Behaviour*. Brook/Cole.

Triandis, H. (1979). Values, Attitudes, and Interpersonal Behavior. In H. Howe Jr (Ed.), *Nebraska Symposium on Motivation* (Vol. 27, pp. 195–259). University of Nebraska Press.

Triandis, H. (1982). Review of Culture’s Consequences: International Differences in Work-Related Values. *Human Organization*, *41*(1), 86–90.

Triandis, H. C. (1977). *Interpersonal Behavior*. Brooks/Cole Publishing Company.

Tse, D. K., & Gorn, G. J. (1993). An Experiment on the Salience of Country-of-Origin in the Era of Global Brands. *Journal of International Marketing*, *1*(1), 57–76. https://www.jstor.org/stable/25048484

Tsytsarau, M., & Palpanas, T. (2012). Survey on mining subjective data on the web. *Data Mining and Knowledge Discovery*, *24*(3), 478–514. https://doi.org/10.1007/s10618-011-0238-6

Turney, P. D., & Littman, M. L. (2003). Measuring praise and criticism. *ACM Transactions on Information Systems*, *21*(4), 315–346. https://doi.org/10.1145/944012.944013

UK Parliament. (2019, April). *Government underestimates challenge of delivering NHS plan*. UK Parliament. https://committees.parliament.uk/committee/127/public-accounts-committee/news/98555/government-underestimates-challenge-of-delivering-nhs-plan/

United Nations. (2016). *Sustainable Development Knowledge Platform*. https://sdgs.un.org/goals

U.S. Department of Health and Human Services. (2018). *Theory at a Glance: A Guide for Health Promotion Practice* (2nd ed.). https://cancercontrol.cancer.gov/sites/default/files/2020-06/theory.pdf

van Asselt, M. B. A. (2000). Perspectives on uncertainty and risk. In *Perspectives on Uncertainty and Risk* (pp. 407–417). Springer Netherlands. https://doi.org/10.1007/978-94-017-2583-5_10

van den Bogaart, E. H. A., Spreeuwenberg, M. D., Kroese, M. E. A. L., van den Boogaart, M. W., Boymans, T. A. E. J., & Ruwaard, D. (2020). Referral decisions and its predictors related to orthopaedic care. A retrospective study in a novel primary care setting. *PLOS ONE*, *15*(1). https://doi.org/10.1371/journal.pone.0227863

Van Loo, E. J., Grebitus, C., & Roosen, J. (2019). Explaining attention and choice for origin labeled cheese by means of consumer ethnocentrism. *Food Quality and Preference*, *78*, 103716. https://doi.org/10.1016/j.foodqual.2019.05.016

Vashishtha, S., & Susan, S. (2019). Fuzzy rule based unsupervised sentiment analysis from social media posts. *Expert Systems with Applications*, *138*, 112834. https://doi.org/10.1016/j.eswa.2019.112834

Verlegh, P. W. J., & Steenkamp, J.-B. E. M. (1999). A review and meta-analysis of country-of-origin research. *Journal of Economic Psychology*, *20*(5), 521–546. https://doi.org/10.1016/S0167-4870(99)00023-9

Verlegh, P. W. J., & van Ittersum, K. (2001). The Origin of the Spices: The Impact of Geographic Product Origin on Consumer Decision Making. In *Food, People and Society* (pp. 267–279). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-662-04601-2_17

Viaene, J., & Januszewska, R. (1999). Quality function deployment in the chocolate industry. *Food Quality and Preference*, *10*(4–5), 377–385. https://doi.org/10.1016/S0950-3293(99)00007-5

Vida, I., & Reardon, J. (2008). Domestic consumption: rational, affective or normative choice? *Journal of Consumer Marketing*, *25*(1), 34–44. https://doi.org/10.1108/07363760810845390

Vigo, D., Thornicroft, G., & Gureje, O. (2020). The Differential Outcomes of Coronavirus Disease 2019 in Low- and Middle-Income Countries vs High-Income Countries. *JAMA Psychiatry*, *77*(12), 1207. https://doi.org/10.1001/jamapsychiatry.2020.2174

von Zedtwitz, M., Corsi, S., Søberg, P. V., & Frega, R. (2015). A Typology of Reverse Innovation. *Journal of Product Innovation Management*, *32*(1). https://doi.org/10.1111/jpim.12181

Walker, P. G. T., Whittaker, C., Watson, O. J., Baguelin, M., Winskill, P., Hamlet, A., Djafaara, B. A., Cucunubá, Z., Olivera Mesa, D., Green, W., Thompson, H., Nayagam, S., Ainslie, K. E. C., Bhatia, S., Bhatt, S., Boonyasiri, A., Boyd, O., Brazeau, N. F., Cattarino, L., … Ghani, A. C. (2020). The impact of COVID-19 and strategies for mitigation and suppression in low- and middle-income countries. *Science*, *369*(6502), 413–422. https://doi.org/10.1126/science.abc0035

Wall, M., & Heslop, L. A. (1986). Consumer attitudes toward Canadian-made versus imported products. *Journal of the Academy of Marketing Science*, *14*(2), 27–36. https://doi.org/10.1007/BF02722154

Wall, M., Liefeld, J., & Heslop, L. A. (1991). Impact of country-of-origin cues on consumer judgments in multi-cue situations: a covariance analysis. *Journal of the Academy of Marketing Science*, *19*, 105–113. https://doi.org/10.1007/BF02726002

Wang, G., Sun, J., Ma, J., Xu, K., & Gu, J. (2014). Sentiment classification: The contribution of ensemble learning. *Decision Support Systems*, *57*, 77–93. https://doi.org/10.1016/j.dss.2013.08.002

Wang, S. Q., Dulaimi, M. F., & Aguria, M. Y. (2004). Risk management framework for construction projects in developing countries. *Construction Management and Economics*, *22*(3), 237–252. https://doi.org/10.1080/0144619032000124689

Wankhade, M., Rao, A. C. S., & Kulkarni, C. (2022). A survey on sentiment analysis methods, applications, and challenges. *Artificial Intelligence Review*, *55*(7), 5731–5780. https://doi.org/10.1007/s10462-022-10144-1

Watson, J. J., & Wright, K. (2000). Consumer ethnocentrism and attitudes toward domestic and foreign products. *European Journal of Marketing*, *34*(9/10), 1149–1166. https://doi.org/10.1108/03090560010342520

Weber, K., Inglis, M., & Mejia-Ramos, J. P. (2014). How Mathematicians Obtain Conviction: Implications for Mathematics Instruction and Research on Epistemic Cognition. *Educational Psychologist*, *49*(1), 36–58. https://doi.org/10.1080/00461520.2013.865527

Weber, M. (1964). *The theory of social and economic organizations* (T. Parsons, Ed.). The Free Press.

Wellen, L., & van Dijk, M. P. (2018). Frugal financial innovations for inclusive finance: the experience with customer care at M-Pesa in Kenya. *Enterprise Development and Microfinance*, *29*(3–4), 262–275. https://doi.org/10.3362/1755-1986.00016

Weyrauch, T., & Herstatt, C. (2017). What is frugal innovation? Three defining criteria. *Journal of Frugal Innovation*, *2*(1). https://doi.org/10.1186/s40669-016-0005-y

Whitaker, B. G., & Godwin, L. N. (2013). The Antecedents of Moral Imagination in the Workplace: A Social Cognitive Theory Perspective. *Journal of Business Ethics*, *114*(1), 61–73. https://doi.org/10.1007/s10551-012-1327-1

Wikgren, M. (2005). Critical realism as a philosophy and social theory in information science? *Journal of Documentation*, *61*(1), 11–22. https://doi.org/10.1108/00220410510577989

Williams, C., & van Triest, S. (2009). The impact of corporate and national cultures on decentralization in multinational corporations. *International Business Review*, *18*(2). https://doi.org/10.1016/j.ibusrev.2009.01.003

Willig, C. (2013). *Introducing qualitative research in psychology* (3rd ed.). Open University Press.

Wilson, T., Wiebe, J., & Hoffmann, P. (2009). Recognizing Contextual Polarity: An Exploration of Features for Phrase-Level Sentiment Analysis. *Computational Linguistics*, *35*(3), 399–433. https://doi.org/10.1162/coli.08-012-R1-06-90

Win, K. T., Phung, H., Young, L., Tran, M., Alcock, C., & Hillman, K. (2004). Electronic Health Record System Risk Assessment: A Case Study from the MINET. *Health Information Management*, *33*(2), 43–48. https://doi.org/10.1177/183335830403300205

Winch, G. (2003). Models of manufacturing and the construction process: the genesis of re-engineering construction. *Building Research & Information*, *31*(2), 107–118. https://doi.org/10.1080/09613210301995

Winch, G. (2010). *Managing Construction Projects* (2nd ed.). Wiley-Blackwell.

Winit, W., Gregory, G., Cleveland, M., & Verlegh, P. (2014). Global vs local brands: how home country bias and price differences impact brand evaluations. *International Marketing Review*, *31*(2), 102–128. https://doi.org/10.1108/IMR-01-2012-0001

Winkler, T., Ulz, A., Knöbl, W., & Lercher, H. (2020). Frugal innovation in developed markets – Adaption of a criteria-based evaluation model. *Journal of Innovation & Knowledge*, *5*(4). https://doi.org/10.1016/j.jik.2019.11.004

Winter, A., & Govindarajan, V. (2015). *Engineering Reverse Innovations*. Harvard Business Review. https://hbr.org/2015/07/engineering-reverse-innovations

Wong, N. (2019). *Injunctive and Descriptive Norms and Theory of Planned Behavior: Influencing Intentions to Use Sunscreen*. Women's Health and Complications.

Woo Jun, J., & Won Choi, C. (2007). Effects of country of origin and country brand attitude on nonprescription drugs. *Journal of Targeting, Measurement and Analysis for Marketing*, *15*(4), 234–243. https://doi.org/10.1057/palgrave.jt.5750050

Wood, R., & Bandura, A. (1989). Social Cognitive Theory of Organizational Management. *Academy of Management Review*, *14*(3), 361–384. https://doi.org/10.5465/amr.1989.4279067

Wooldridge, A. (2010). *First break all the rules: the charms of frugal innovation.* 3–5.

World Health Organization. (2012). *WHO recommendations for prevention and treatment of postpartum haemorrhage*. https://www.who.int/reproductivehealth/publications/maternal_perinatal_health/9789241548502/en/

World Health Organization. (2021, February 8). *Musculoskeletal conditions*.

Wu, D., Gu, H., Gu, S., & You, H. (2021). Individual motivation and social influence: a study of telemedicine adoption in China based on social cognitive theory. *Health Policy and Technology*, *10*(3), 100525. https://doi.org/10.1016/j.hlpt.2021.100525

Xia, R., Xu, F., Zong, C., Li, Q., Qi, Y., & Li, T. (2015). Dual Sentiment Analysis: Considering Two Sides of One Review. *IEEE Transactions on Knowledge and Data Engineering*, *27*(8), 2120–2133. https://doi.org/10.1109/TKDE.2015.2407371

Xin, L., & Seo, S. (Sunny). (2019). The role of consumer ethnocentrism, country image, and subjective knowledge in predicting intention to purchase imported functional foods. *British Food Journal*, *122*(2), 448–464. https://doi.org/10.1108/BFJ-05-2019-0326

Ye, Q., Zhang, Z., & Law, R. (2009). Sentiment classification of online reviews to travel destinations by supervised machine learning approaches. *Expert Systems with Applications*, *36*(3), 6527–6535. https://doi.org/10.1016/j.eswa.2008.07.035

Yessenalina, A., Yue, Y., & Cardie, C. (2010). Multi-level Structured Models for Document-level Sentiment Classification. *Proceedings of the 2010 Conference on Empirical Methods in Natural Language Processing*, 1046–1056.

Yoon, E., & Tello, S. (2009). Drivers of Sustainable Innovation: Exploratory Views and Corporate Strategies. *Seoul Journal of Business*, *15*(2). https://doi.org/10.35152/snusjb.2009.15.2.004

Yucel, G., Cebi, S., Hoege, B., & Ozok, A. F. (2012). A fuzzy risk assessment model for hospital information system implementation. *Expert Systems with Applications*, *39*(1), 1211–1218. https://doi.org/10.1016/j.eswa.2011.07.129

Zadeh, L. A. (1978). Fuzzy sets as a basis for a theory of possibility. *Fuzzy Sets and Systems*, *1*(1), 3–28. https://doi.org/10.1016/0165-0114(78)90029-5

Zahoor, S., & Rohilla, R. (2020). Twitter Sentiment Analysis Using Lexical or Rule Based Approach: A Case Study. *2020 8th International Conference on Reliability, Infocom Technologies and Optimization (Trends and Future Directions) (ICRITO)*, 537–542. https://doi.org/10.1109/ICRITO48877.2020.9197910

Zajonc, R., & Markus, H. (1982). Affective and Cognitive Factors in Preferences. *Journal of Consumer Research*, *9*(6), 123–131. http://www.jstor.org/stable/2489121

Zeithaml, V. A. (1988). Consumer Perceptions of Price, Quality, and Value: A Means-End Model and Synthesis of Evidence. *Journal of Marketing*, *52*(3), 2. https://doi.org/10.2307/1251446

Zeng, J., An, M., & Smith, N. J. (2007). Application of a fuzzy based decision making methodology to construction project risk assessment. *International Journal of Project Management*, *25*(6), 589–600. https://doi.org/10.1016/j.ijproman.2007.02.006

Zeschky, M. B., Winterhalter, S., & Gassmann, O. (2014). From Cost to Frugal and Reverse Innovation: Mapping the Field and Implications for Global Competitiveness. *Research-Technology Management*, *57*(4), 20–27.

Zeschky, M., Widenmayer, B., & Gassmann, O. (2011). Frugal Innovation in Emerging Markets. *Research-Technology Management*, *54*(4). https://doi.org/10.5437/08956308X5404007

Zhang, X., Yu, P., Yan, J., & Ton A M Spil, I. (2015). Using diffusion of innovation theory to understand the factors impacting patient acceptance and use of consumer e-health innovations: a case study in a primary care clinic. *BMC Health Services Research*, *15*(1), 71. https://doi.org/10.1186/s12913-015-0726-2

Zhang, Y., Meng, J. E., Venkatesan, R., Wang, N., & Pratama, M. (2016). Sentiment classification using Comprehensive Attention Recurrent models. *2016 International Joint Conference on Neural Networks (IJCNN)*, 1562–1569. https://doi.org/10.1109/IJCNN.2016.7727384

Zhao, F., Wang, B., & Chen, J. (2021). Comparison between robotic and laparoscopic inguinal hernia repair in Caucasian patients: a systematic review and meta-analysis. *Annals of Translational Medicine*, *9*(10). https://doi.org/10.21037/atm-21-2126

Zhou, J., & Fan, T. (2019). Understanding the Factors Influencing Patient E-Health Literacy in Online Health Communities (OHCs): A Social Cognitive Theory Perspective. *International Journal of Environmental Research and Public Health*, *16*(14), 2455. https://doi.org/10.3390/ijerph16142455

Zou, P. X. W., Zhang, G., & Wang, J. (2007). Understanding the key risks in construction projects in China. *International Journal of Project Management*, *25*(6), 601–614. https://doi.org/10.1016/j.ijproman.2007.03.001

Appendices

Appendix 1: Critical Review

Review

OPEN ACCESS

Defining frugal innovation: a critical review

Chandni N Hindocha,[1] Grazia Antonacci,[1] James Barlow,[2] Matthew Harris [1]

[1]Department of Primary Care and Public Health, Imperial College London, London, UK
[2]Business School, Imperial College London, London, UK

Correspondence to
Dr Matthew Harris, Department of Primary Care and Public Health, Imperial College London, London W6 8RP, UK; m.harris@imperial.ac.uk

Received 18 August 2021
Accepted 27 September 2021
Published Online First
5 October 2021

Check for updates

© Author(s) (or their employer(s)) 2021. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

To cite: Hindocha CN, Antonacci G, Barlow J, *et al*. *BMJ Innov* 2021;**7**:647–656.

ABSTRACT

Frugal innovation (FI), which has gained traction in various sectors, is loosely defined as developing quality solutions in a resource-constrained environment that are affordable to low-income consumers. However, with its popularity, multiple and diverse definitions have emerged that often lack a theoretical foundation. This has led to a convoluted conceptualisation that hinders research and adoption in practice. Despite this plethora of perspectives and definitions, scholars do agree that there is a need for a unified definition. This critical review across the management, entrepreneurship, business and organisation studies literatures explores the multiple definitions of FI that have appeared in the last two decades and seeks to examine the commonalities and differences. One definition is supported by a theoretical underpinning, and main themes include affordability, adaptability, resource scarcity, accessibility and sustainability, however, there remains significant ambiguity around what constitutes an FI. Defining FI as a concept should not deter from focusing on its core aim and identifying an FI may be best achieved by comparing it to an incumbent alternative, rather than against an ill-defined concept. There is merit in developing a common understanding of FI to support strategies for its successful acceptance and diffusion globally.

Summary box

What is already known?
- Frugal innovation (FI) is ill defined and is synonymous with numerous innovation types such as jugaad, bricolage, disruptive, cost and grass roots innovation.
- The premise of FI is essentially to develop quality and affordable solutions in resource-constrained environments for low-income consumers.
- Since its introduction and with its growing popularity, a plethora of definitions and descriptions have been developed often supported by conceptual and case studies thus lacking a theoretical underpinning.

What are the new findings?
- Various definitions share many overlapping characteristics such as affordability, functionality, resource-scarcity, accessibility and sustainability.
- Conceptualising FI should not deter from focusing on its core aim. Identifying an FI may be best achieved by comparing it to an incumbent alternative, rather than against an ill-defined concept.
- A common understanding of FI will add significant value to research and practice.

INTRODUCTION

Since its introduction in The Economist (2010), frugal innovation (FI) has gained traction in various sectors such as healthcare, manufacturing, food, automotive, energy and academia across the world.[1–4] But with its popularity, multiple definitions have also developed, depicted mostly through case studies and lacking in a grounded conceptual basis or a theoretical foundation.[3 5–8] FI is not a new strategy but is a flexible approach to thinking about repurposing and sustainable resourcing.[9] Coupled with reduced government spending, reducing incomes and limited budgets, it has recently also caught the attention of developed markets.[10 11] Protagonists view it as an entrepreneurial mindset, having the ability to develop innovative solutions using limited resources for underserved consumers typically in low-income to middle-income countries (LMICs). In this perspective, FI can create new markets and contribute towards a more sustainable and inclusive world by supporting a more circular economy. In contrast, others may view FI as a cheaper and ineffective solution to a temporary problem as aspirations for 'bigger and better' are ever-growing.[12] In this review, we explore

FI definitions across the business, management, entrepreneurship and organisation behaviour literatures, we compare and contrast the many perspectives of FI, provide a synthesis of its core features and make suggestions for policy and practice.

DEFINING FI

The increasing interest in FI has led to a wide array of criteria[11 13–15] and conceptualisations.[4 12 16 17] It is often defined by its similarities and differences with other types of innovation,[18–20] through case study research in different markets[10 21] and its relationship with sustainability and other core principles such as cost and adaptability,[4 22 23] (see table 1). There is consensus about the lack of transparency and clarity in defining FI and what constitutes an FI.[24] At present, there is no standard definition of FI which may be in part due to the various terminologies such as jugaad,[25] reverse innovation,[26] Ghandian,[15] shanzhai,[27] bricolage,[27] disruptive,[28] resource-constrained innovation,[29] good-enough,[30] grass root innovation,[18 31] cost innovation,[20 32] that are frequently used interchangeably due to its similar premise despite its different backgrounds.[8 31 33 34] Several core characteristics typify the approach to defining FI, including, 'bottom-of-the-pyramid (BOP) innovation', 'good-enough innovation', 'doing more with less', 'resource scarcity' and 'sustainable innovation.'

BOP innovation

> Innovative solutions to support more than four billion people who live on less than $2 a day[35]

According to Pisoni *et al*,[36] the term 'FI' was conceived in emerging markets to meet the needs of low-income consumers by producing innovations that maintained quality and added value but that were produced at low expenditure.[11 25 37] However, this can be analogous to disruptive innovation[38] and the principle of 'disrupting the pyramid' in emerging markets while also focusing on those with a low-income or cost-conscious consumers in developed markets. It is also an extension of jugaad innovation,[8] as a business model of innovation to create low-cost solutions to everyday problems. Gupta[39] argued that '*frugal innovation is a new management philosophy, which integrates specific needs of the bottom of the pyramid markets as a starting point and works backward to develop appropriate solutions which may be significantly different from existing solutions designed to address needs of up market segments*'. Brem and Wolfram[18] shared the same understanding defining FI as having, '*…low to medium sophistication, medium sustainability, and medium emerging market orientation*'.[40] This definition again coincides with Christensen's[41] work on disruptive innovation but also Pisoni *et al*[36] and Prahalad's[37] work on introducing creative low-cost innovations to improve the social lifestyle of those at the BOP in developing markets. Gupta[39] refers to a new philosophy that involves addressing the needs of those with low purchasing power as the starting point to develop solutions that may be different to mainstream alternatives designed to address the needs of typical market segments.[42] Gupta[39] further added that FI was a response to contextual concerns created with resource constraints to focus on neglected demographic consumers. It is important to note that those at the BOP are not just confined to low-income countries (LICs) but also to markets in higher-income countries (HICs), as people who earn a lower-income than the national average exists in every country, '*frugal innovations can target customers in any segment of the economic pyramid who are price-sensitive by choice or looking for 'simpler' products that best meet their real needs*'.[42]

Good-enough innovation

> Imperfect adapted innovations which involve simple and essential functions that are good-enough to meet the needs of underserved consumers and offered at low-cost[43 44]

Angot and Plé[45] described FI as 'good-enough' solutions that rely on limited and cheaper resources to face resource scarcity' which overlaps with many other definitions, such as 'FI is 'good-enough,' affordable products that suffice the needs of resource-constrained consumers'[16] 'FI refers to products and services that are developed under resource constraints'[46] and 'FI stems from resource scarcity: using limited resources to meet the needs of LICs'.[47] Zeschky et al[48] defined FI as 'responding to severe resource constraints with products having extreme cost advantages compared with existing solutions' and 'good-enough, affordable products that meet the needs of resource-constrained consumers' with both definitions focusing on the aspects of cost, basic functionality targeting resource-constrained consumers.

Doing more with less

> Creating significantly more value while minimising the use of resources[49]

Radjou and Prabhu[49] defined FI as 'doing with more less' and Ratten[3] defined FI as 'the affordable use of products and services that have been innovated under conditions of resource scarcity', both referring to FI as a process of innovating in an easy to use and cost-efficient way. Although, this definition lacks any contingent aspects, it sets its focal point on the inclusion of a psychological strategy *or* changing behaviours by seeing resource constraints not as a disadvantage but more as an opportunity.[49] This mindset denotes a creative hemisphere where an innovator strives to deliver high quality at lower costs in comparison to more mainstream solutions. The authors also described FI as an opportunity to innovate cost effectively and sustainably under resource scarcity. The narrative of this definition aligns to that provided by The

BMJ Innov: first published as 10.1136/bmjinnov-2021-000830 on 5 October 2021. Downloaded from http://innovations.bmj.com/ on July 13, 2023 by guest. Protected by copyright.

Table 1 Definitions of frugal innovation

Definition(s)	Reference(s)
'Frugal innovation is a new management philosophy, which integrates specific needs of the bottom of the pyramid markets as a starting point and works backward to develop appropriate solutions which may be significantly different from existing solutions designed to address needs of up market segments'.	39
'…low to medium sophistication, medium sustainability, and medium emerging market orientation'.	18
'Frugal innovations can target customers in any segment of the economic pyramid who are price-sensitive by choice or looking for 'simpler' products that best meet their real needs'.	42
'The affordable use of products and services that have been innovated under conditions of resource scarcity'.	3
'Good enough' solutions that rely on limited and cheaper resources to face the resources' scarcity'.	45
'Frugal innovation is 'good-enough,' affordable products that suffice the needs of resource-constrained consumers'.	16
'Frugal innovation refers to products and services that are developed under resource constraints'.	46
'Frugal innovations are products and services that focus on crucial needs, spare resource use or eliminate non-essential features in the design process'.	52
'Frugal innovation stems from resource scarcity: utilizing limited resources to meet the needs of low-income customers'.	47
'Responding to severe resource constraints with products having extreme cost advantages compared to existing solutions'. *'Good-enough, affordable products that meet the needs of resource-constrained consumers'*.	48
'Frugal innovations are not re-engineered solutions but products or services developed for very specific applications in resource constrained environments' ► Technical novelty ► Market novelty ► Refers to market, rather than product or service.	20
'Frugal innovation refers to products, services or combination of them that are affordable, sustainable, easy-to-use, and have been innovated under the resource scarcity. In general, frugal innovations are developed in and for low-income market contexts and are seen to differ from innovations in developed markets'.	31
'…characterized by affordability, robustness, user friendliness, scalability and having an attractive value proposition'.	63
'Doing with more less' Principles of FI: *'(1) engage and iterate, (2) flex your assets, (3) create sustainable solutions, (4) shape customer behaviour, (5) co-create value with prosumers and (6) make innovative friends'*.	49
'Frugal innovation is not just about redesigning products; it involves rethinking entire production processes and business models'.	1
'…Three attributes: substantial cost reduction, concentration on core functionalities, and optimized performance level'.	19
'Meeting the desired objective with a good- enough, economical means'.	17
'Frugal innovation is a design innovation process in which the needs and context of citizens in the developing world are put 'first in order to develop appropriate, adaptable, affordable, and accessible services and products for emerging markets'.	13
'Scarcity-induced-, minimalist- or reverse innovation' *'By economizing the usage of resource-use and aiming for simple products and services, albeit sometimes using cutting edge technology, frugal-innovations have a lot to offer for sustainable-development'*.	64
'Frugal innovations are not only lower in cost, but outperform the alternative, and can be made available at large scale'.	74
'Frugal innovation is a means and ends to do more with less for more people'.	7
'…a means or an ends, to do more with less, for the many'.	6
'Frugal innovation can be defined as a product, service or a solution that emerges despite financial, human, technological and other resource constraints, and where the final outcome is less pricey than competitive offerings (if available) and which meets the needs of those customers who otherwise remain un-served'.	24

Economist[1] as it denotes FI as a strategy to rethink the architecture of the production process and use materials sparingly with a conscious effort to limit negative impacts towards the environment (sustainability) 'FI is not just about redesigning products; it involves rethinking entire production processes and business models'.[1]

Resource scarcity

FI occurs when there is a lack of sufficient or adequate equipment, qualified personnel, finance, institutional support or infrastructure during the development of innovative solutions[50 51]

Though FI is typically cited as an innovation developed in LMICs, it applies to both emerging and developed economies as they seek to target those at the BOP.[31] Furthermore, the idea of resource scarcity is not necessarily limited to consumers at the BOP, as depicted in the definition by Gupta.[39] FI needs to be further explored outside the domain of affordability due to its ability to adapt to any contextual concerns, for example, in a global crisis such as the COVID-19 pandemic, 'FIs are products and services that focus on crucial needs, spare resource use or eliminate non-essential features in the design process'.[52] The urgency provoked an imminent need to be efficient, innovative and scalable, which initiated an increase in the development and adoption of FIs as the developed world lacked time and resources to follow the traditional process of trials and testing.[53–55] The quick responses to COVID-19 from LICs such as India and Africa are progressing far better in comparison to HICs such as USA and in Europe.[56] Subsequently, these innovations provoke a competitive market, promoting an increase in sustainability despite significant constraints.[57]

Sustainable innovation

The development of innovative solutions that contributes towards sustainable development and provides economic, ecological and social benefits[58 59]

BMJ Innov: first published as 10.1136/bmjinnov-2021-000830 on 5 October 2021. Downloaded from http://innovations.bmj.com/ on July 13, 2023 by guest. Protected by copyright.

A significant amount of the literature on FI connects to issues of sustainability, although the explorations of such connections may differ.[60] Many scholars argue that FI can contribute towards a more sustainable world[13] and sustainable development,[61] although other have contested that FI does not create a sustainable impact,[23] does not necessarily involve sustainability[19] and are not initially eco-friendly.[47] Bhatti *et al*[6] and Prahalad and Mashelkar[15] suggested that FI involved redefining business models, reconfiguring value chains, redesigning products to target those with low purchasing power, creating a new market, using a scalable and sustainable approach. Weyrauch and Herstatt[19] suggested that sustainability was not necessary for FI and defined it as consisting of '…three attributes: substantial cost reduction, concentration on core functionalities and optimised performance level'.

Overall, FI can be referred to a polysemy term, the existence of numerous meanings for a single term, and these are summarised in table 1.

IDENTIFYING FI

The ever-increasing ways to conceptualise FI poses a significant challenge in how to actually identify one.[19 62] Some of the key characteristics typically used to describe FI and distinguish innovation types are functional and market aspects such as technical novelty, market novelty, functionality and resource scarcity[19] (see table 2). According to Weyrauch and Herstatt,[19] universal, multidisciplinary criteria are needed to define FI, irrespective of the context of study, due to its wide international application even in developed markets.[62]

Bhatti *et al*[53] conducted a mixed-method exploratory descriptive study to search for and evaluate less well-known FIs from LMICs that possess similar potential as the oft-repeated examples such as Narayana's US$1500 cardiac surgery, general electric's US$800 portable ECG machine, Aravind's US$30 cataract surgery, non-electric Mitticool fridge and the world's most affordable car by Tata Motors.[53] Many of these potential FIs were published by 'innovation curator' organisations, which identify and collate innovations providing accessible information to all who are seeking new policies, products or practice.[53] However, oftentimes there is no explicit statement of the criteria used, if at all, to identify such innovations as frugal.

Some scholars have proposed a criteria to identify FIs such as Kumar and Puranam's[14] six principles: (1) robustness, (2) portability, (3) defeaturing, (4) leapfrog technology, (5) mega-scale production and (6) service ecosystem. The FI Hub at Santa Clara University defined 10 core competencies of FI typically used to provide economically efficient, appropriate, adaptable, affordable and accessible products and services to solve needs when facing severe resource scarcity with particular attention to the emerging markets and are used to assess potential adoption.[13] The 10 competences include: (1) ruggedisation (use of robust materials to withstand harsh physical environments), (2) lightweight (ease of transportation, portability), (3) mobile enabled solutions (unlimited connectivity sources), (4) human centric design (user-friendly for all), (5) simplification (essential and basic features and functionalities only), (6) new distribution models ('unconventional channels and access'), (7) adaptation (leveraging existing alternatives), (8) use of local resources (designed and manufactured locally), (9) green technologies ('powered by renewable sources') and (10) affordability ('based on high volume at low expenditure, attainable to those with low purchasing power').[6 13] Although these competencies can serve as a rich basis for conceptualising FI, it is still unclear whether an FI must adhere to all competencies or a minimum number to be considered as an FI.

Based on literature review and interviews with managers and researchers, Weyrauch and Herstatt[19] proposed criteria for a universal definition that would distinguish FI from other types of innovation. They found that much of the discourse about FI mostly occurs within three main categories: (1) substantial cost reduction, (2) concentration on core functionalities and (3) optimised performance level and they proposed that an innovation must meet all three criteria simultaneously to be considered as an FI.[19] So, while each criteria on its own could also be used to describe another type of innovation, for example, cost innovation aims to produce products and services that are significantly low cost, only FI would be characterised by all three criteria at the same time.[19] These principles in actual products and services are also significantly dependent on the user environment and context, that is, the core functionalities—though the criteria applies to all markets, this criteria will differ depending on the context.[19]

First criterion: 'substantial cost reduction'

The premise of the first criteria of the framework, 'substantial cost reduction', is having products and services that are significantly lower in cost for consumers compared with more conventional mainstream products and services.[19] The amount or degree of the 'significant low cost' is not specified but they propose that the cost reduction must be a minimum of one third of the comparable product or service, or if no alternative exists, the estimated costs, for example, importation of current solutions.

Second criterion: 'core functionalities'

The second criterion of the framework, 'core functionalities' relates directly to the user requirements of the FI, that is, simplicity, ease of use, essential functions and high consumer benefits.[19] According to Wooldridge[27] 'numerous unnecessary bells and whistles to their products…makes the products more attractive to wealthier consumers, but the bells and whistles don't

BMJ Innov: first published as 10.1136/bmjinnov-2021-000830 on 5 October 2021. Downloaded from http://innovations.bmj.com/ on July 13, 2023 by guest. Protected by copyright.

Table 2 Key characteristics extracted from the definitions of FI*

Key characteristic	Associated key words	Reference(s)
Affordability	► Unnecessary costs ► Low cost ► Cost-conscious ► Cost-effective ► Minimum-cost ► Non-essential costs ► Significantly lower costs ► Low budget ► Low purchasing power ► Low income ► Low priced ► Economic means	42
Adaptability	► Addressing specific needs ► Flexible ► Conforming to needs ► Suffice the needs ► Focus on crucial needs ► Developed for very specific applications ► Meeting the needs ► Innovated under ► Doing more for less ► Means or an ends ► Needs and context of citizens in the developing world are put first	39
Accessibility	► Availability ► Convenience ► Ease of access ► In any segment of the economic pyramid ► Both emerging and developed markets ► For the many ► For more people	6 7 13 16 24 31 42 45–48
Sustainability	► Eco-friendly ► Ecosystem ► Low environmental impact ► Repurposing ► Low environmental intervention ► Ecological ► Renewable ► Spare resource use ► Sustainable development	18 31 49 52 64
Scalability	► Volume ► Profitable ► Expanding ► Scaling ► Changing markets ► Market orientation ► Reverse innovation ► Large scale	1 18 20 39
Simplicity	► Easy to use ► User-friendly ► User-friendliness ► No previous training required ► Low competency ► Strip back ► Essential ► Basic ► Simple ► Simpler ► Sophistication ► Non-essential ► Minimising the use of material ► Reduces material waste	18 31 42 52 63 64

Continued

BMJ Innov: first published as 10.1136/bmjinnov-2021-000830 on 5 October 2021. Downloaded from http://innovations.bmj.com/ on July 13, 2023 by guest. Protected by copyright.

Table 2 Continued

Key characteristic	Associated key words	Reference(s)
Emerging market	► Bottom of the pyramid ► Low-income market ► Developing countries ► Developing world ► Low-income to middle-income countries ► Low purchasing power ► Resource constrained ► Resource scarcity ► Unserved customers ► Underserved consumers	13 18 20 24 31 39 42 47
Developed market	► Top of the pyramid ► High-income market ► Developed countries ► Developed world ► High-income countries ► Medium to high purchasing power	39 42
Functionality	► Essential ► Appropriate ► Minimalistic ► Minimalism ► De-featuring ► Unnecessary frills stripped out	19 64
Performance	► Optimisation ► Robust ► Outperform ► Enhanced ► Advanced ► High quality	19 74
Process	► Approach ► Procedure ► Moving counterparts	6 7 13
Outcome	► Result ► Conclusion ► Consequence ► Reaction	24 31
Mindset	► Psychological ► Cognitive ► Behaviour ► Lifestyle ► Mentality ► Attitude ► Ethos ► Decision making ► Thought process	17 49
Resource scarcity/constrained	► Limited resources ► Sparing resources ► Budget constraints ► Insufficiency ► Resource shortages ► Limited or no access ► Shortages	3 16 20 24 31 45–48 64
Good-enough	► Sufficient ► Suffice ► Functional ► Acceptable ► Appropriate ► Passable ► Decent ► Satisfactory ► Contention	13 16 17 45 48

Continued

BMJ Innov: first published as 10.1136/bmjinnov-2021-000830 on 5 October 2021. Downloaded from http://innovations.bmj.com/ on July 13, 2023 by guest. Protected by copyright.

Table 2 Continued

Key characteristic	Associated key words	Reference(s)
High value	► Potential ► Profitable ► Scalable ► Attractive ► Novelty	20 49 63

*Adapted from Weyrauch and Herstatt.[19]
FI, frugal innovation.

really deliver any essential value'. This criterion is not limited to cost, but extends to saving resources, lowering the impact on the environment and addressing specific consumer behaviours.[13 19 27 47 63–65]

Third criterion: 'optimised performance level'

The third criterion, optimised performance level, is perhaps the most important of the three criteria as it is believed to encapsulate the true meaning of FI.[19] FIs should 'meet the required performance level that fulfils its purpose and the local conditions'.[19] The term 'performance' encompasses a wide array of functionalities and engineering characteristics, for rxample, speed, durability and power and will vary depending on the type of innovation, that is, the components of a frugal car will differ to those of a frugal ultrasound device.[19] Tiwari and Herstatt[63] stated that FIs are 'fulfilling or even exceeding certain predefined criteria of acceptable quality standards'.[4]

TOWARDS AN INTEGRATED VIEW

More recently, scholars have developed an integrated view of FI that combine technological and market aspects. For example, Hossain[31] defined FI as 'a product, service or a solution that emerges despite financial, human, technological and other resource constraints, and where the final outcome is less pricey than competitive offerings (if available) and which meets the needs of those customers who otherwise remain unserved'.[24 31] This definition integrates issues of affordability, basic functionality, simplification and serving those with income constraints. They refer to FI as a process of creating simple low-cost products to create value for consumers with low purchasing power,[24] which also seemed to overlap with aspects of Tiwari and Herstatt's[63] definition of FI, '…characterised by affordability, robustness, user friendliness, scalability and having an attractive value proposition'.

Soni and Krishnan[17] conducted a typology review of FI and presented three types of FI: (1) mindset, (2) process and (3) outcome in the form of products or services. At the basic level, the concept can be thought of as 'way of life' or lifestyle whereas on an activity level, it was thought of as a process in which the 'outcome' reflects the actual good or service.[17] They defined FI as 'meeting the desired objective with a good-enough, economical means' and referred to it as an outcome of frugal engineering which was signified as the process.[17] In contrast, Basu *et al*[13] defined FI as 'a design innovation process in which the needs and context of citizens in the developing world are put 'first in order to develop appropriate, adaptable, affordable and accessible services and products for emerging markets' and thus referred to FI as complex process as opposed to just an outcome.

Bhatti and Ventresca[7] critically reviewed the typology of various definitions of FI and proposed a theory-driven definition through analysing the concepts of 'frugality' and 'innovation' individually from a historical and current perspective. They argued that the concept of FI was not novel and dates back to World War Two.[7] Bhatti *et al*[6] interviewed social entrepreneurs and developed a framework that used a range of theories such as resource-based view, competitive advantage and creation of shared value to demonstrate the theoretical aspects of FI. The authors defined FI as '…a means or an ends, to do more with less, for the many'[6 50], which is anchored to three core characteristics: (1) affordability, (2) adaptability and (3) accessibility, that apply to goods, processes and business model innovations and is not limited to a certain market.[6]

Affordability ('means and ends') refers to the process and outcome of an innovation, which may include low expenditure materials, cost-effective delivery, cheaper manufacturing or disposal.[6] Adaptability ('to do more with less') refers to the efficiency and versatility of the innovation to the contextual needs, whereby the product can be 'good-enough'.[6] Accessibility ('for the many') refers to the entire population as a target market, including those at all levels of the pyramid, as all could benefit from the innovation and allows for future scaling.[6 53 54] However, before scaling could be considered there are number of challenges impeding the successful adoption of FI and its subsequent translation to other sectors such as policy-making, funding regulations and institutional and contextual barriers (social and cognitive).

NEXT STEPS FOR POLICY, PRACTICE AND RESEARCH

Despite this array of perspectives and definitions, scholars do agree that the characteristics of FIs are

BMJ Innov: first published as 10.1136/bmjinnov-2021-000830 on 5 October 2021. Downloaded from http://innovations.bmj.com/ on July 13, 2023 by guest. Protected by copyright.

different to those of mainstream innovations, for example (1) the geographical context is different,[64] (2) the diffusion pattern is different,[66] (3) business models are different[48] and (4) distribution channels are different.[24] Although there is no universal definition, many share the basic principles of (1) cost or affordability, (2) functionality, (3) accessibility and (4) sustainability[6 13 19 59] FI essentially encompasses the idea that more value can be achieved using less expenditure while using the resources available.

According to Ratten,[3] a clear definition of anything should adhere to three characteristics: (1) 'measurable design elements ('evaluation of term or concept'), (2) validity ('application to setting' or context) and (3) theoretical foundation' ('supported by research').[3] Bhatti *et al*[6] provide a definition supported by a theoretical underpinning and consolidates the predominant principles involved in previous definitions.

There are many semantic benefits to a universal definition of FI such as a unified understanding and approach—what is it, how will it work, how can it be applied and what is needed. Although there is growing interest and publications exploring FI, its application and effectiveness, there is still a lack of a comprehensive theoretical understanding of FI.[6 7 50] To fully grasp what FI is, a standardised approach needs to be developed. It could be argued that FI has a political component because it detracts attention from deeper inequities and socioeconomic classification of countries, distribution of resources and geo-political power. FI diverts attention away from questioning why some countries lack the resources to innovate in the same way as other HICs. On the other hand, it could be argued that the exploration and implementation of FI across contexts, though global learning, can overcome some of these geo-political power differentials and support an awakening that higher-income contexts have much to learn from lower-income ones. Ambiguity surrounding the conceptualisation of FI could be attributed to the overtheorisation of the concept resulting in excessive definitions and perspectives.[67–70] It may be that a pragmatic way to identify an FI is not to examine it against ill-defined concepts but to compare it to its next closest alternative. If, compared with the incumbent, the innovation is more affordable, more accessible and more adaptable, then it might be an FI.[71 72]

The existence of numerous definitions of FI did not halt its development and implementation, but it did in fact increase interest in, knowledge of and market for FI. However, consolidation of the various definitions of FI has the capacity to add a significant value to practice and research such as building a reporting group explicitly focusing on FIs, assessing the impact of such innovations, create a body of knowledge about FI and agreement around how to standardise reporting of such innovations.[73]

CONCLUSION

Although there is growing interest and efforts to understand, design and develop FIs with the aim of mitigating problems efficiently and effectively, there still remains the challenge of conceptualising and characterising FI due to its significant overlap with other innovation types. But perhaps this is due to the diversity in definition for other concepts which feature in the definition of FI such as sustainability, low income and good-enough. Defining FI as a concept should not deter from focusing on its core aim. Identifying an FI may be best achieved by comparing it to an incumbent alternative, rather than against an ill-defined concept. There is merit in developing a common understanding of FI to support strategies for its successful acceptance and diffusion globally.

Twitter James Barlow @jgbarlow2010

Contributors CNH designed the study, performed the literature review, completed the first draft and revised subsequent drafts for important intellectual content. GA proposed the study, read the first draft and revised subsequent drafts for important intellectual content. JB proposed the study, read the first draft and revised subsequent drafts for important intellectual content. MH proposed the study, read the first draft and revised subsequent drafts for important intellectual content. All authors read and approved the final manuscript.

Funding MH is supported in part by the NW London NIHR Applied Research Collaboration. Imperial College London is grateful for support from the NW London NIHR Applied Research Collaboration and the Imperial NIHR Biomedical Research Centre.

Disclaimer The views expressed in this publication are those of the authors and not necessarily those of the NIHR or the Department of Health and Social Care.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement No data are available.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: http://creativecommons.org/licenses/by-nc/4.0/.

ORCID iD
Matthew Harris http://orcid.org/0000-0002-0005-9710

REFERENCES

1 The Economist. *In praise of techno-austerity*, 2010.
2 Prabhu J. Frugal innovation: doing more with less for more. *Philos Trans A Math Phys Eng Sci* 2017;375:375.
3 Ratten V. *Frugal innovation*. 1st ed. Oxon, UK: Routledge, 2019.
4 Tiwari R, Fischer L, Kalogerakis K. Frugal innovation in scholarly and social discourse: an assessment of trends and potential societal implications. Joint working paper of Fraunhofer MOEZ Leipzig and Hamburg University of Technology in the BMBF-ITA project, 2016:2–28.

BMJ Innov: first published as 10.1136/bmjinnov-2021-000830 on 5 October 2021. Downloaded from http://innovations.bmj.com/ on July 13, 2023 by guest. Protected by copyright.

5 Arshad H, Radić M, Radić D. Patterns of Frugal innovation in healthcare. *TIM Review* 2018;8:28–37.
6 Bhatti Y, Basu R, Barron D. *Frugal innovation: models, means, methods*. Cambridge, UK: Cambridge University Press, 2018.
7 Bhatti YA, Ventresca M. How can 'frugal innovation' be conceptualized? *SSRN* 2013;71.
8 Grover A, Caulfield P, Roehrich K. *Frugal innovation in healthcare and its applicability to developed markets*. British Academy of Management, 2014: 1–57.
9 Bencsik A, Machová R, Tóth Z. Cheap and clever – symbiosis of frugal innovation and knowledge management. *Probl Perspect Manag* 2016;14:85–93.
10 Winkler T, Ulz A, Knöbl W, *et al*. Frugal innovation in developed markets – adaption of a criteria-based evaluation model. *J Innov Knowl* 2020;5:251–9.
11 Radjou N, Prabhu J, Ahuja S. The CEO's Frugal Innovation Agenda. *Harv Bus Rev* 2012.
12 Tiwari R, Fischer L, Kalogerakis K. *Frugal innovation in Germany: a qualitative analysis of potential socio-economic impacts. S, working paper, no 96*. Hamburg University of Technology (TUHH), Institute for Technology and Innovation Management (TIM), 2017: 2–24.
13 Basu R, Banerjee P, Sweeny E. Frugal innovation: core competencies to address global sustainability. *JM* 2013;1:63–82.
14 Kumar N, Puranam P. Frugal engineering: an emerging innovation paradigm. *IBJ* 2012;76.
15 Prahalad CK, Mashelkar RA. Innovation's Holy Grail. *Harv Bus Rev* 2010.
16 Agarwal N, Brem A. Frugal innovation-past, present, and future. *IEEE Eng Manag Rev* 2017;45:37–41.
17 Soni P, T. Krishnan R. Frugal innovation: aligning theory, practice, and public policy. *J Indian Bus Res* 2014;6:29–47.
18 Brem A, Wolfram P. Research and development from the bottom up - introduction of terminologies for new product development in emerging markets. *J Innov Entrep* 2014;3:9.
19 Weyrauch T, Herstatt C. What is frugal innovation? three defining criteria. *J Frugal Innov* 2017;2.
20 Zeschky MB, Winterhalter S, Gassmann O. From cost to Frugal and reverse innovation: mapping the field and implications for global competitiveness. *Res Technol Manag* 2014;57:20–7.
21 Kuo A, Ng S. Frugal innovation: a strategy for emerging market penetration and beyond. *Int J Account Bus Manag* 2016;4.
22 Pansera M, Sarkar S. Crafting sustainable development solutions: Frugal innovations of Grassroots entrepreneurs. *Sustainability* 2016;8:51.
23 Rosca E, Arnold M, Bendul JC. Business models for sustainable innovation – an empirical analysis of frugal products and services. *J Clean Prod* 2017;162:S133–45.
24 Simula H, Hossain M, Halme M. Frugal and reverse innovations quo vadis? *Curr Sci* 2015;64.
25 Radjou N, Prabhu J, Ahuja S. *Jugaad innovation: think Frugal, be flexible, generate breakthrough growth*. San Francisco, USA: Wiley Publishing, 2012.
26 Govindarajan V, Trimble C. Is reverse innovation like disruptive innovation? *Harv Bus Rev* 2009.
27 Wooldridge A. *First break all the rules: the charms of frugal innovation*. The Economist, 2010: 3–5. https://www.economist.com/special-report/2010/04/17/first-break-all-the-rules
28 Christensen C, Raynor ME, Verlinden M. Skate to where the money will be. *Harv Bus Rev* 2001.
29 Ray PK, Ray S. Resource-Constrained innovation for emerging economies: the case of the Indian telecommunications industry. *IEEE Trans Eng Manag* 2010;57:144–56.
30 Gadiesh O, Leung P, Vestring T. The Battle for China's Good-Enough Market. *Harv Bus Rev* 2007.
31 Hossain M. *Frugal innovation: a systematic literature review*. SSRN, 2016.
32 Williams C, van Triest S. The impact of corporate and national cultures on decentralization in multinational corporations. *Int Bus Rev* 2009;18:156–67.
33 Barlow J. *Managing innovation in healthcare*. London, UK: World Scientific Publishing Company, 2016.
34 Hossain M. Frugal innovation: conception, development, diffusion, and outcome. *J Clean Prod* 2020;262:121456.
35 Prahalad CK. Bottom of the pyramid as a source of breakthrough innovations. *J Prod Innov Manage* 2012;29:6–12.
36 Pisoni A, Michelini L, Martignoni G. Frugal approach to innovation: state of the art and future perspectives. *J Clean Prod* 2018;171:107–26.
37 Prahalad CK. *The fortune at the bottom of the pyramid*. New Jersey, USA: Pearson Education Inc, 2006.
38 Christensen C, Raynor M. *The Innovator's Solution: creating and sustaining successful growth*. 1 edn. Boston, USA: Harvard Business Review Press, 2003.
39 Gupta V. Corporate response to global financial crisis: a knowledge-based model. *Glob Econ J* 2011;11:1850224.
40 Hossain M. Frugal innovation: a review and research agenda. *J Clean Prod* 2018;182:926–36.
41 Christensen CM. The ongoing process of building a theory of disruption. *J Prod Innov Manage* 2006;23:39–55.
42 Koerich GV, Cancellier E. Frugal innovation: origins, evolution and future perspectives. *Cad. EBAPE.BR* 2019;17:1079–93.
43 Brulé G, Munier F. *Happiness, technology and innovation*. Cham, Switzerland: Springer International Publishing, 2021.
44 Christensen C. The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail. *Harv Bus Rev* 1997.
45 Angot J, Plé L. Serving poor people in rich countries: the bottom-of-the-pyramid business model solution. *J Bus Strategy* 2015;36:3–15.
46 Agnihotri A. Low-cost innovation in emerging markets. *J Strateg Mark* 2015;23:399–411.
47 Sharma A, Iyer GR. Resource-Constrained product development: implications for green marketing and green supply chains. *Ind Mark Manag* 2012;41:599–608.
48 Zeschky M, Widenmayer B, Gassmann O. Frugal innovation in emerging markets. *Res Technol Manag* 2011;54:38–45.
49 Radjou N, Prabhu J. What Frugal Innovators do. *Harv Bus Rev* 2014.
50 Bhatti YA. Frugal innovation: social entrepreneurs' perceptions of innovation under institutional voids, resource scarcity and affordability constraints. University of Oxford, 2014. Available: https://ora.ox.ac.uk/objects/uuid:17121614-7918-4e56-bccc-2806c9ecbfb3 [Accessed 17 Jul 2021].
51 Bianchi C, Bianco M, Ardanche M, *et al*. Healthcare frugal innovation: a solving problem rationale under scarcity conditions. *Technol Soc* 2017;51:74–80.
52 Kuo A. Creating Social Value through Frugal Innovation. In: *In entrepreneurship in Asia social enterprise, network and Grassroots case studies (Japanese management and international studies*. Singapore: World Scientific Publishing Company, 2014: 53–66. https://www.researchgate.net/publication/272821460_Creating_Social_Value_through_

BMJ Innov: first published as 10.1136/bmjinnov-2021-000830 on 5 October 2021. Downloaded from http://innovations.bmj.com/ on July 13, 2023 by guest. Protected by copyright.

Frugal_Innovation/link/54f01eb20cf2495330e3c524/download
53 Bhatti YA, Prime M, Harris M, *et al*. The search for the Holy Grail: frugal innovation in healthcare from low-income or middle-income countries for reverse innovation to developed countries. *BMJ Innov* 2017;3:212–20.
54 Bhatti Y, Taylor A, Harris M, *et al*. Global lessons in Frugal innovation to improve health care delivery in the United States. *Health Aff* 2017;36:11.
55 Corsini L, Dammicco V, Moultrie J. Frugal innovation in a crisis: the digital fabrication maker response to COVID-19. *R&D Management* 2021;51.
56 Harris M, Bhatti Y, Buckley J, *et al*. Fast and frugal innovations in response to the COVID-19 pandemic. *Nat Med* 2020;26:814–7.
57 Herstatt C, Tiwari R. Opportunities of frugality in the post-corona era. *Int J Technol Manag* 2020;83:15.
58 Yoon E, Tello S. Drivers of sustainable innovation: exploratory views and corporate strategies. *Seoul J Bus* 2009;15.
59 Khan R. How Frugal innovation promotes social sustainability. *Sustainability* 2016;8:1034.
60 Albert M. Sustainable frugal innovation - The connection between frugal innovation and sustainability. *J Clean Prod* 2019;237:117747.
61 Rao BC. Alleviating poverty in the twenty-first century through Frugal innovations. *Challenge* 2014;57:40–59.
62 Prabhu GN, Gupta S. Heuristics of frugal service innovations. *IEEE* 2014:3309–12.
63 Tiwari R, Herstatt C. *"Too good" to succeed? Why not just try "good enough"! Some deliberations on the prospects of frugal innovations. Working Paper, No* 76. Hamburg University of Technology (TUHH), Institute for Technology and Innovation Management (TIM), 2013.
64 Rao BC. How disruptive is frugal? *Technol Soc* 2013;35:65–73.
65 Flatters P W. Understanding the Postrecession consumer. *Harv Bus Rev* 2009.
66 Hossain M, Simula H, Halme M. Can frugal go global? diffusion patterns of frugal innovations. *Technol Soc* 2016;46:132–9.
67 Bhatti YA, Ventresca M. The emerging market for Frugal innovation: FAD, fashion, or fit? *SSRN* 2012;16.
68 Nari Kahle H, Dubiel A, Ernst H, *et al*. The democratizing effects of frugal innovation. *Jnl of Indian Business Res* 2013;5:220–34.
69 Pansera M. Frugal or fair? the unfulfilled promises of Frugal innovation. *TIM Review* 2018;8:6–13.
70 Knorringa P, Peša I, Leliveld A, *et al*. Frugal innovation and development: Aides or Adversaries? *Eur J Dev Res* 2016;28:143–53.
71 Skopec M, Grillo A, Kureshi A. Double standards in healthcare innovations: the case of mosquito net mesh for hernia repair 2021. *BMJ Innov* 202;7.
72 Dallera G, Skopec M, Barlow J. Frugal cooling mattress to induce therapeutic hypothermia for treatment of hypoxic-ischaemic encephalopathy in the UK NHS. *Forthcoming*.
73 Sharma D, Harris M, Agrawal V, *et al*. Plea for standardised reporting of frugal innovations. *BMJ Innovations* 2021;111:bmjinnov-2021-000710.
74 Bound K, Thornton I. Our Frugal Future: Lessons from India's Innovation System. Nesta, 2012. Available: https://media.nesta.org.uk/documents/our_frugal_future.pdf [Accessed 12 Jun 2021].

BMJ Innov: first published as 10.1136/bmjinnov-2021-000830 on 5 October 2021. Downloaded from http://innovations.bmj.com/ on July 13, 2023 by guest. Protected by copyright.

Appendix 2: Risk Assessment of FI Candidates

THE INDIVIDUAL RISK OF SIX FRUGAL INNOVATIONS

Individual Risk	Innovation					
	Arbutus Drill Cover System	Kangaroo Care	Sayeba's Method	Mosquito Net-Mesh	Family Health Strategy	Aravind Eye Care System
Risk of long-term complications e.g., breathing problems, paralysis						
Risk of hospital readmissions/longer stay e.g., delayed recovery						
Risk of side effects e.g., haemorrhage, scarring, pain						
Risk of death						
Risk of long-term treatment e.g., additional medication, physiotherapy						
Risk of invasiveness e.g., surgical, entry to internal cavity						
Implantable						

Overall Scores	
Arbutus Drill Cover System	4
Kangaroo Care	0
Sayeba's Method	3
Mosquito Net-Mesh	5
Family Health Strategy	0
Aravind Eye Care System	0

THE ORGANISATIONAL RISK OF SIX FRUGAL INNOVATIONS

Organisational Risk	Innovation					
	Arbutus Drill Cover System	Kangaroo Care	Sayeba's Method	Mosquito Net-Mesh	Family Health Strategy	Aravind Eye Care System
Complexity of the innovation						
Scalability (across the NHS)						
Cost effectiveness (innovation against present incumbents including training costs)						
Does it have regulatory markings? (e.g., CE markings)						
Does it have regulatory approval? (e.g., MHRA approval)						
Trialability (e.g., evidence-based, findings)						
Distribution channels						
Addresses a gap in healthcare (e.g., cost, safety, quality, waiting times)						
Risk of legal problems (e.g., malpractice, mishandling of patients, confidentiality, lawsuits)						

Overall Scores	
Arbutus Drill Cover System	3
Kangaroo Care	0
Sayeba's Method	5
Mosquito Net-Mesh	5
Family Health Strategy	0
Aravind Eye Care System	3

Final Ranking		
Arbutus Drill Cover System	4	(1) FHS
Kangaroo Care	0	(2) KC
Sayeba's Method	3	(3) ACES
Mosquito Net-Mesh	5	(4) Sayeba's Method
Family Health Strategy	0	(5) ADCS
Aravind Eye Care System	2	(6) MNM

Scale	Value
Surgical, implantable, high likelihood of injury, death, complications, hospital readmissions/longer hospital stay (over 5 days), side effects (e.g., breathing, scarring, pain), long-term treatment (3 > weeks), risk of invasiveness (complete entry to internal cavity)	**High** = 4-5
Surgical, non- or semi-implantable (temporary), moderate likelihood of injury, death, complications, hospital readmissions/longer hospital stay (approx. 3-5 days), side effects (e.g., breathing, scarring, pain), long-term treatment (1-2 weeks), risk of invasiveness (some entry to internal cavity)	**Moderate** = 2-3
Non-surgical, non-implantable, no likelihood of injury, death, complications, hospital readmissions/longer hospital stay (less than 3 days), side effects (e.g., breathing scarring, pain), long-term treatment (<1 week), risk of invasiveness (no entry to internal cavity)	**Low** = 0-1

ORGANISATIONAL RISK SCALE	
Scale	**Value**
Complexity (highly sophisticated with a complex human centric design and functionality which requires high level competency e.g., training for > 3 weeks and testing)	**High** = 4-5
Scalability (no or very small potential for implementation across the NHS)	
Cost effectiveness (does not provide significant cost savings in comparison to current incumbents (reflective of the current NHS budgets and quotas)	
Does it have regulatory markings? (does not possess regulatory markings)	
Does it have regulatory approval? = (does not possess regulatory approval)	
Trialability (has no evidence of effectiveness, has not been trialled nor tested)	
Distribution channels (has no established distribution channels e.g., manufacturer to customer)	
Addresses a gap in healthcare (an innovative idea which does not necessarily address a gap in healthcare, particularly in the NHS)	
Risk of legal problems (no evidence of insurance, no legal support in the course of lawsuits)	
Complexity (fairly complex with moderate level of sophistication and human centric design and functionality which requires some high level competency e.g., training for > 2 weeks and/or testing)	**Moderate** = 2-3
Scalability (there is some potential for implementation across the NHS)	
Cost effectiveness (provides little cost savings in comparison to current incumbents (reflective of the current NHS budgets and quotas)	
Does it have regulatory markings? (may be in the process of acquiring regulatory markings)	
Does it have regulatory approval? = (may be in the process of acquiring regulatory approval)	
Trialability (is currently being trialled or awaiting trials, obtained limited evidence of effectiveness)	
Distribution channels (developing distribution channels e.g., manufacturer to customer)	
Addresses a gap in healthcare (an innovative idea that has the potential to address a gap in healthcare, particularly in the NHS)	
Risk of legal problems (some or no evidence of insurance, awaiting legal support in the course of lawsuits)	
Complexity (no complexity with a simple human centric design and functionality which requires no or basic level of competency)	**Low** = 0-1
Scalability (strong potential for implementation across the NHS)	
Cost effectiveness (provides significant cost savings in comparison to current incumbents (reflective of the current NHS budgets and quotas)	
Does it have regulatory markings? (already possesses or does not need regulatory markings)	
Does it have regulatory approval? = (already possess or does not need regulatory approval)	
Trialability (thoroughly trialled and tested, demonstrating evidence-base effectiveness)	
Distribution channels (established distribution channels e.g., manufacturer to customer or already exists in the UK)	
Addresses a gap in healthcare (strongly responds to a gap in healthcare, particularly in the NHS)	
Risk of legal problems (obtains insurance and legal support in the course of lawsuits or is low risk regarding legal formalities	

Appendix 3: Participant Information Sheet – NHS Staff

Imperial College London

NIHR | Applied Research Collaboration Northwest London

PARTICIPANT INFORMATION SHEET (PIS) – NHS STAFF

YOU WILL BE GIVEN A COPY OF THIS INFORMATION SHEET

Title of Study: Exploring the acceptability of healthcare innovations within the NHS

Name and Contact Details of the Lead Researcher: Chandni N Hindocha**,** Department of Primary Care and Public Health, Imperial College London, London, W6 8RP, UK

Name and Contact Details of the Principal Investigator and Primary Supervisor: Dr Matthew J Harris, School of Public Health, Imperial College London, London, W6 8RP, UK

Invitation Paragraph

We would like to invite you to take part in this research project. Before you decide, it is important that you understand why the research is being done and what it will involve. Please take your time to read the following information carefully and discuss it with others if you wish. A member of the research team will go through this information sheet with you. You may ask us anything that is not clear or if you would like more information.

This study will involve a 15-minute presentation and an open-ended interview with you for approximately 1 hour. The interview aims to explore perceptions and perspectives of various healthcare innovations and its potential for use in the NHS. Your responses from this study will not affect your employment.

1. What is the project's purpose?

Over the years, we have seen the use of many healthcare innovations around the world that have supported the management of various complex health conditions and diseases. With the growing ageing population and the increasing rate of complex diseases, innovative research from around the world is needed to support its treatment and management. However, coupled with this challenge is the funding for health services in England.

We are interested in exploring perceptions of various healthcare innovations and its potential use in the UK, particularly in the NHS. The information gained from this study will help us understand the attitudes towards such innovations, what could be done to increase its awareness and whether it would be suitable for the UK.

2. Why have I been chosen?

As you are an NHS staff, who can provide informed consent and aged 18 years or over and can speak fluent English, you may participate in this project.

3. Do I have to take part?

Any participation in this study is completely voluntary. We appreciate that not all staff members will feel that participation is right for them. We will discuss the study and go through this information sheet with you. If you do agree to participate, you will be asked to sign a

consent form. You will have the option to withdraw from the study at any time without having to provide a reason. If you do not wish to participate, it will not affect your employment in any way. If you withdraw from the study all the data that has been collected will be securely destroyed.

4. What will happen to me if I take part?

The researcher will explain the process of the study and to ensure that you want to take part. You will be given a consent form to sign as an acknowledgement of your willingness to participate.

At the start of this study, you will be required to attend a 15-minute presentation which will provide an introduction to a specific healthcare innovation. The lead researcher (Chandni Hindocha) will then ask you for some basic information about yourself and your contact information. You will then take part in an interview lasting approximately 1-hour, where you will be asked a number of questions reflecting your views about the innovations presented. These interviews will be audio-recorded and transcribed verbatim to ensure the accuracy of your responses. The lead researcher will use a prepared list of questions to facilitate the interview. These questions will be open-ended allowing you to speak freely without feeling constrained to choosing any pre-set options.

5. What are the possible disadvantages and risks of taking part?

This is a qualitative study whereby the primary information collected is solely based on the interview with the researcher. The study does not involve the use of the innovation and will not have any influence on your employment. Therefore, it should not cause any additional burden to you. In the event you feel stressed or overwhelmed by the questions being asked, you can stop the interview at any time by informing the lead researcher and withdraw from study without providing a reason.

6. What are the possible benefits of taking part?

We cannot guarantee that the study will help you directly. However, the information we collect from this study will increase our knowledge about the perceptions and attitudes towards different healthcare innovations, how we can increase the awareness of such innovations and whether it would be suitable for the UK particularly in the NHS. It may also increase your awareness about the various healthcare innovations currently in use around the world.

7. What if something goes wrong?

If you have any problems or questions about the study or questions regarding your participation, you can speak to the research team whose contact details have been provided at the beginning of this information sheet. If you feel that your complaint has not been handled to your satisfaction, you may contact the Research Governance and Integrity Team (RGIT) at Imperial College London (ICL) via email rgitcoordinator@imperial.ac.uk.

8. Will my taking part in this project be kept confidential?

Yes. All information collected about you during this study will be kept strictly confidential. We will follow the ethical and legal practice. All information collected about you, including contact information, case report forms, consent forms will be held securely in a locked cabinet at ICL. However, some of this information may need to be transferred to an electronic database, which will be password protected.

To ensure anonymity, you will be assigned a participant ID number. This will be pseudonymised (key-coded) information, which will be collected, stored, handled and processed by the research team at ICL. You will not be able to be identified in any future reports or publications.

In accordance with ICL's policy on data archives, the data collected from this study will be kept securely for at least 10 years following the end of the study. However, your contact details will be removed from all databases at the end of the study.

9. What will happen if I decide to leave the study?

We understand that after consenting at the beginning of this study, you may change your mind about participating. Your participation is completely voluntary, and you are free to withdraw from the study at any time without providing a reason. This will not affect you and/or your employment. If you decide to withdraw from the study before we have completed the data collection, your information and data collected from you, will not be used in the analysis.

10. What will happen to the results of the research project?

The lead researcher will analyse the interview, in which their supervisors will provide support throughout the study. The results will also be presented in medical journals, at conferences and published in a PhD thesis. The data will not include your name and you will not be identified in any report or publication. If you wish to have a copy of the study results, publication and/or your responses, please inform a member of the research team. All data will be held on a secure database on a password-protected computer at ICL. The information will be archived in a secured cabinet at ICL. Access to stored records is strictly controlled and is limited to the research team.

11. Data Protection Privacy Notice

The data controller for this project will be ICL. The ICL Data Protection Office provides oversight of ICL activities involving the processing of personal data and can be contacted at dpo@imperial.ac.uk. ICL's Data Protection Officer is Robert Scott and can be contacted at Robert.scott@imperial.ac.uk.

Your personal data will be processed for the purposes outlined in this information sheet. We will anonymise the personal data you provide, and we will endeavour to minimise the processing of personal data wherever possible.

If you are concerned about how your personal data is being processed, please contact dpo@imperial.ac.uk. You may also wish to contact the Information Commissioner's Office (ICO) at https://ico.org.uk/.

12. Who is organising and funding the research?

The research is funded by the National Institute for Health Research (NIHR) Applied Research Collaboration (ARC) Northwest London (NWL) and supported by the Imperial College London. This study is part of a PhD project.

13. Further information and contact details

If you would like to have more information, please contact Chandni Hindocha via email (C.hindocha20@imperial.ac.uk).

Thank you for taking the time to consider the study and for reading this information. If you do decide that you would like to participate you will be given this information sheet to keep and be asked to sign a consent form.

Appendix 4: Participant Information Sheet – Patient Representatives

Imperial College London

NIHR | Applied Research Collaboration Northwest London

PARTICIPANT INFORMATION SHEET (PIS) – PATIENT REPRESENTATIVES

YOU WILL BE GIVEN A COPY OF THIS INFORMATION SHEET

Title of Study: Exploring the acceptability of healthcare innovations within the NHS

Name and Contact Details of the Lead Researcher: Chandni N Hindocha**,** Department of Primary Care and Public Health, Imperial College London, London, W6 8RP, UK

Name and Contact Details of the Principal Investigator and Primary Supervisor: Dr Matthew J Harris, School of Public Health, Imperial College London, London, W6 8RP, UK

Invitation Paragraph

We would like to invite you to take part in this research project. Before you decide, it is important that you understand why the research is being done and what it will involve. Please take your time reading the following information carefully. Feel free to discuss it with others too if you wish. A member of the research team will go through this information sheet with you. You may ask us anything that is not clear or if you would like more information.

This study will involve a 15-minute presentation and a 1 to-1 conversation with you that will last for about 1 hour. The goal of this conversation is to explore your thoughts and feelings about various healthcare innovations, for example new technologies, treatments and devices, and the possibility for their use in the NHS. Your responses from this study will not affect your care or treatment you receive.

1. What is the project's purpose?

Over the years, we have seen the use of many healthcare innovations around the world that have supported the management of various complex health conditions and diseases. As the population in the UK gets older and complex diseases get more common, innovative ideas are needed to support treatment and management of these disease.

We are interested in understanding what people think about various healthcare innovations and how likely they are to be used in the UK, particularly in the NHS. The information collected from this study will help us understand what could be done to make people more aware of these innovations and whether they would be suitable for the UK.

2. Why have I been chosen?

As you are a patient representative, who can provide informed consent and aged 18 years or over and can speak fluent English, you may participate in this project.

3. Do I have to take part?

Any participation in this study is completely voluntary, so you do not have to participate. We appreciate that not all patient representatives will feel that participation is right for them. We will discuss the study and go through this information sheet with you. If you do agree to take

part, you will be asked to sign a consent form. You will have the option to withdraw from the study at any time without having to provide a reason. If you do not wish to participate, it will not affect your care in any way. If you withdraw from the study, all the data that has been collected will be securely destroyed.

4. What will happen to me if I take part?

The researcher will explain the process of this study and to ensure that you want to take part. You will be asked to sign a consent form to confirm that you are willing to take part in this study.

At the start of this study, you will be required to attend a 15-minute presentation which will introduce you to different healthcare innovations. The lead researcher (Chandni Hindocha) will then ask you for some basic information about yourself and your contact information. You will then be asked to take part in a 1-to-1 conversation that will last approximately 1 hour, where you will be asked a number of questions about your views of the innovations presented. These conversations will be audio-recorded and written out word for word to ensure the accuracy of your responses. The lead researcher will use a prepared list of questions to guide the conversation. These questions are designed to allow you to speak freely.

5. What are the possible disadvantages and risks of taking part?

This study involves providing a presentation and a 1-to-1 conversation with the researcher. The study does not involve any treatment. Your responses will not affect your treatment or care. It should not cause any additional burden to you. If you feel stressed or overwhelmed by the questions being asked, you can stop the interview at any time and withdraw from the study without providing a reason.

6. What are the possible benefits of taking part?

You will receive a payment in accordance with the standard involved guidance for lay representatives. We cannot guarantee that the study will help you directly. However, the information we collect from this study will increase our knowledge about the thoughts and feelings towards different healthcare innovations, how we can increase the awareness of such innovations and whether they would be suitable for the UK, particularly in the NHS. It may also increase your awareness about the various healthcare innovations currently being used around the world.

7. What if something goes wrong?

If you have any problems or questions about the study or questions regarding your participation, you can speak to the research team whose contact details have been provided at the beginning of this information sheet. If you feel that your complaint has not been handled or resolved, you may contact the Research Governance and Integrity Team (RGIT) at Imperial College London (ICL) via email rgitcoordinator@imperial.ac.uk.

8. Will my taking part in this project be kept confidential?

Yes. All information collected about you during this study will be kept strictly confidential, meaning it will not be shared with anyone outside the research team. All information collected about you, including contact information, your responses, consent forms will be held securely in a locked cabinet at ICL. However, some of this information may need to be transferred to an electronic database, which will be password protected.

You will be given a participant ID number so that no one can identify you. You will not be identified in any future reports or publications.

In accordance with ICL's policy on data archives, the data collected from this study will be kept securely for at least 10 years following the end of the study. However, your contact details will be removed from all databases at the end of the study.

9. What will happen if I decide to leave the study?

We understand that after agreeing to take part in this study, you may change your mind about participating. Your participation is completely voluntary, and you are free to withdraw from the study at any time without providing a reason. This will not affect you and/or your care. If you decide to withdraw from the study before we have completed the data collection, your information and data collected from you, will not be used in the analysis.

10. What will happen to the results of the research project?

The lead researcher will analysis the conversation. The results will be presented in medical journals, conferences and published in a PhD thesis. The data will not include your name and you will not be identified in any report or publication. If you wish to have a copy of the study results, publication and/or your responses, please inform a member of the research team.

11. Data Protection Privacy Notice

The data controller for this project will be ICL. The ICL Data Protection Office provides oversight of ICL activities involving the processing of personal data and can be contacted at dpo@imperial.ac.uk. ICL's Data Protection Officer is Robert Scott and can be contacted at Robert.scott@imperial.ac.uk.

Your personal data will be processed for the purposes outlined in this information sheet. We will anonymise the personal data you provide, and we will try to minimise the processing of personal data wherever possible.

If you are concerned about how your personal data is being processed, please contact dpo@imperial.ac.uk. You may also wish to contact the Information Commissioner's Office (ICO) at https://ico.org.uk/.

12. Who is organising and funding the research?

The research is funded by the National Institute for Health Research (NIHR) Applied Research Collaboration (ARC) Northwest London (NWL) and supported by the Imperial College London. This study is part of a PhD project.

13. Further information and contact details

If you would like to have more information, please contact Chandni Hindocha via email (C.hindocha20@imperial.ac.uk).

Thank you for taking the time to consider the study and for reading this information. If you do decide that you would like to participate you will be given this information sheet to keep and be asked to sign a consent form.

Appendix 5: Consent Form – NHS Staff

Imperial College London

NIHR | Applied Research Collaboration Northwest London

CONSENT FORM – NHS Staff

Please complete this form after you have read the Information Sheet received an explanation about the research.

Title of Study: Exploring the acceptability of healthcare innovations within the NHS

Name and Contact Details of the Lead Researcher: Chandni N Hindocha**,** Department of Primary Care and Public Health, Imperial College London, London, W6 8RP, UK; c.hindocha20@imperial.ac.uk

Name and Contact Details of the Principal Investigator and Primary Supervisor: Dr Matthew J Harris, School of Public Health, Imperial College London, London, W6 8RP, UK; m.harris@imperial.ac.uk

Name and Contact Details of the ICL Data Protection Officer: Robert Scott, robert.scott@imperial.ac.uk

I confirm that I understand that by initialling each box below I am consenting to this element of the study.

		Initials
1	I _____ [name of staff] have been consulted about my participation in this research project. I confirm that I have read and understood the Information Sheet for the above study. I have had an opportunity to consider the information and ask questions which have been answered to my satisfaction.	
2	I understand that my participation is voluntary and that I will be able to withdraw from the study at any time without giving a reason, without my legal rights being affected.	
3	I consent to the processing of my personal information for the purposes explained to me. I understand that such information will be handled in accordance with all applicable data protection legislation.	
4	I understand that data collected during the study may be looked at by individuals from Imperial College London and/or regulatory authorities, where it is relevant to their taking part in this research. I give permission for these individuals to have access to my study records.	
5	I consent to being contacted at a later date by the research team.	
6	I voluntarily agree to take part in this study.	

If you would like your contact details to be retained so that you can be contacted in the future by ICL researchers who would like to invite you to participate in follow up studies to this project, or in future studies of a similar nature, please tick the appropriate box below.

1	Yes, I would be happy to be contacted in this way	
2	No, I would not like to be contacted	

_____	_____	_____
Name of **Staff Member**	Date	Signature
_____	_____	_____
Researcher obtaining consent	Date	Signature

For Researcher Use:

Participant Name:
Participant Number:

Appendix 6: Consent Form – Patient Representatives

Imperial College London

NIHR | Applied Research Collaboration Northwest London

CONSENT FORM – PATIENT REPRESENTATIVES

Please complete this form after you have read the Information Sheet received an explanation about the research.

Title of Study: Exploring the acceptability healthcare innovations within the NHS

Name and Contact Details of the Lead Researcher: Chandni N Hindocha**,** Department of Primary Care and Public Health, Imperial College London, London, W6 8RP, UK; c.hindocha20@imperial.ac.uk

Name and Contact Details of the Principal Investigator and Primary Supervisor: Dr Matthew J Harris, School of Public Health, Imperial College London, London, W6 8RP, UK; m.harris@imperial.ac.uk

Name and Contact Details of the ICL Data Protection Officer: Robert Scott, robert.scott@imperial.ac.uk

I confirm that I understand that by initialling each box below I am consenting to this element of the study.

		Initials
1	I _____ [name of patient representative] have been consulted about my participation in this research project. I confirm that I have read and understood the Information Sheet for the above study. I have had an opportunity to consider the information and ask questions which have been answered to my satisfaction.	
2	I understand that my participation is voluntary and that I will be able to withdraw from the study at any time without giving a reason, without my legal rights being affected.	
3	I consent to the processing of my personal information for the purposes explained to me. I understand that such information will be handled in accordance with all applicable data protection legislation.	
4	I understand that data collected during the study may be looked at by individuals from Imperial College London and/or regulatory authorities, where it is relevant to their taking part in this research. I give permission for these individuals to have access to my study records.	
5	I consent to being contacted at a later date by the research team.	
6	I would like to be informed about the results of this research.	
7	I voluntarily agree to take part in this study.	

If you would like your contact details to be retained so that you can be contacted in the future by ICL researchers who would like to invite you to participate in follow up studies to this project, or in future studies of a similar nature, please tick the appropriate box below.

1	Yes, I would be happy to be contacted in this way	
2	No, I would not like to be contacted	

_____	_____	_____
Name of **Patient Representative**	Date	Signature
_____	_____	_____
Researcher obtaining consent	Date	Signature

For Researcher Use:

Participant Name:
Participant Number:

Appendix 7: Case Report Form (CRF) A – NHS Staff

Imperial College London

NIHR | Applied Research Collaboration Northwest London

CASE REPORT FORM (CRF) - A

INTERVIEW WITH NHS STAFF

Exploring the acceptability of frugal innovation at the individual level within the NHS

Lead Researcher: Chandni N Hindocha
Principle Investigator: Dr Matthew J Harris
Sponsor Number:
REC Reference:
CRF Version Number: 1.0

For Researcher Use:
Participant Name: Participant Number:

INITIAL SCREENING & CONSENT

Date of consent (DD/MM/YYYY)	
Informed consent for interview provided	☐ Yes ☐ No
Name of the person taking consent	
Date of the interview (DD/MM/YYYY)	

I. FIELD NOTES

II. DEMOGRAPHICS

Date of Birth (DD/MM/YYYY)		
Age		
Gender	☐ Female ☐ Male	
Ethnicity (*Please choose one option that best describes your ethnicity*)	White	☐ White British ☐ White Irish ☐ Other (*please specify below*) _____
	Mixed/Multiple Ethnic Groups	☐ White & Black Caribbean ☐ White & Black African ☐ White & Asian ☐ White & Indian ☐ Other (*please specify below*) _____
	Asian/Asian British	☐ Indian ☐ Pakistani ☐ Bangladeshi ☐ Chinese ☐ Japanese ☐ Other (*please specify below*) _____
	Black	☐ Black British ☐ Caribbean ☐ African ☐ Jamaican ☐ Other (*please specify below*) _____
	Other Ethnic Group	☐ Other (*please specify below*) _____
Marital Status	☐ Married ☐ Divorced ☐ Widowed ☐ Single ☐ Rather Not Say	
Highest Level of Education Completed	☐ Higher Degree ☐ A Level (or equivalent) ☐ NVQ (or equivalent) ☐ GCSE (or equivalent) ☐ Other (*specify below*) _____	Number of Years in General Education _____

III. STAFF EMPLOYMENT DETAILS

Staff Role	☐ General Practitioner ☐ Consultant ☐ Surgeon ☐ Scrub Nurse ☐ Registered General Nurse ☐ Administrator ☐ Procurement Lead ☐ Procurement Staff ☐ Care Assistant ☐ Manager/ Deputy Manager ☐ Clinic Lead/ Unit Manager ☐ Other (*specify below*) _____
Length of Employment (*Current position*)	☐ Less than 1 year ☐ 1-5 years ☐ 6-10 years ☐ More than 10 years

IV. INTERVIEW WITH STAFF

DISCLAIMER: **Staff would have received a presentation on various examples of innovations.** A number of questions will be asked regarding your thoughts about the innovations that were presented. You won't be given a pre-set response such as yes or no. You can speak as freely as you wish as these questions look to explore perspectives of such innovations. If you would like me to elaborate or repeat a question, please feel free to ask. Your responses will not influence your employment and will remain confidential among the research team only. In the event, you feel stressed or overwhelmed, you may ask to stop the interview at any point without providing a reason.	
Q1: do you require more information about the innovation?	
Q2: what did you think of the innovations? (prompts: find key aspects to elaborate on "tell me more", what were the key aspects for you? (good and bad), elaborate on these aspects e.g., safety, design, etc – why doesn't it look safe or robust to you?)	
Q3: what were the key aspects for you? (good and bad) (prompts: elaborate on these aspects e.g., safety, design, etc – why doesn't it look safe or robust to you?)	
Q4: what do you expect will happen if you was to use the innovation on your patient? (prompts: positive and negative expectations, elaborate on outcomes e.g., safety, infection, death, etc).	
Q5: what does 'innovation' mean to you?	
Q6: what does the term 'risk' mean to you? (prompts: what information would you need to address these concerns?)	

Q7: where do you get information about medical innovations? OR how would you like to get information about medical innovations? (prompt: why is one method preferred over another, do you typically do your own research about medical devices and care tools?)	
Q8: do you discuss medical innovations with your colleagues, friends and/or family? (prompt: would it be beneficial to talk to your colleagues about it and hear what they have chosen to do? And why?)	
Q9: do you discuss or mention the tools used in your care/surgery to your patient? (prompt: do you feel comfortable with patients asking about what is being used in their care/surgery?)	
Q10: does the patient ask you about the tools used in the surgery/care provided? And how often?	
Q11: would you accept the use of healthcare innovation if you were in a different situational position? and why? (prompts: provide a global pandemic and personal situations (location, support group, clinician behaviour towards a treatment) as an example, have you implemented an innovation before?)	
Q12: how confident are you in making your decision about whether to use an innovation? (prompt: would you like to have a choice in what you can use? And why?)	
OTHER	

Is there anything we have not mentioned that you would like to discuss?	

V. WITHDRAWAL OF DATA (IF APPLICABLE)

Date (DD/MM/YYYY)	
Recording numbers affected	
Details (*state reason if available*)	

Appendix 8: Case Report Form (CRF) B – Patient Representatives

Imperial College London

NIHR | Applied Research Collaboration Northwest London

CASE REPORT FORM (CRF) - B

INTERVIEW WITH PATIENT REPRESENTATIVES

Exploring the acceptability of frugal innovation at the individual level within the NHS

Lead Researcher: Chandni N Hindocha
Principle Investigator: Dr Matthew J Harris
Sponsor Number:
REC Reference:
CRF Version Number: 1.0

For Researcher Use:
Participant Name: Participant Number:

Date of consent (DD/MM/YYYY)	
Informed consent for interview provided	☐ Yes ☐ No
Name of the person taking consent	
Date of the interview (DD/MM/YYYY)	

INITIAL SCREENING & CONSENT

I. FIELD NOTES

II. DEMOGRAPHICS

Date of Birth (DD/MM/YYYY)		
Age		
Gender	☐ Female ☐ Male	
Ethnicity (*Please choose one option that best describes your ethnicity*)	White	☐ White British ☐ White Irish ☐ Other (*please specify below*) _____
	Mixed/Multiple Ethnic Groups	☐ White & Black Caribbean ☐ White & Black African ☐ White & Asian ☐ White & Indian ☐ Other (*please specify below*) _____
	Asian/Asian British	☐ Indian ☐ Pakistani ☐ Bangladeshi ☐ Chinese ☐ Japanese ☐ Other (*please specify below*) _____
	Black	☐ Black British ☐ Caribbean ☐ African ☐ Jamaican ☐ Other (*please specify below*)
	Other Ethnic Group	☐ Other (*please specify below*) _____
Marital Status	☐ Married ☐ Divorced ☐ Widowed ☐ Single ☐ Rather Not Say	
Highest Level of Education Completed	☐ Higher Degree ☐ A Level (or equivalent) ☐ NVQ (or equivalent) ☐ GCSE (or equivalent) ☐ Other (*specify below*)	Number of Years in General Education _____

	_____	

III. EMPLOYMENT DETAILS

Are you currently employed?	☐ Yes ☐ No ☐ Rather Not Say
What is your job role?	_____

IV. CLINIC DETAILS

What clinic are you attending today?	☐ Maternity/Neonatal ☐ Orthopaedic ☐ Gynecology ☐ Ophthalmology ☐ Cardiology ☐ General Surgery ☐ Urology ☐ Dermatology ☐ Other (*specify below*) _____
How long have you been attending this clinic?	_____
Is your appointment with your regular staff member? (*e.g., same consultant, clinician, nurse, etc.)*	☐ Yes ☐ No ☐ Rather Not Say

V. INTERVIEW WITH PATIENT

DISCLAIMER: **Patients would have received a presentation on various examples of innovations.** A number of questions will be asked regarding your thoughts about the innovations that were presented. You won't be given a pre-set response such as yes or no. You can speak as freely as you wish as these questions look to explore perspectives of such innovations. If you would like me to elaborate or repeat a question, please feel free to ask. Your responses will not influence your care and treatment and will remain confidential among the research team only. In the event, you feel stressed or overwhelmed, you may ask to stop the interview at any point without providing a reason.	
Q1: do you require more information about the innovations just presented? (note: what aspects are mentioned, perhaps elaborate its importance to them)	**Arbutus Drill Cover System:**
	Sayeba's Method:
	Mosquito Net Mesh:
Q2: what did you think of the innovations? (prompts: does the country of origin matter? (*only in related group*) find key aspects to elaborate on "tell me more", what were the key aspects for you? (what do you think makes this good and/or bad), elaborate on these aspects e.g., safety, design, etc – why doesn't it look safe or robust to you?)	**Arbutus Drill Cover System:**
	Sayeba's Method:
	Mosquito Net Mesh:
Q3: what do you expect will happen, if this innovation was to be used in your treatment? (prompts: elaborate on outcomes e.g., safety, health, infection, death, positive and negative expectations etc).	**Arbutus Drill Cover System:**
	Sayeba's Method:
	Mosquito Net Mesh:

Q4: what does 'innovation' mean to you? (does the FI encompass the attributes mentioned here)	
Q5: what does the term 'risk' mean to you? (prompts: what information would you need to address these concerns?)	
Q6: where do you get information about medical innovations? OR how would you like to get information about medical innovations? (prompts: ask why they consider one method over another?)	
Q7: do you discuss choices with anyone? And why? (prompt: elaborate on key information e.g., friends, family, healthcare provider; would it be beneficial to talk with other people in the same position as you and hear what they have chosen to do? And why?)	
Q8: do you feel different situations would affect how you feel about innovation? And why? (prompts: provide a global pandemic and personal situations (location, support group, clinician behaviour towards a treatment) as an example)	
Q9: would you feel confident in making informed decisions about your healthcare? (prompt: explain what an informed decision is, have they made such decisions before?)	
Q10: would you accept the innovations previously presented to be used in your care?	**Arbutus Drill Cover System:**

	Sayeba's Method:
	Mosquito Net Mesh:
OTHER	
Is there anything we have not mentioned that you would like to discuss?	

VI. WITHDRAWAL OF DATA (IF APPLICABLE)

Date (DD/MM/YYYY)	
Recording numbers affected	
Details (*state reason if available*)	

Appendix 9: Ethics Approval

Ymchwil Iechyd a Gofal Cymru
Health and Care Research Wales

NHS
Health Research Authority

Dr Matthew J Harris
Clinical Senior Lecturer in Public Health, Imperial College London and Honorary Consultant in Public Health Medicine
Imperial College London, School of Public Health
Reynolds Building, St Dunstan's Road
London
W6 8RP

Email: approvals@hra.nhs.uk
HCRW.approvals@wales.nhs.uk

19 July 2022

Dear Dr Harris

HRA and Health and Care Research Wales (HCRW) Approval Letter

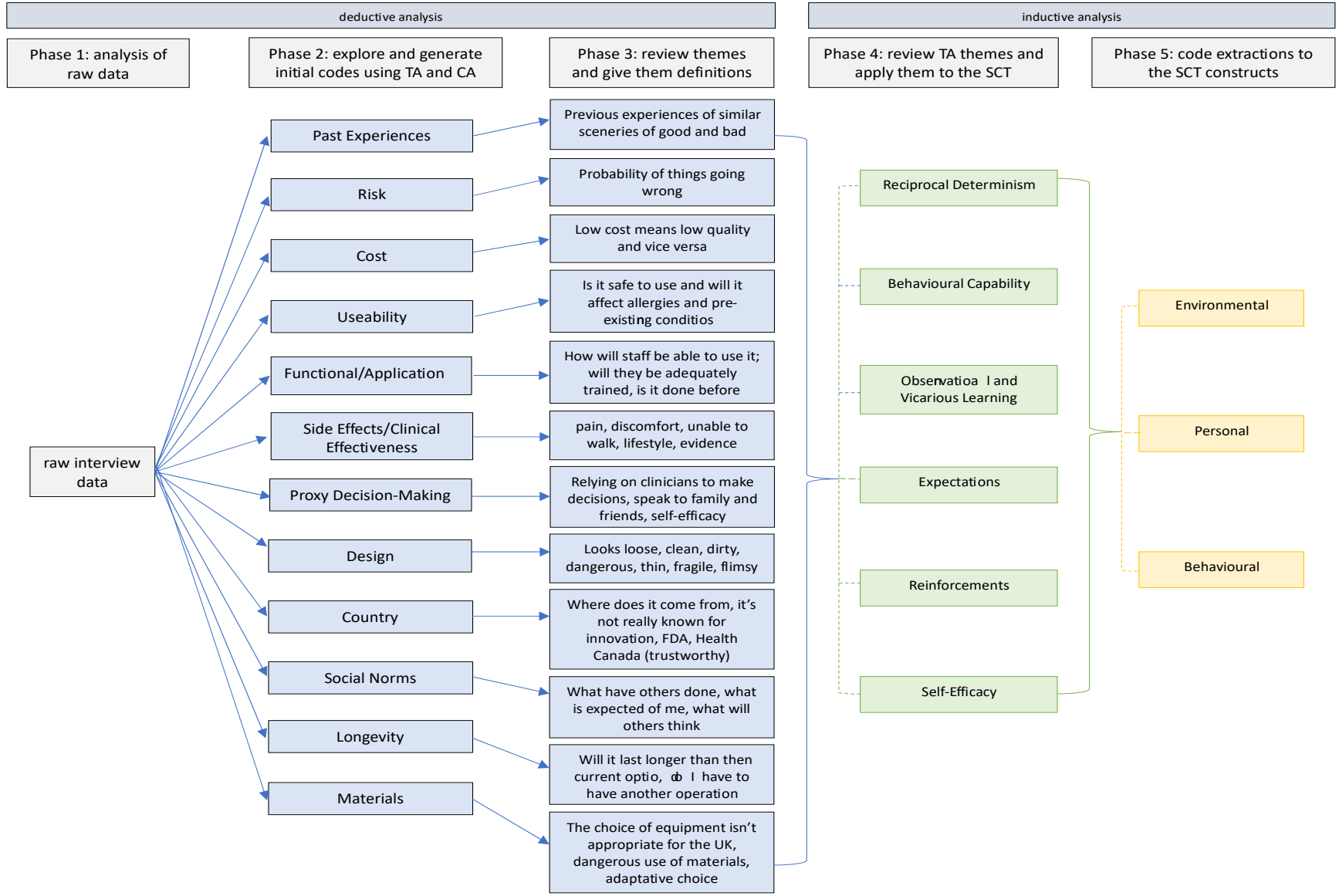
Study title:	**Exploring the acceptability of frugal innovation at the individual level within the NHS**
IRAS project ID:	**313656**
Protocol number:	**N/A**
REC reference:	**22/PR/0971**
Sponsor	**Imperial College London, Research Governance and Integrity**

I am pleased to confirm that **HRA and Health and Care Research Wales (HCRW) Approval** has been given for the above referenced study, on the basis described in the application form, protocol, supporting documentation and any clarifications received. You should not expect to receive anything further relating to this application.

Please now work with participating NHS organisations to confirm capacity and capability, in line with the instructions provided in the "Information to support study set up" section towards the end of this letter.

How should I work with participating NHS/HSC organisations in Northern Ireland and Scotland?
HRA and HCRW Approval does not apply to NHS/HSC organisations within Northern Ireland and Scotland.

Appendix 10: Data Coding Tree



Example Coding from An Interview with A Patient Representative

Extract	Initial Coding	SCT Attribute Coding	SCT Construct Coding
"…I don't really know whether I would want it to be used on me to be honest. I've never heard of medical innovations coming from Bangladesh and this does really fall into that image doesn't it [rhetorical] cause it uses a condom, like that screams [widening eyes, shaking the head side to side] dangerous, flimsy and scatty, it will be risky to use it, I mean why have they chosen to use it over the balloon you've [interviewer] talked about, I get its cheaper but it won't last as long and the fact that nurses can do something that doctors typically do is just unsafe and unfair to put that on the patients cause we then have to just agree with this choice. I wouldn't have known they couldn't do it unless you didn't tell me [laughs]. I haven't experienced haemorrhage before, but my friend has, and it was an awful experience…will it hurt more? [rhetorical], does it work faster? [rhetorical]…"	Risk Country Design Materials Social Norms Side Effects Useability Application Cost Clinical Effectiveness Shared Decision-Making	Expectations Vicarious Learning Reciprocal Determinism Self-Efficacy	Behavioural Personal Environmental

Example Coding from An Interview with An NHS Staff Participant

Extract	Initial Coding	SCT Attribute Coding	SCT Construct Coding
"…I'm sure it's a good medical innovation and certainly maybe in Bangladesh [raised eyebrows; nodding head], I mean you can only give them credit for being innovative, adaptative [shrugged shoulders] to their resources and environment. Do I think it would work here? [rhetorical], why not [shrugged shoulders], as long as it's able to collect more data about its application, functional properties and clinical trial data [rapid speech] then I'm sure we could all use the help of nurses performing this task. I know my opinion will differ from some of my colleagues because they are hell bent [hands together] on medical innovations that have been thoroughly tested for years maybe decades [raised shoulders] and they like all that fancy stuff [laughter; hand swipe gesture], but I just need concrete evidence[focused speech and movement of hands] that it works and its simple to use then yeah, I can see it be used here [smiling; nodding of the head]…its only as dangerous as all the other things we use, but welcome to healthcare [laughter, nodding head]…the cost doesn't concern [nodding head] it's about the quality and safety I can provide my patients with and I expect to see that from the clinical evidence"	Risk (clinical evidence) Country Social Norms Side Effects Useability Functional/Application	Expectations Vicarious Learning Reciprocal Determinism Self-Efficacy Behavioural Capability Reinforcements	Behavioural Personal Environmental