Quality of prescribing in UK care homes: using local data to recommend optimal prescribing strategies

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Declaration of Originality

I, Mathumalar Loganathan, declare that the contents of this thesis are from my own work. Where the work of others has been used, this has been indicated and appropriately referenced.

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Abstract

Background

Inappropriate prescribing (IP) for older people is a public health concern worldwide because of its implications for increased healthcare costs and adverse drug events (ADE). Care home residents are particularly prone to IP due to intrinsic (frailty) and extrinsic (governance and management of homes) factors. My PhD focussed on prescribing for this vulnerable population.

Methods

I conducted two systematic reviews which were aimed at: 1) establishing an IP-ADE link; and 2) interpreting interventions employed to reduce IP. Additionally, I evaluated the effectiveness of a multidisciplinary intervention in reducing IP in two nursing homes (combined sample size of 143 residents) managed by one general practice. In this multidisciplinary intervention, feedback from both a pharmacist medication review and an audit using STOPP (Screening Tool of Older Person's Prescriptions) which identified potentially inappropriate medication (PIM) and START (Screening Tool to Alert doctors to Right Treatment) which identified potential prescribing omission (PPO) were utilised by two general practitioners (GPs) to make appropriate changes to prescriptions. I compared the pre and post-intervention scores for PIMs and PPOs. Finally, I provided recommendations to improve overall prescribing quality in UK care homes.

Main findings

The findings include: 1) Evidence for a correlation between IP and ADE was weak; 2) Interventions involving academic detailing, pharmacist medication review and multidisciplinary team meetings were more successful; 3) After the 13 months study,

residents in the post-intervention group were significantly less likely to have been prescribed a PIM (RR 0.52, 95% CI 0.41-0.67) or a PPO (RR 0.58, 95% CI 0.48-0.69) as compared to residents in the pre-group. Factors influencing the number of PIMs and PPOs were number of medications and number of comorbidities respectively; 4) Recommendations for improving prescribing quality were broadly categorised into five areas: future research; legislation and directives; education and training; integrated healthcare services; and information technology.

Conclusion

The multidisciplinary pharmacist-GP-researcher intervention is an effective and practical approach to reducing IP for nursing home residents.

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Abbreviations

GPs	General practitioners
IP	Inappropriate prescribing
NHS	National Health Service
CQC	Care Quality Commission
κ	Kappa
χ	Chi-square
BUPA	British United Provident Association
GMC	General Medical Council
ISO	International Organization for Standardization
HbA1c	Glycated haemoglobin
UK	United Kingdom of Great Britain
USA	United States of America
PCT	Primary care trust
RPSGB	Royal Pharmaceutical Society of Great Britain
MHRA	Medicines & Healthcare products Regulatory Agency
NPC	National Prescribing Centre
BNF	British National Formulary
NSAID	Non-steroidal anti-inflammatory drugs
START	Screening Tool to Alert doctors to Right Treatment
STOPP	Screening Tool of Older Persons' Prescriptions
MAI	Medication Appropriateness Index
CASP	Critical Appraisal Skills Programme
OR	Odds ratio

CI	Confidence interval
MDT	Multidisciplinary team
CDSSs	Computerised clinical decision support systems
OBRA	Omnibus Reconciliation Act
SMPA	Swedish Medical Product Agency
CPOE	Computerized physician order entry
PIM	Potentially inappropriate medication
PPO	Potential prescribing omission
GEE	Generalised estimating equation
QOF	Quality and outcomes framework
eGFR	Estimated glomerular filtration rate
MAR	Medication administration records
DRP	Drug-related problems
NICE	National Institute for Health and Clinical Excellence
LES	Local Enhanced Services
MEE	Medical education England
GPSI	General practitioner with special interest

Chapter 1

Introduction to the thesis

I will start this introduction by presenting an overview of the social issues and problems surrounding the topic of my research. The importance of addressing these problems is the main motivation for undertaking this study. I will also build upon the general challenges, findings, and experiences of other researchers in the UK who have spearheaded this field. My PhD research project was broadly aimed at bridging the gap between research and practice. My endeavour will hopefully provide better insights to practitioners; policy makers and future researchers.

My thesis consolidates two mainstream health priorities: older people and prescribing quality; I have linked them by appraising inappropriate prescribing in care homes.

1.1 Overview and importance of addressing the problem

1.1.1 Ageing population

Firstly, research on older people in the UK is important because Britain's population is ageing at a considerable rate. An increasing number of people are living longer and the proportion of those living beyond 65 years has increased and will continue to increase further. Not only is the population ageing, but most striking has been the increase in the number and proportion of the "oldest old". By 2035 the number of people aged 85 and over is projected to be 2.5 times larger than in 2010, reaching approximately 3.6 million and accounting for 5 per cent of the total population.[1] This unfolding shift in demographic trends has serious implications for the healthcare system as resources are pooled and directed towards meeting the needs of this vulnerable older population.

1.1.2 Demand for care home

Secondly, research on older people living in UK care homes is important. As the population ages, increasing proportions of older people are being admitted to care homes. Nearly half a million older people in England now live in care homes[2] and this figure is expected to rise. With an increasing demand for care homes, there is a greater need to ensure that the population living in these institutions is provided with the best quality of care. Quality of care for one of the frailest population of the society undoubtedly involves prescribing which is of good quality.

1.1.3 Improving medication safety for people in care homes

Thirdly, the quality and safety of medication use in older people living in UK care homes is of paramount importance. Medication safety in care homes is an important subject of research because of the high prevalence of medication errors reported in these settings.[3] In patient safety terms, research data revealed that preventable harm including death from drug therapy, is a major public health challenge in most industrialised nations.[4] It has been estimated that 5% of hospital admissions, an admission rate similar to that of cancer are a result of preventable harm from medicines.[4] In particular, harm from inappropriate prescribing in older people has been subjected to increasing scrutiny by researchers and policy-makers.[5]

1.2 Synthesising the evidence

Drawing on the experiences of others, many have encountered challenges pertaining generally to: limitations in the sources and type of data available; the lack of baseline data and the variation in assessment method, and in use of terminologies.

1.2.1 Limitations in data

Very little routine prescribing data in care homes are collected or made available for analysis. This could be due to the difficulty in obtaining patient medical details that are complete and

accurate on computerised electronic patient records. In assessing prescribing quality, data available from computerised electronic patient records alone are usually not comprehensive enough for use. It is often the case that electronic patient medical records and case notes have to be read hand-in-hand for overall quality assessment. In addition, most general practices in the UK now use electronic patient records while many care homes have their own paper-based patient record systems. Using these two systems can cause problems as key data may be missing from one unless general practitioners and care home staff are very diligent about recording data.[3]

Record updating for care homes is also a huge barrier as these institutions can have high turn-over rates (for example, through hospital admission or death) and often these changes are not reflected in the computerised electronic patient records. Moreover, recruitment of care homes for research purposes is difficult as they are largely autonomous. Gaining the consent or assent of vulnerable and frail residents is another challenge.[3]

1.2.2 Lack of baseline data

Due to the various limitations in sources of prescribing data, the magnitude of inappropriate prescribing in care homes is difficult to ascertain. Consequently, baseline information and research within care homes is relatively scarce as compared to other healthcare settings.

1.2.3 Variation in assessment method and use of terminologies

The difficulty in comparing findings has been exacerbated by the fact that some researchers have included either non-evidenced-based or consensus criteria for their research, which may be subjective or difficult to apply. This has led to an inconsistency in definitions and methods of assessment, which may have caused ambiguity in the reporting of the "true" prevalence of inappropriate prescribing. Many studies have also included drugs that are currently rarely prescribed in the UK. As a result meaningful comparison cannot be made.

1.3 Aims and objectives

I embarked on this very important topic with the aim of answering research questions on firstly, how to improve prescribing quality and secondly, on how it can be done in this particular healthcare setting. I have attempted to do this by means of: 1) an extensive literature review; 2) conducting two systematic reviews; and 3) by initiating, conducting and evaluating a quality improvement project in two nursing homes managed by one general practice. The work throughout my PhD was undertaken with the following aims, listed here according to the chapters in which they are addressed:

Chapter 2 (Background)

1) to identify policy and regulatory issues from the published evidence on governance of, and healthcare provision by the National Health Service to care homes in England;
2) to evaluate and build upon the published evidence relating to the key challenges in providing high quality prescriptions and on improving overall prescribing safety for care home residents;
3) to evaluate and build upon the published evidence regarding research on inappropriate prescribing, particularly its assessment methods;
4) to compare and contrast the strengths and weaknesses of these assessment methods, and to identify one that may be applicable for use in the work described in Chapter 5;

Chapter 3 (Systematic review: association between inappropriate prescribing and adverse drug events)

5) by means of a systematic review, to establish the relationship between inappropriate prescribing in care home residents and adverse drug events, specifically death and hospitalisation in order to underscore the importance of improving prescribing practices;

Chapter 4 (Systematic review: interventions to optimise prescribing)

6) to interpret the results of studies that have evaluated any type of strategy to improve prescribing in care homes;
7) to identify strategies which have sufficient evidence of success to be used in the work described in Chapter 5;

Chapter 5 (Reducing inappropriate prescribing in nursing homes: a collaborative, general practice-based quality improvement project)

8) to evaluate the validity and practicality of applying an assessment method identified in the literature review of Chapter 1, on clinical and prescribing data for nursing home residents to assess baseline levels of inappropriate prescribing;
9) to evaluate the practicality and feasibility of adapting the two interventions identified in Chapter 4 to optimise prescribing;
10) to plan and conduct a quality improvement project in collaboration with a general practice, two nursing homes and the primary care trust;
11) to evaluate the effectiveness of the quality improvement project;

Chapter 6 (Reflections, conclusion and recommendations)

12) to draw conclusions based on my overall work presented in Chapters 2 to 5 and what they add or contribute to literature;
13) to reflect on the experience of conducting the quality improvement project; and
14) to provide recommendations to optimise prescribing in care homes in the UK.

Chapter 2

Background

2.1 Introduction

In this chapter, I will present the context and background of the topic of my thesis following an extensive literature review. The following background information will firstly, highlight the complexities of current governance pertaining to healthcare and medical services provision in care homes, and the reasons for the National Health Service's limited role and lack of leadership in providing medical services for this population. Next, this chapter will highlight the myriad of definitions and approaches used to describe prescribing quality. It will also focus on the underlying principles that make prescribing for older people a challenge, particularly for those in care homes. Finally, it will compare and contrast the different prescribing indicators used to address inappropriate prescribing in care homes.

2.2 Care homes in the UK

2.2.1 Complexity of governance

Care homes in England and Wales are governed by the Care Standard Act 2000,[6] in Scotland by the Regulation of Care Act (Scotland) 2001[7] and in Northern Ireland by the Health and Personal Social Services Act (Northern Ireland) 2002[8]. This legislation led to the introduction of the 'national minimum standards' by the Department of Health, the Scottish Executive and the Welsh Assembly. Regulations specific to each of the UK's four constituent nations (England, Scotland, Wales and Northern Ireland) were also introduced to determine the responsibilities of care home providers in maintaining and promoting the health of their residents. Apart from setting out requirements for activities such as record keeping, planning and monitoring health by care home staff, these regulations also set out healthcare

requirements. Although the care homes are ultimately responsible for compliance with the healthcare requirements, in practice, the provision of healthcare is largely dependent on healthcare professionals in the National Health Service (NHS). Others parties whose cooperation are required include local authorities, and private or voluntary organisations. While there is mention of the NHS in the policies of the four UK constituent nations, these policies are largely focused on funding and regulatory issues, and do not outline specific requirements on the clinical aspects of the NHS responsibilities for healthcare. Because of this omission, the health departments have been criticised for failing to clarify NHS obligations or government expectations of its local NHS services for care home residents.[9]

In addition, independent health and social care regulatory bodies with the responsibility to apply and monitor the stipulated standards and regulations have been set up in each nation. In England, the independent regulator of health and adult social care, the Care Quality Commission (CQC),[10] was established by the Health and Social Act 2008[11], and began operating in April 2009. It replaced three earlier commissions: the healthcare commission, the commission for social care inspection and the mental health act commission. The equivalent health and social care regulator in Scotland is the Care Inspectorate (previously Social Care and Social Work Improvement Scotland)[12], in Wales, the Care and Social Services Inspectorate Wales[13] and in Northern Ireland, the Regulation and Quality Improvement Authority.[14] These regulators have a responsibility to regulate not only those who are responsible for care home provision such as the British United Provident Association (BUPA)[15], but also providers and commissioners of NHS health services. Apart from the health and social care regulations, care homes and those working within them are also subject to various standards set by the relevant agencies and professional bodies, such as: 1) the requirements on healthcare professionals to meet professional standards by the General Medical Council (GMC), Nursing and Midwifery Council and the RPSGB; and 2)

accreditation of quality standards by the International Organization for Standardisation (ISO), Health and Safety Acts and safeguarding confidentiality of residents' personal information as stipulated in the Regulation and Data Protection Act 1998.[15]

To summarise this section, there are many institutions and sectors that are directly involved in the provisions and regulation of healthcare for care home residents. The relevant establishments that are responsible for provision of medical services in England are: 1) the Care Quality Commission (CQC), that regulates services by the NHS, local authorities, private companies or voluntary organisations; 2) NHS primary and secondary care organisations which provide clinical and medical services; 3) primary care trusts or local commissioners who assess and commission care; and 4) local authorities who manage, monitor and improve local services. Each local authority has a social service department which is responsible for care needs assessment primarily carried out to establish what help and support is needed by each resident.[16]

My thesis will focus on provision of medication-related services for these residents, focussing on NHS primary care in England.

2.2.2 Nursing and residential homes

Given that all of the four constituent nations in the UK use different terms to refer to care homes, it is important to clarify and elucidate the term that will be used throughout this thesis. A care home can be defined as a 'residential setting where older people live, usually in single rooms, and have access to on-site care services'.[17] The CQC, categorised care homes in England by the type of care they provide: 'care homes with nursing care' and 'care homes without nursing care'.[10] In Northern Ireland, the terms 'nursing homes' and 'residential homes' are used.[14] In Scotland and Wales, the term care home is used to include those with and without nursing care.[12] Homes that provide nursing care often house older

people with higher levels of morbidity and disability, hence justifying the need for additional nursing support.[18] In practice, providing accommodation to older people is a regulated activity which means that there is a distinction between accommodation providing only meals and assistance with activities of daily living, and accommodation that is registered to have a qualified nurse for additional nursing care. Furthermore, the level of nursing care (i.e. high, medium, low needs) required will determine a resident's entitlement to NHS services, specifically whether or not he or she is entitled to general district nursing.

Dual registered homes no longer exist, but homes registered for nursing care may accept individuals who at present require assistance only with activities of daily living but may potentially require nursing care in the near future.

In my thesis, unless otherwise specified, the term 'care home' will apply to both types of homes: those providing residential services only, and those providing additional nursing care. This is because the majority of the issues highlighted affect both types of homes.

2.3 Challenges in NHS healthcare provision

Firstly, the framework of a social care model within which healthcare for care home residents is operating is now viewed as outdated.[9] This is because their priorities are set primarily by social care and not healthcare. In the past, residents have often entered care homes due to social factors, for example as a result of decisions made by their relatives or as a result of a crisis or emergency. However, nowadays the trend has changed where residents are admitted, overwhelmingly, as a consequence of illness driven disability.[19] The social care model is as such vital but insufficient to meet residents' health needs. Furthermore, fragmentation in organisation and service delivery between health and social care (and also within the NHS) has been identified as another impediment, and has hampered the development of a collaborative model of care in which the NHS could deliver sustained support.[9]

Secondly, there are clearly increased health demands for the ageing population. It is estimated that by 2035, 23% of the population is projected to be aged 65 and over.[1] In contrast, only 18% of the population is expected to be below 16 years of age.[1] Currently in the UK, there are almost three times as many beds in care homes as compared to beds in NHS hospitals.[20, 21] Moreover, the needs of this vulnerable population are specific and demanding as many of these residents are suffering from dementia and most are living with at least one disability (reportedly 40% and 75% respectively[22]).

Finally, with such an overwhelming increase in needs, this could mean that the estimated half a million older people[23] residing in UK care homes could have variable access to NHS services (e.g. problems obtaining local GP services for residents, particularly in areas where large or numerous care homes have increased the number of residents).[18] There have been reports claiming that there is considerable unwarranted variation in the quality of NHS provision, especially around medication management, dementia and end of life care.[9] These issues of variations have prompted the Care Quality Commission in England to conduct a special review which is now in its final phase of finding solutions to meet the healthcare needs and demands of people living in care homes. The review was conducted on the basis of determining whether or not people living in care homes had equal access to NHS services, had choice and control over their healthcare, and whether delivered healthcare was safe and respected their dignity.[2] Aspects of locally-enhanced services reviewed include: (1) medication reviews, (2) health assessments on admission, (3) specialist assessments, (4) regular visits to home, (5) support with end-of-life care plans, and (6) advising care home staff. Liaison with other healthcare professionals was identified in the review's preliminary findings as one way to improve NHS healthcare services for people living in care homes.

2.4 Improving medication safety in care homes

Another aspect of NHS medical services provision in care homes which is of concern to the Department of Health is medication safety. This concern was reflected in the issuance of an alert in 2010 requesting Primary Care Trusts (PCTs) to coordinate actions with their primary medical care contractors, providers of pharmaceutical services and social care to pursue how medication errors in care homes can be reduced.[24] This directive was issued following the completion of an important research study, commissioned by the Department of Health's Patient Safety Research Programme entitled "The Care Homes Use of Medicines Study: prevalence, causes and potential harm of medication errors in care homes for older people". The authors in the study found that 70% of residents had medication errors and these errors were related to prescribing, dispensing, administration, and monitoring. They further identified that unclear local leadership and lack of inter-professional communication were primary causes of these errors.[3]

In terms of what has been done to address issues pertaining to medication safety, the Department of Health has reiterated the use of the Royal Pharmaceutical Society of Great Britain (RPSGB) guidance "The handling of medicines in social care" and the CQC standards when making relevant commissioning decisions. The RPSGB guidance provides best practice guidance based on current legislation governing the handling of medicines in the social care environment. It addresses handling of controlled drug storage in care homes, and ethical issues to consider when residents refuse their medicines.[25] CQC standards pertaining to medication will be clearer once its review, which is now in its final stages, will be made available; according to the CQC website, the final report was due to be published in winter 2011 but as of January 2012, it has yet to be made available.[26] Similar to RPSGB and CQC, a previous arm's length executive body of the Department of Health, the National Patient Safety Agency [27], was involved in promoting good practice guidance by, for example,

outlining guidance in care home procedures for dealing with medication errors in an attempt to reduce risks and improve safety in care homes.[28] Likewise, the Medicines and Healthcare products Regulatory Agency (MHRA), an executive agency of the Department of Health that is responsible for the investigation of harmful incidents as well as regulation of medicines, medical devices and equipment used in healthcare, has contributed to this facet of safety. The MHRA has a section on its website designed specifically for care home staff; the website includes guidance, safety alerts, and links to educational material to assist staff in the safe use and management of a wide range of medicines and medical devices used.[29]

In terms of who should take the lead on initiating collaboration on medication safety, many agencies and organisations have been proposed. The white paper, "Pharmacy in England: building on strengths- delivering the future" in 2008 clearly identified chief pharmacists for providers and commissioners as the most appropriate professionals to take the lead on medication safety matters.[23]

In recent developments regarding medication safety, concerted efforts have been initiated, and will be led by the RPSGB to minimise dispensing errors. This was triggered by the debate in the House of Lords in December 2011 of a tabled amendment to the Health and Social Care Bill to address the issue of healthcare professionals currently being at a risk of prosecution when an inadvertent dispensing error is made. This risk of prosecution, to which there is currently no defence, is said to discourage reporting of dispensing errors. The amendment was withdrawn pending further consideration of the issues.[30] The RPSGB has consequently announced on its website on 12 January 2012 that it will work closely with the Department of Health and the Medicines and Healthcare products Regulatory Agency (MHRA) to take more stringent measures to induce improvement and address the current situation with regards to dispensing errors.[31]

2.5 Improving prescribing quality in care homes

Improving safety in care homes is an urgent priority for the Department of Health and, as discussed above, much evidence of published guidance is pointing towards improving safety & managing risk in medicines management systems and processes, medicines management for long term conditions [32] and medicines reconciliation [33]. Aspects of prescribing guidance, however, are lacking considerably as there is no evidence on which to base such guidance. This is mainly because randomised controlled trials involving older patients have often focussed on managing a single disease state; when involving complicated disease states, outcomes for older people have been based on consensus and involved extrapolating data derived from healthier patients.[34] In reality, however, older people have numerous comorbidities for which they are prescribed multiple medications and this must ideally be reflected in the guidance on their treatment.[34]

One resource document was released in 1998 by the National Prescribing Centre (NPC). The document 'GP prescribing support'[35] was aimed at guiding PCTs and health authorities to develop effective prescribing support. In reference to care homes, the document suggested the following measures to be adopted: 1) setting up manageable and efficient systems for reordering of repeat prescriptions; 2) agreeing a list of "domestic remedies" which the home keeps for the use of its residents, avoiding repeat prescribing of, for example, "as required" simple analgesics; and 3) appointing a GP as a specific point of contact within the practice to deal with queries from nursing and residential home staff and who should also make regular care home visits to maintain systems, and implement changes once they are agreed. In addition, when reviewing care home prescribing, the guidance advocated that particular attention be paid to overuse of antipsychotics, sedatives, and hypnotics, and directions which indicated inappropriate timing of drug administration, e.g. to consider timing to suit the home's schedule.[35] Nevertheless, the guidance did not propose any alternative for conducting

a more comprehensive medication review for care home residents. Another government document which recognised the specific needs of the elderly with regards to regular medication review was the National Service Framework for Older People.[36] Although it did not address the more complex prescribing needs of care home residents', it did highlight inherent issues that unpin the principles of care for this group of older people, such as for palliative care.

Many have also agreed and supported the notion that additional precautions are necessary when prescribing to care home residents. These include taking measures to optimise the repeat prescribing system, for instance by having only one senior nurse in each care home responsible for ordering medication and for notifying GPs of any amendments to a prescription so that a new prescription could be generated if necessary.[3, 35] Other precautions include the regular monitoring of residents and ensuring that essential laboratory tests are undertaken periodically, side-effects are detected and that therapy is optimised. Effective management of laboratory test results is equally pivotal as some reports attributed poor management for causing delays in receiving laboratory test results.[37] It was also of a concern to GPs that the evidence base for medication monitoring was not fully established for many drugs, particularly in terms of the frequency of monitoring; even so, it has been deemed important to have agreed policies for laboratory test monitoring of drugs.[38] Additionally, BNF drug datasheets are potentially useful, specifically with regards to advice on laboratory test monitoring.[38]

2.6 Quality of prescribing

Good prescribing quality is an important reflection of healthcare quality.[39, 40] In this section, I will describe the numerous terms and approaches used to define quality of prescribing. The

term ‘prescribing’ is used here in the context of a clinical decision-making process to prescribe, rather than the technical aspects of communicating a prescription.

2.6.1 Expressions of prescribing quality

It is a challenging task to summarise measures of prescribing quality given the vast variations in definitions, different methodological approaches and the intended scope for each approach.

One approach identified was defining good prescribing as rational or appropriate. The term “appropriate” is more commonly used in recent years because it is viewed as the result and therefore the outcome of what should entail if the prescribing decision process was rational.[41-43] In another article, appropriateness in prescribing has been defined as ‘the outcome of a process of decision-making that maximises net individual health gains within society’s available resources’.[41] This definition also emphasises that the patient’s attitude is equally important in deciding appropriateness. For example, a patient who suffers a severe adverse reaction to what would otherwise have been considered appropriate therapy may interpret it as inappropriate, even though he or she makes a full recovery. Conversely, a patient who feels better after taking an ineffective remedy may consider it to have been appropriate even though it lacks an underlying rationale.[43]

The second approach has been to view quality of prescribing as simply being represented by a scale. At the two extreme ends of the scale are “extremely poor” and “extremely good. Other terms which have been used are “balanced”, “appropriate”, “safe”, “effective”, “suboptimal”, and “inappropriate”.[4, 44] To give an example of one definition: safe prescribing is defined as a process that recommends a medicine appropriate to the patient’s condition and ideally optimises the balance of benefit to harm.[40] With many of these terms seeming to have very similar meanings which may suggest quality that is of acceptable standards, one is likely

to question the rationale in which these terms are presented and whether one is more superior that the other. There is, however, no definitive answer.

Lastly, whilst many have focussed on finding the most suitable definitions,[40, 45, 46] others have suggested that the more important questions are what needs to be achieved,[39] what one intends to measure, how it was measured and whether it was measured by indicators that had face and content validity.[47-49]

2.6.2 Appropriateness in prescribing

In my thesis, I have chosen to use "appropriateness" as it is found in most literature to imply quality that is achievable in practice. "Safe" and "effective", on the contrary, imply achieving absolutes and are not sensitive enough to deal with the small differences that exist between drugs today.[39] Appropriate prescribing encompasses a range of values and behaviour to describe quality.[44, 47, 50, 51] A judgment of appropriateness will therefore depend on consideration and circumstances for all three domains: 1) what the patient wants; 2) scientific, technical rationalism (including the clinical pharmacology of the drug); and 3) the general good.[41, 52, 53] The last domain is a mixture of issues, including societal, cost and family-related consequences of prescribing.

Inappropriate prescribing is a term employed in the published literature to express prescribing quality that is not appropriate; it is a more common term than appropriateness because, as its name suggests, it identifies and measures the extent of "the problem" which, in research, could be more appreciated as then "the problem" can be improved or resolved. In addition, there are some other terms which are described to be specific to inappropriateness, such as: (1) overprescribing i.e. prescribing more drugs than are clinically needed; [54, 55] and (2) misprescribing i.e. incorrectly prescribing a drug that is needed;[50] and (3) under-prescribing i.e. omitting drugs which are clinically indicated. [54, 56, 57]

In the context of research, for an appropriate or inappropriate prescribing indicator to be clinically meaningful, it should have parameters which are representative, measurable and that can reflect the overall quality, i.e. good proxy measures. For this reason, the second domain, scientific and technical rationalism aspects of appropriate prescribing has been extensively researched and has had implications on practice. Many have in fact proposed that these indicators be termed pharmacological indicators. In primary care, for instance, prescribing indicators focussed on pharmacological aspects, such as 'prescribing within the dose recommended in the British National Formulary (BNF)' and 'prescribing of drugs contraindicated in a disease (e.g. beta-blocker to a patient with asthma)', have been proposed as indicators of appropriateness in prescribing.[58-60] Others have considered and evaluated prescriber's and patient's perspectives,[47] cost effectiveness[61, 62], and communication, i.e. directions for use given by the prescriber.[60]

2.7 Inappropriate prescribing in older people

In this section, I will firstly, explain the complexities associated with prescribing for older people in care home residents. Secondly, the evidence available in the published literature about inappropriate prescribing will be discussed. Thirdly, inappropriate prescribing indicators that have been employed in the care home setting will be explored.

2.7.1 Prescribing challenges for care home residents

Prescribing challenges for residents in care homes will be divided here into two groups based on intrinsic and extrinsic factors. Intrinsic factors are those that are associated directly with the patient while all challenges arising from the system in care homes are classified as extrinsic factors.

2.7.1.1 Intrinsic factors

These factors are also applicable to the older population who are not living in care homes. Whilst the three domains of appropriate prescribing do not fundamentally change, prescribing in older people has its own complexities which causes them to be at a greater risk of inappropriate prescribing.[34] These complexities include co-existing medical problems, multiple medications, factors attributed to age-related changes in pharmacodynamics and pharmacokinetics, as well as frailty (e.g. in bedbound patients where muscle cells are prone to atrophy, a statin would be considered inappropriate in view of toxicity build-up in these cells). Furthermore, evidence of clinical effectiveness of drugs in older people is scarce and there is a lack of standardised recommendations for older people. Additionally, there is a possibility that goals of treatment change significantly in a short period of time (e.g. in Alzheimer's disease when mild dementia is usually pharmacologically treated but as disease progresses, medication might be discontinued considering that the harm might outweigh the benefits). There is also a need to consider that social and economic factors are possibly more important for these patients than for a younger population.[34]

There are additional challenges faced when prescribing for care home residents: these residents are frail, vulnerable and often unable to care for their own health needs because of mental infirmity and their dependence on the institution they live in. Their care needs are very often greater than those of community-dwelling elderly. It was reported that 82% of older people in care homes have long-standing illness and 48% have two or more chronic conditions which require greater care. [19] Furthermore, a longer period of time is required to be attended by a GP, particularly when the resident is slow moving and may present communication difficulties because of speech, hearing and/or mental impairment. It has been demonstrated that a high level of morbidity in this elderly group is associated with a high

level of prescription medicines, with care home residents receiving an average of seven medicines at any one time.[3, 63]

2.7.1.2 Extrinsic factors

The first challenge is in the process of establishing a relatively efficient record keeping system. Very often the changes in treatment when residents get admitted and discharged from hospitals are not properly recorded on the patient's computer file at the GP's practice. Many practices permit a few GPs to work in a care home while some practices ensure that one GP is responsible for one home.[64] In the interest of ensuring that continued care and updating of information is efficiently done, the latter option is recommended.[64] Regardless of the approach, the current GP repeat prescribing systems has been identified as a barrier in ensuring that therapy is adequately monitored or reviewed.[65] These problems are compounded when more than one practice manages the residents of a care home. Multi-practice management of care homes still occurs but is becoming less common as primary care trusts have encouraged single practices to manage a care home (for example, through the additional payments to the practice to compensate for the extra workload).[9]

Apart from the GPs, residents are also attended by out-of-hours doctors and visiting specialists.[3] Under these circumstances, maintaining accuracy and up-to-date drug records can be difficult. Another issue is that communication with community pharmacists is generally done only by prescription, and therefore pharmacists are at a disadvantage because of their limited knowledge about the specific indications and complexities of the resident concerned. There may be scope for devising protocols of medicines management to ensure consistency of medication records between the care home, pharmacy and GP practice.[3]

In conclusion, due to the fragmented care and medicine management systems, coupled with a limited access to centralised healthcare records within the care home, these residents living in care homes are subject to a high risk of inappropriate prescribing.[19, 22]

The second challenge is the inherent concept and perception that residents in care homes are too frail and are approaching their end of life, and that a greater emphasis should be placed on improving their quality of life.[18] Hence, medications which would otherwise be scrutinised before being prescribed, such as opioids for relatively mild pain (non-steroidal anti-inflammatory drugs may be a better option but these are often contraindicated in older people) are more commonly prescribed. In addition, some medications would be prescribed at the request of residents or their families; they are also reportedly prescribed at the request of carers and staff in these homes.[9] The latter situation arises when residents with mental health problems, for instance, become aggressive; in such cases hypnotics or anti-psychotics are requested in the interest of keeping peace and maintaining a safe environment for staff and other residents.

2.7.2 Existing research on inappropriate prescribing in care homes

While the USA is possibly the pioneer in this field, there is an abundance of research highlighting inappropriate prescribing in care homes (both residential and nursing) in the UK. The two countries' findings, however, cannot easily be compared as the baseline information such as regulations, systems of care, databases and medicines used vary significantly. Furthermore, the use of different terminologies and a potential lack of understanding of each term can affect the interpretation of the findings. For instance, some literature which expressed results of inappropriate prescribing, i.e. the decision-making process of prescribing, were compared with results of studies which aimed at identifying prescribing errors i.e. occurred as a result of errors in both the decision-making process and the prescription writing process.[66] Depending on the inappropriate prescribing indicator used

(discussed below), studies of prescribing in UK care homes suggest the prevalence of inappropriate prescribing to range from 50 to 90% of patients.[67-69]

2.7.3 Inappropriate prescribing indicators

Inappropriate prescribing indicators can be pivotal in evaluating the performance of general practitioners who prescribe for older people in care homes; the evaluation can also encourage improvements in their quality of prescribing. Methods of evaluating inappropriate prescribing are subject to the aspects of prescribing that are intended to be measured and the prescribing data available. There are two methods that are generally employed: process measures which assess prescribing standards, i.e. they are direct measures of performance, and outcome measures which are indicators of adverse outcomes (e.g. additional morbidities, hospital admissions) that can occur as a result of process measures i.e. they are secondary measures of inappropriate prescribing.[44]

In this section, some advantages and disadvantages of explicit and implicit measures of inappropriate prescribing for both process and outcome measures will be explored, followed by some examples of these more commonly used measures. Process and outcome measures will briefly be discussed; the link between these two measures will be further established in the Chapter 3 systematic review.

2.7.3.1 Explicit and implicit criteria measuring processes

Explicit (criterion- based) indicators are usually developed from published reviews, expert opinions, and consensus techniques. These criteria are usually drug-orientated or disease-oriented, and can be applied with little or no clinical judgment. Another advantage of using explicit criteria is that they can be applied to large prescribing databases, provided they need little clinical detail. With criteria that require increasing amounts of additional clinical details, valid data from computerised databases will be needed.[44] Explicit criteria also do not take

into account all factors that define high quality prescribing for the individual (for instance in cases where an older patient is for palliative care, the prescribing of opioids would be deemed necessary). In contrast, in implicit (judgement-based) approaches, these factors are taken into consideration as the clinician uses information from the patient and published work to make judgments about appropriateness for each individual case. Nonetheless, implicit approaches have the disadvantage of being subject to the clinician's knowledge and attitude and hence the reliability of the implicit criteria is relatively low when compared to explicit criteria. In addition, the application of implicit criteria can be time consuming. [44]

Numerous explicit criteria for potentially inappropriate prescribing in older people have been published which: 1) in the USA, there are the Beers' criteria by Beers and colleagues,[70, 71] Zhan criteria, [72] and Assessing Care of Vulnerable Elders (ACOVE) project [73]; 2) in Canada, these are the Improved Prescribing in the Elderly Tool (IPET),[74] and McLeod criteria[75]; 3) in Australia, there are the Australian indicators [76]; 4) in France, there is the French consensus panel list [77] and in the Republic of Ireland, there are the Screening Tool of Older Persons' Prescriptions (STOPP) and Screening Tool to Alert doctors to Right Treatment (START)[78]. STOPP and START have in fact been adopted by the European Union Geriatric Medicine Society and consequently translated into several languages i.e. Czech,[79] Spanish,[80] and French.[81]

While in the USA, Beers' criteria was regarded the gold standard to identify inappropriate prescribing in USA nursing homes[82-84] as well as in other care settings[85-87] (also used in other countries in various settings[88-94]), there was an issue of transferability of these criteria to Europe. In Ireland, after many attempts of having adapted the criteria or after having compared the differences in outcomes when Beers' criteria was used against another criteria ,[95-97] there was criticism that many of the drugs listed in Beers' criteria were not available outside the USA or are rarely used nowadays, e.g. ergot mesyloids. The presentation of the

criteria was also reportedly lacking in structure, i.e. not organised according to physiological system hence making it time-consuming to apply in everyday clinical practice.[98, 99] Several European studies had reported that 50% of the drugs listed in Beer criteria were not listed in their formularies.[93]

As for implicit criteria, the two sets of criteria, Medication Appropriateness Index (MAI)[100] and the Assessment of Underutilization of Medicine[101], that identify process measures of inappropriate prescribing in older people, were published in the USA. The MAI measures the appropriateness of each prescribed medication using ten criteria: indication, effectiveness, dose, correct directions, practical directions, drug-drug interactions, drug-disease interactions, duplication, duration and cost. The MAI has some explicit instructions, which standardise the rating process, although clinical judgement is required to assess most criteria. Several researchers have used the MAI and recommended this in their articles[102-105], although the articles did highlight that application of the criteria was time-consuming. While the MAI does not address under-prescribing, the less commonly used Assessment of Underutilization of Medicine does. The Assessment of Underutilization of Medication requires the reviewer to match the patient's list of chronic medical conditions to the patients' list of prescribed medications to determine omission of an indicated drug based on the scientific literature. While one study demonstrated good inter-rater reliability between two clinical pharmacists who applied the criteria and suggested good sensitivity, other studies reported several limitations to the criteria. As the focus was more on the individual patient rather than on the drugs or diseases, the approach was very time-consuming, depended highly on clinicians' knowledge, skills, and attitudes; and hence the reproducibility was questionable. [101]

2.7.3.2 Explicit and implicit approaches to measuring outcomes

New measures have been developed that detect inappropriate prescriptions which cause harm to older patients. In one study, which employed the implicit approach, the association

between hospital admission and the use of interacting drugs in the week preceding the admission was investigated by clinicians.[106] Other researchers attempted to develop indicators of preventable drug-related morbidity (explicit approaches).[107-110] These indicators were suggested for use in epidemiological databases if appropriate linkage codes could be created; however, they could prove difficult to operationalise and their specificity as well as sensitivity were questionable.[111]

2.7.3.3 Process and outcome measures

As demonstrated above, there are diverse criteria for and approaches to assessing inappropriate prescribing, with each of these having its advantages and drawbacks. There is also an uncertainty as to whether the process measures are of any significance unless they have causal links with important outcomes (e.g. mortality, morbidity, adverse drug events, and quality of life). This important issue will be explored in the following chapter.

Chapter 3

Systematic review: association between inappropriate prescribing in care homes and adverse drug events

3.1 Introduction

In the previous chapter, I described the differences between process and outcome measures, both worthwhile measures depending on what data was available and what was intended to be measured. Process measures are useful in directly evaluating performance of GPs and their prescribing quality. To attest their validity and clinical relevance, these measures should demonstrate causal links with important adverse health outcomes such as adverse drug events. Adverse drug events in older people include hospitalisation and mortality which are contributed significantly by medication errors (e.g. errors in prescribing, dispensing, administration, monitoring).[112, 113] As described in Chapter 2, prescribing errors occur as a consequence of errors in both the decision-making process and prescription writing process, while inappropriate prescribing occurs following an inappropriate decision which was made during the decision-making process. In short, inappropriate prescribing can contribute to medication errors which contribute to adverse drug events; although not all IP are medication errors. In addition, not all medication errors (and inappropriate prescribing) result in harm, i.e. adverse drug events to patients (Figure 3.1).

One point to note is that the World Health Organization defined an adverse drug reaction as a response to a drug that is noxious, unintended and occurs at therapeutic doses. [114] While it is usually assumed that most drug reactions are non-preventable, the issue of whether or not there is any overlap between medication errors (which are considered preventable) and

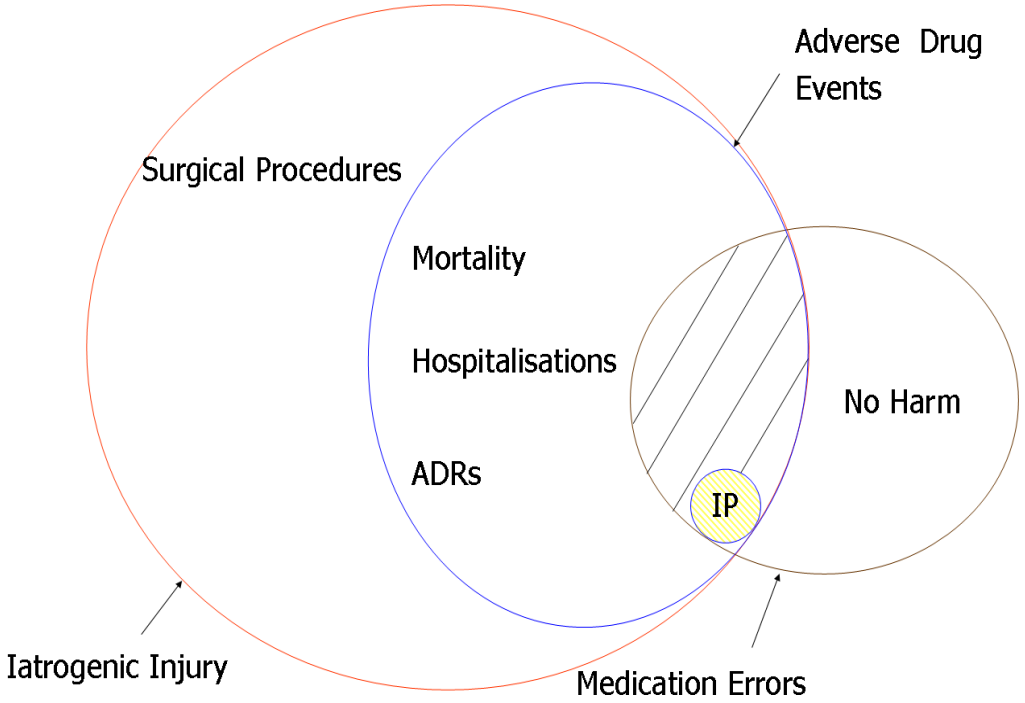
adverse drug reactions (because an interaction between some drugs may lead to an adverse drug reaction) or drug-drug interactions are controversial. Medication errors and adverse drug reactions are represented as two overlapping events[115] in Figure 3.1.

A study in the USA estimated that 3.6% of emergency department visits by community-dwelling older people were due to inappropriate prescribing as identified by Beers' criteria.[116] What is also already known is that older people have multiple co-existing morbidities which require them to have more prescriptions that their younger counterparts and hence they are at a greater risk of polypharmacy. This is consistent with previous studies that have demonstrated that polypharmacy is a predictor of inappropriate prescribing and adverse drug reactions.[117] Apart from causing harm to patients, medications errors were also known to have a significant impact on healthcare resources, public health and cost. For example, in the UK, the NHS reportedly paid out around £863 million in 2010/11 in the settlement of clinical negligence claims [118]; in 2000, medication errors accounted for around 25% of all claims in general practice [119, 120]

Whilst medication errors in older people are associated with adverse drug events, studies linking inappropriate prescribing and adverse drug events are limited. Such studies involving care home residents are further limited. Despite the limited number of studies, I undertook this systematic review. I reasoned that, without a better understanding of this association, one cannot extrapolate the results obtained from these process measures (assessing prescribing standards) to suggest that inappropriate prescribing does affect the relevant population, i.e. all older people living in care homes. I hence set out on a systematic review that was aimed to interpret studies that have established the association between inappropriate prescribing in care home residents and adverse drug events, specifically, hospitalisation and mortality.

This is the first systematic review to examine the relationship between inappropriate prescribing (IP) for care home residents and: (1) hospitalisation; and/ or (2) mortality. In this review, IP in older people was defined as: (1) use of medicines that pose more risk than benefit (particularly when safer alternatives exist); (2) prescribing of inappropriate dose or duration of drugs; (3) presence of clinically significant drug-drug interaction and drug-disease interactions; (4) under-use of potentially beneficial medications; (5) duplication of agents[121].

Figure 3.1: Relationship between medication errors and adverse drug events; not all medication errors or inappropriate prescribing result in patient harm (adapted from Franklin et al, 2005)[115]



Iatrogenic injury: harm caused by medical/surgical procedure **adverse drug events (ADEs):** harm that is drug-related **adverse drug reactions (ADRs):** unintended harm caused during normal use (also those that occur as a result of drug-drug interactions) **medication errors that result in harm (shaded):** any error in the prescribing, dispensing, administration, and monitoring of a drug and is a preventable cause of patient harm **inappropriate prescribing (IP):** occurs during the clinical decision-making process of prescribing; some IP contribute to medication errors that result in harm

*not all IP result in patient harm; some IP cannot be categorised as medication errors

+areas of the circles do not necessarily reflect the numbers or proportions in reality –figure is merely illustrating the relationships

3.2 Methods

3.2.1 Data sources and search strategy

The search for articles was first conducted in the first year of my PhD in June 2009. Kimberley Hockley (KH) and I designed the search strategy and performed the search together to identify published articles. I subsequently updated the search in the first week of January 2012 using the same strategy.

The search aimed to retrieve published articles on the association between inappropriate prescribing in care homes and one or both of hospitalisation and mortality. Definitions of care homes are included in Appendix 1. Databases used were OVIDSP (MEDLINE and EMBASE), International Pharmaceutical Abstracts and the Cochrane Library. We combined three groups of keywords: those relating to the care home setting; those relating to IP and those relating to hospitalisation and mortality. An example of a search strategy for the database EMBASE is illustrated in Figure 3.2; similar terms were used to search the other databases. All potentially relevant articles were exported into EndNote X2 software and duplicate articles were removed.

3.2.2 Study selection and data extraction

KH and I had then independently reviewed all articles retrieved by title and abstract to find relevant papers (Figure 3.3). Full text of the remaining articles were scrutinised and screened for eligibility based on the inclusion and exclusion criteria; these articles were assessed against the following inclusion criteria: i) randomised or non-randomised controlled studies, quasi randomised studies (including interrupted and non-interrupted time) and observational studies (case control, cohort or cross sectional); ii) those involving care home residents and their mean age 65 and above; iii) studies which identified inappropriate prescribing (IP) using

validated tool; iv) studies which evaluated the relationship between IP and the likelihood of hospitalisation and/ or mortality; v) those published between 1980 and December 2011.

Figure 3.2: Example of search strategy on EMBASE <1980 to 2012 Week 1>

1	(care home* or nursing home* or residential home* or long-term facility).mp. (521)
2	(adverse outcome* or hospital* or mortality or death or preventable admission or harm).mp. (173459)
3	(suboptimal presc* or misprescrib* or inappropriate or overpresc* or underpresc* or "prescr* error*").mp. (3148)
4	exp geriatric care/ or nursing home/ or elderly care/ or residential home (88195)
5	exp hospital admission/ or hospitalization/ or mortality (760226)
6	exp inappropriate prescribing/ or prescribing error (387)
7	1 or 4 (88706)
8	2 or 5 (933545)
9	3 or 6 (3235)
10	7 and 8 and 9 (263)

Mp: indicates that title, abstract, medical subject headings (MeSH), heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name and keyword were searched

Apart from mapping keywords to MeSH, the explode function (exp) was also used to search for MeSH and related narrower terms

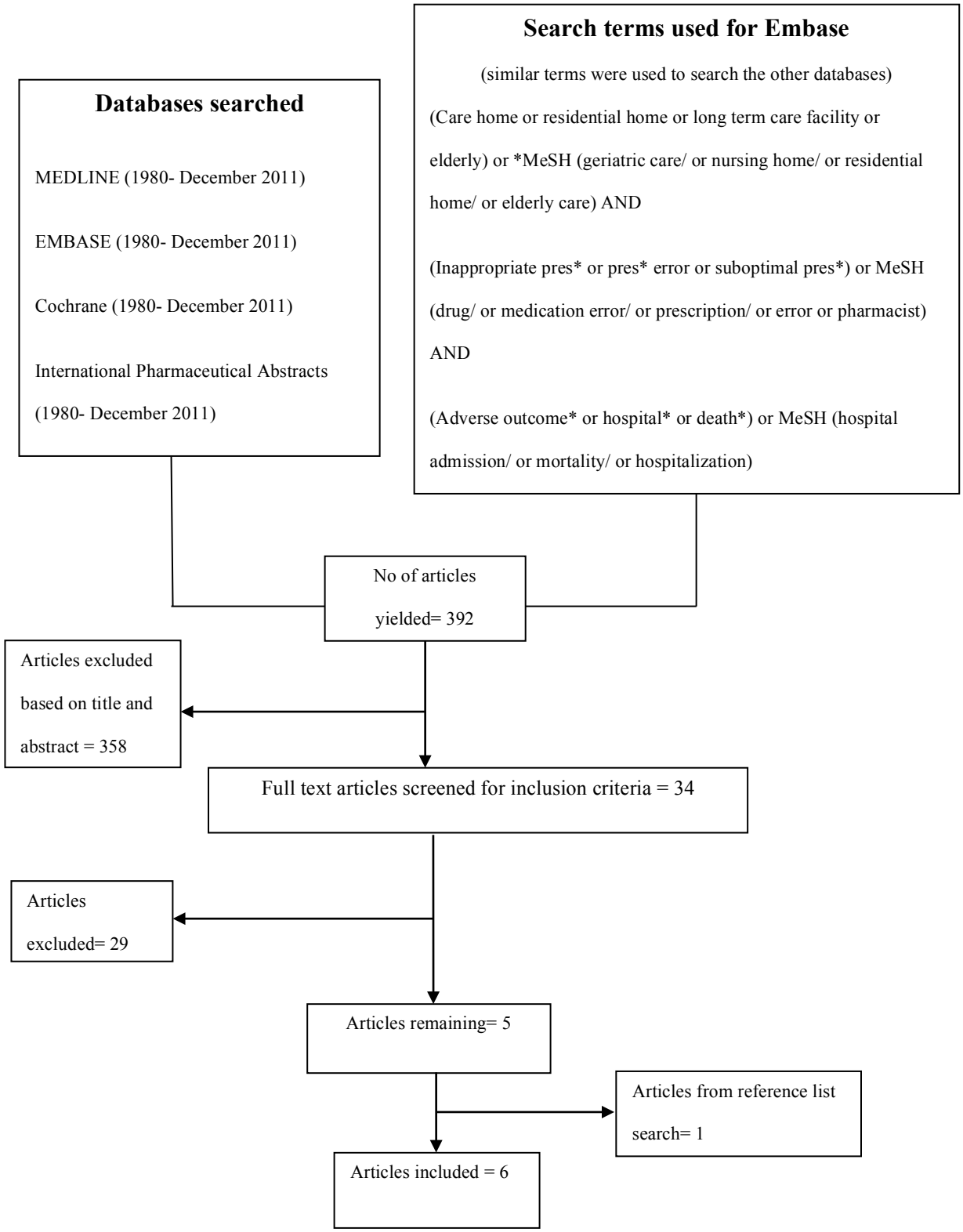
Articles were excluded if they did not use specific criteria to assess IP (e.g. the presence of high rates of antipsychotic prescribing associated with short-term mortality[123]) The reference lists for articles that met the inclusion and exclusion criteria were then reviewed to identify

any further articles. Any discrepancies in the inclusion of articles independently assessed by KH and I were resolved by discussion or by Professor Azeem Majeed (AM), acting as the third independent reviewer. In the updated version of the search, I conducted the search and AM verified the final additional paper(s) identified. Data from the final articles included were extracted onto Microsoft Excel software.

3.2.3 Quality assessment

As all our final studies were cohort studies, the quality assessment was conducted for each of the study using the Critical Appraisal Skills Programme (CASP) for observational cohort studies checklist.[124] The published checklist comprised 12 questions and was designed for appraising a cohort study and the broad issues (e.g. focussed in terms of population studies, appropriateness of study design, selection bias of the cohort, methodological control of confounders) that need to be considered when appraising such a study. The last two questions on implication to the local population were disregarded as the majority of studies did not originate from the UK; hence the maximum score given to an article was 10. In relation to question 9, follow-up period of less than 6 months was regarded as sufficient to accurately capture the relationship between IP and adverse outcomes. Scoring was completed independently by KH, AM and I. For the one article identified in the later search, I alone performed the scoring.

Figure 3.3: Schematic diagram of the literature search



3.3 Results

After the removal of duplicates, a total of 392 articles were identified, of which 6 met the inclusion and exclusion criteria. The other articles were excluded mainly because sub-analyses for nursing home residents were not performed or they were review articles or were about studies assessing medication utilisation. Following a literature search that resulted in such few studies, a meta-analysis that is usually performed to increase power and precision of a systematic review or a funnel plot to determine publication bias seemed inappropriate.

Data extracted from each study in the articles is depicted in Table 3.1. Some characteristics of the studies worth mentioning are: 1) all studies were retrospective cohorts; 2) participants of the studies, whose data was included lived in sheltered homes, intermediate care facilities, their own homes or apartments, residential and nursing homes, while some were admitted to geriatric wards; 3) data on exposure to IP was derived from Medicaid's medication claim history[125] (Medicaid is USA's health programme for individuals and families with low incomes and resources), medication administration records and charts,[126, 127] face-to-face interviews with residents and their carers or families,[128] and central medical database; [95] 4) outcomes i.e. mortality and hospitalisation, were identified from Medicaid claim forms signifying "recipient's death date", computerised in-patient registers,[128] central registers,[129] linked database[95], local authorities,[128] nursing home,[126] and local hospital records;[126, 129] 5) IP was measured using the Beers' criteria (the criteria has 2 subsets); the majority of studies used the subset 'medications that should generally be avoided independent of diagnoses'. Several studies disregarded the other subset 'medications that should generally be avoided considering dose and diagnoses' while a few studies excluded one criterion from this subset i.e. 'over the dosage limit'.

Results of the studies are presented in Table 3.1. One study found a significant association between IP and both hospitalisation and mortality.[126] Another study found that the odds of overall hospital admissions significantly increased in the presence of IP (OR 2.00; 95% CI: 1.33 to 3.00) although a sub-analysis for nursing home residents did not demonstrate similar associations.[128] One found a significant positive association with at least one outcome i.e. hospitalisation, mortality or emergency department visits.[127] Three studies, two which aimed at finding an association with mortality [95, 125] and one which targeted hospitalisation[129] found no significant results.

Mean quality scores are presented in Table 3.2. Studies were generally of high quality with mean scores of 8 and above. One study [125] was scored 8 out of 10 because of the incompleteness in measurement of IP (score of zero for criteria 4), and hence the reliability of results is questionable (score of zero for criteria 10). This was due to the limitations in the record-keeping of the exposure data, i.e. cases where only names of medications were available on Medicaid claim forms. The authors had no access to information on dosage, duration, or indication for each of the medication prescribed. We are therefore unsure of how they applied the Beers' criteria[70] as there was no exclusion listed clearly in their aims or methods. Measurement of IP and thus the reliability of results are questionable. In another study,[95] authors used the updated Beers' criteria[71] and for the four criteria which required dosage consideration, an estimation was made from dosage data that was available only for diabetic patients. This study also received a score of zero for criteria 4. They however, excluded data of patients whose dosage was estimated in their overall IP prevalence results and hence their results were more reliable. For this reason, a score of 1 was awarded for criteria 10.

Table 3.1: Characteristics of included studies

Study (year, country)	Design and setting	Population description exclusion, n, age	Exposure			Outcomes			Main findings
			Description of IP screening	Exposure data	Follow up	Measured outcomes	Outcome data	Adjusted covariates	
Gupta et al,[125] 1996, USA	retrospective cohort; *intermediate-care facilities	Medicaid beneficiaries listed in the Louisiana Medical Dataset; n= 19932; age≥65	no. of inappropriate Rx); Beers' criteria (1991):[70] "do not use"	Louisiana Medicaid datasets, Medicaid claim history and drug files	1 year	cost of pharmaceutical services, mortality	"date of death" on Medicaid last claim document	sex, race, geographic region of origin, age, no. of physicians, no. of pharmacies, no. of inappropriate Rx	non-sig: no. of inappropriate Rx has no association with mortality (p= 0.31)
Klarin et al,[128] 2005, Sweden	retrospective cohort; house or apartment (n: 657), *sheltered housing (n: 110), nursing home (n: 18)	Nordanstig cohort (Kungsholmen Project); n= 785; age ≥75	OTC and prescribed Rx; drug-disease interaction from McLeod criteria (1997)[75] plus Beers' (1997):[130] "do not use-only high severity" plus several clinical indicators of preventable drug-related morbidity	interviews with patients (show medication containers, Rx and medication lists)	3 years	hospitalisation, mortality	details of hospitalisation via the country computerised inpatient register; mortality via community authorities.	age, sex, education level, housing, comorbidity, dependency in ADL, smoking, body mass index, smoking status	non sig: odds of hospitalisation and/or mortality did not increase in the presence of IP (model was not shown) **sig: risk of acute hospital admissions increased in the presence of IP** (OR 2.00; 95% CI: 1.33 to 3.00, p=0.001)

Lau et al,[126] 2005, USA	retrospective cohort; nursing homes	Residents listed in the 1996 Medical Expenditure Panel Survey Nursing Home Component with a stay of ≥3 consecutive months in NHs; exclusion criteria: comatose, missing all drug data, received no drugs, NHs that specialise in treatment of HIV/AIDS or other specialty; n= 3372; age≥65	IP identified monthly; Beers' (1997):[130] 1) "do not use", 2) incorrect dosage, 3) drug-disease interaction	Medication administra-tion records, medical charts	1 year	hospitalisation after 1 month or 2 months of IP (consecutive measurements because IP dates reflect month but not day so if both occurred in the same month, could not be determined if IP preceded or followed hospitalisation); mortality in the same month, 1 month or 2 months after IP	dates of inpatient hospital stays & dates of death from nursing home records	age, sex, race, Medicaid coverage, admission before 1996, functional status, communica-tion problems	**sig:1)odds of hospitalisation higher in the presence of IP** i) in each month (OR 1.27, 95% CI 1.09 to 1.47, p=0.002); ii) for two consecutive months (OR 1.27, 95% CI 1.08 to 1.51; p=0.004) iii) for the first of two consecutive months (OR 1.80, 95% CI 1.34 to 2.41, p=0.001) 2) **odds of mortality higher in the presence of IP** i) in each month (OR 1.28, 95% CI 1.05 to 1.55, p=0.01) ii) for 2 consecutive months (OR 1.89, 95% CI 1.47 to 2.44,p < 0.001)

Perri et al,[127] 2005, United States	retrospective cohort; 15 nursing homes	Medicaid beneficiaries of Georgia nursing home considered at risk of polypharmacy; n= 1117; age ≥65	prescribed OTC & prescribed Rx Beers' (1997)[130] : "do not use", additionally clinicians identified "acute medication for chronic use", duplication, ADRs, drugs matched to indication	pharmacist medication review of medical records, medical charts	3 mths	hospitalisation, emergency department visits, mortality	Medicaid claims	age, sex, length of stay, "do not resuscitate" status, diagnosis	**sig: IP positively associated with at least one outcome** (OR 2.342, 95% CI 1.610 to 3.405, p< 0.01)
Raivio et al,[129] 2006, Finland	retrospective cohort; 7 acute wards of 2 geriatric hospitals (n: 230), 13 wards of 7 nursing homes (n= 195)	admitted in Helsinki NHs and acute geriatric hospitals; exclusion criteria: coma; n= 425; age>70	only medications used daily; Beers' (1997)[130] : "do not use-diagnosis independent"	patient interviews, caregiver interviews, medical records	2 years	hospitalisation, mortality	mortality: data from central registers; hospitalisation: medical records at area hospitals	age, sex, education, comorbidity, dementia, nursing home vs. hospital, number of appropriate drugs, functional impairment	non-sig: no association between IP & hospitalisation (p=0.43 without dementia; p=0.34 with dementia); no association between IP& mortality (p=0.23 without dementia; p=0.51 with dementia)

Barnett et al,[95] 2011, UK	retrospective cohort study; living at home (n=65,742), living in care homes (n=4557)	population of Tayside, Scotland; exclusion criteria: 100 years and older, those who moved out of the area; n=70299; age=66-69	modified Beers' criteria (2003)[71] : UK equivalent drugs, "do not use" (not stated but likely diagnoses-independent), criteria on incorrect dosage mainly excluded	anonymised patient medical database managed by Health Informatics Centre of University of Dundee	2 years	Mortality	separate database that was linked to exposure data via unique community health identifier numbers	age, sex, comorbidity, polypharmacy, place of residence (home vs. care home)	non sig: IP did not increase the risk of mortality (OR 0.98 95% CI 0.92 to 1.05); when exposed to IP, care home residents were about 4 times more likely to die than those living at home (OR 3.48, 95% CI 3.24 to 3.75)

*Intermediate care facilities are residential programmes where individuals with intellectual disabilities or other related conditions provided with services and support they need; residents usually require care on an intermittent basis and are fairly independent of activities of daily living.

Sheltered housing covers a wide range of rented housing for older and/or disabled or other vulnerable people; Medicaid is USA's health programme for individuals and families with low incomes and resources.

"Do not use" refers to list of medication in Beers' criteria that should generally be avoided in persons 65 years or older because they are either ineffective or they pose unnecessarily high risk for older persons and a safer alternative is available (considering dose and diagnoses and without considering diagnoses)

IP: inappropriate prescribing **no:** number **Rx:** prescriptions **non-sig:** non-significant **sig:** significant **NHs**: nursing homes **OTC**: over-the-counter **ADL:** activities of daily living **OR:** odds ratio **CI:** confidence interval **HIV:** human immunodeficiency virus **AIDS**: acquired immunodeficiency syndrome **mths**: months **ADRs**: adverse drug reactions

Table 3.2: Mean quality scores of three reviewers based on the Critical Appraisal Skills Programme (CASP) for observational cohort studies checklist

	Criteria addressed	Gupta et al (1996)	Klarin et al (2005)	Lau et al (2005)	Perri et al (2005)	Raivio et al (2006)	*Barnett et al (2011)
1	Focused: population, risk factors, outcomes	1	1	1	1	1	1
2	Appropriateness of study design	1	1	1	1	1	1
3	Cohort: generalisability	1	1	1	1	1	1
4	Exposure: objective measurement with validated instruments	0	1	1	1	1	0
5	Outcome: objective measurement with validated instruments	1	1	1	1	1	1
6	Confounders: identification	1	1	1	1	1	1
7	Confounders: methodological control	1	1	1	1	1	1
8	Follow up: complete	1	1	1	1	1	1
9	Follow up: time	1	1	1	0	1	1
10	Results: reliability	0	1	1	1	1	1
	Total	**8**	**10**	**10**	**9**	**10**	**9**

***for the study by Barnett et al, only one reviewer performed the scoring**

1: criteria evidently met **0: criteria not accounted for/ unclear**

maximum score 10

3.4 Discussion

3.4.1 Summary of evidence

There were mixed results for the evidence of a positive association between IP and either or both hospitalisation and mortality. Studies by Lau et al, Perri et al and Klarin et al found some positive associations for either or both outcomes; the common theme between these studies is that they had tried to capture as much IP as possible. They either used: 1) both of the subcriteria of Beers criteria[126] ('medications that should generally be avoided considering dose and diagnoses' including "over the dosage limit" and "drug-disease interaction" and 'medications that should generally be avoided independent of diagnoses'); or 2) they employed a panel of clinicians to identify additional inappropriateness[127] (e.g. duplication, adverse drug reactions); or 3) they used a modified set of criteria incorporating indicators that captured the additional inappropriateness[128]. When a greater exposure to IP is captured, there is a greater probability of establishing an association with the outcome. Such positive associations were also evident in another study where researchers found that the higher the rate of IP, the higher were the numbers of hospitalisation.[131] The study however took it a step further by also employing causality measurement[132] and preventability[133] i.e. in addition to using criteria that measured IP, they used two other criteria to assess if hospitalisation was cause by the adverse drug events and whether these events were preventable. This study was not included in our review because nursing home residents who made up 16% of the population sample studied were not analysed as a sub-group when determining the extent of associations.

Both studies by Gupta et al and Raivio et al did not find significant results; hence we could not ascertain if there is no association or perhaps a lack of association. The study by Barnett et al did not find that the odds of mortality increased in the presence of IP (OR 0.98 95% CI

0.92 to 1.05)[95]; however they reported that care home residents were 3.5 times (OR 3.48, 95% CI 3.24 to 3.75) more likely to die than those living at home when both groups were equally exposed to IP. There were other studies in the published literature that found no association between IP and hospitalisation[134] or mortality[135]. One common conclusion identified in most of these studies which did not find an association, was the criticism of Beers' criteria due to the irrelevance of some of the drugs listed and thus the criteria's reliability were questioned.[95, 129, 134] In fact, the more successful studies had instead adopted alternative approaches i.e. by using explicit methods (Screening tool of older persons' prescriptions, STOPP [131] or Medication appropriateness index, MAI [136]) and/or using implicit methods[127] to identify IP.

3.4.2 Limitations

There are several limitations to our review. They can be divided into review limitations and study limitations. Study limitations include: 1) differences in sources of outcome data and methods of measuring of IP; and 2) inclusion of patients with dementia or with high rates of polypharmacy, both of which could have potentially introduced selection bias. On the other hand, at the review level, I had aimed to find articles which assessed IP associations with adverse drug events that are very severe i.e. mortality. One could potentially disagree and argue as to whether death is a good measure in an already frail population. Besides, we made two important assumptions: 1) that at least 6 months was necessary to assess an outcome (see quality assessment), when in reality we cannot be certain of the temporal relationship between IP and hospitalisation or death; 2) that residents died due to medication use and not worsening of an underlying disease.

3.5 Conclusion

Demonstrating a link between process and outcome measures is complex. We attempted to do this but were left with inconclusive evidence for any association between inappropriate prescribing and either/ both hospitalisation and mortality. Nevertheless, the review highlights a vital point and that is the lack of research within this field and therefore a need for more large scale studies. Despite the limited evidence not just in care homes but also in other settings for similar associations, many studies have successfully demonstrated associations of IP with other health outcomes such as cost of pharmaceutical services,[125] emergency department visits[136] and adverse drug reactions.[137]

With too few studies, any findings (or perhaps the lack of it) cannot be extrapolated to implicate policy. As for implications to practice, process measures using explicit criteria are good indicators and are useful for monitoring high risk medications and at-risk populations. They however, cannot substitute clinical judgement. It seems unlikely that assessment tools and indicators of inappropriate prescribing were developed for reasons other than because they prevented at least a certain level of harm to patients. Therefore, there still is a great need to underscore the importance of improving prescribing practices especially for vulnerable older population in care homes. Evidence for effective interventions that have been employed in the care home setting to improve such prescribing practices will be explored in the next chapter.

Chapter 4

Systematic review: interventions to optimise prescribing in care homes

4.1 Introduction

As demonstrated in previous chapters, inappropriate prescribing is associated with various adverse drug events, such as increased emergency department visits[136], adverse drug reactions, hospitalisation and mortality.[126-128] Despite a growing body of evidence that inappropriate prescribing is common, and an important cause of these adverse drug events, effective interventions to reduce such harm is still limited.[138] The lack of effective interventions is greater in older people living in care homes.

I emphasised in Chapter 2 the various intrinsic factors that make prescribing in older people a complex process. Briefly, older people often have multiple co-morbidities, age-related pharmacokinetic and pharmacodynamic changes and polypharmacy.[139] In addition, due to their multiple co-morbidities, older people are prescribed more medication than younger people. In England, for instance, while younger people received an average of 9.5 items per year, people aged 60 and over received an average of 42.4 items in 2007.[140] This almost doubled over a 10 year period; the corresponding figure in 1997 was 22.3 prescription items.[140] With an ageing population, medication use is projected to rise further as chronic conditions, such as diabetes and hypertension will require more intensive therapy.

In addition to the intrinsic factors which make prescribing in older people a complex process, there are limited guidelines to base prescribing on. Randomised controlled trials of drug treatment for common conditions in the elderly often focus on a single-disease process; they

often do not take into account co-morbidities and other factors that may affect the response to treatment; for example, drug–drug interactions and the effect of the drug on other disease processes.[34]

In addition to the intrinsic factors, care home residents are particularly vulnerable to inappropriate prescribing: they are more fragile, unable to detect errors in their prescriptions and receive interventions from multiple sources.[3] These residents are therefore at risk of sub-optimal prescribing, particularly overprescribing, receiving up to four times as many prescriptions compared with older people living in the community [141] and prone to 'prescribing cascades'.[53] In the UK, the average number of medications taken at one time by a care home resident is between six and seven, with over 20% of residents using more than 10 medications.[69, 126, 142]

While there is evidence of interventions to minimise inappropriate prescribing in hospitals, outpatient settings and primary care, little has been done to evaluate interventions in care homes. Reviews have been published in recent years on interventions designed to reduce IP in older people,[143, 144] and one has examined pharmacists' interventions to optimise medication use in nursing homes.[144] Adopting a more holistic approach, my systematic review was aimed at interpreting the results of studies that have evaluated any type of strategy to improve prescribing in care homes. This is the first systematic review examining a range of different types of interventions solely based in care home settings.

4.2 Methods

4.2.1 Data sources and search strategy

The search for articles was conducted in the second year of my PhD in April 2010. Shonella Singh (SS) and I designed the search strategy and performed the search together to identify

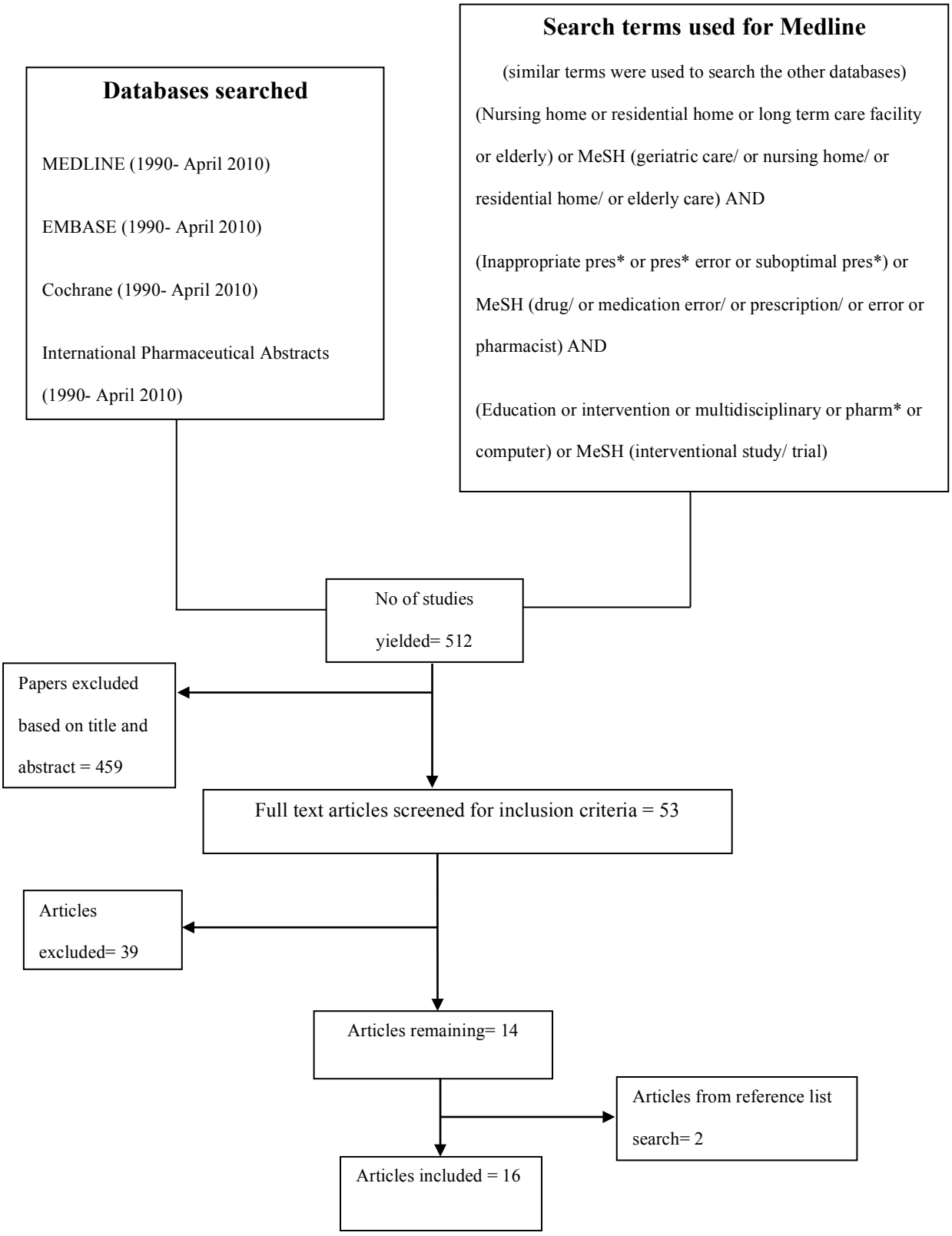
published articles. We did not create a review protocol. The search has not been updated since because of the relatively larger number of studies found initially, and time constraints.

Our search strategy aimed to retrieve only published articles on interventions to improve prescribing in care homes (residential, nursing and mixed homes; defined in Appendix 1). SS and I used the databases OVIDSP (MEDLINE and EMBASE), International Pharmaceutical Abstracts and the Cochrane Library. We combined three groups of keywords: those relating to the care home setting, those relating to IP and those relating to interventions (Figure 4.1). All potentially relevant articles were exported into EndNote X2 software and duplicate articles were removed.

4.2.2 Study selection and data extraction

SS and I had then independently reviewed all articles retrieved by title and abstract to find relevant papers. Full text of these relevant papers were retrieved, scrutinised and screened for eligibility based on the following inclusion criteria: (i) randomised or non-randomised controlled studies; (ii) residents' mean age of at least 65; (iii) care home-based setting; (iv) evaluated the effect of an intervention on prescribing, aimed at improving appropriate prescribing or reducing inappropriate prescribing (IP); (v) written in English; and (vi) published between 1990 and April 2010. Studies published only as abstracts were excluded. In this review, IP in older people was defined as either, or a combination of the: (i) use of medicines that pose more risk than benefit (particularly when safer alternatives exist); (ii) prescribing of inappropriate dose or duration of drugs; (iii) presence of clinically significant drug–drug and drug–disease interactions; (iv) under-use of potentially beneficial medications; or (v) duplication of agents.[121] The reference lists for articles that met the inclusion criteria were then reviewed to identify any further papers.

Figure 4.1: Schematic diagram of the literature search



Any discrepancies in the inclusion of articles independently screened by SS and I were resolved by discussion or by Professor Azeem Majeed (AM), acting as the third independent reviewer. Specific data from the final articles included were then extracted onto Microsoft Excel software. Outcome measures were examined to assess whether a meta-analysis could be performed.

4.2.3 Quality assessment

A quality assessment was conducted for each study using a modification of the Downs and Black tool. [145] The published tool comprises 27 items with a maximum score of 32; the last item evaluating the power of the study is scored out of 5. However, in line with previous studies[146], this was omitted due to its potential ambiguity; hence, the maximum score in our review was 27. Scoring was independently completed by SS and I, and any discrepancies were resolved through discussion or by AM. Higher scores reflected better study quality (Table 4.1).

Table 4.1: Mean quality scores of two reviewers based on Downs & Black checklist

	Fossey et al,2006[19]	Eide et al, 2001[18]	Avorn et al, 1992[22]	Rovner et al, 1996[25]	Stein et al, 2001[23]	Meador et al, 1997[20]	Crotty et al, 2004[24]	Ray et al, 1993[21]	Zermansky et al,2006[26]	Furniss et al, 2000[27]	Roberts et al, 2001[28]	Schmidt et al, 1998[29]	Crotty et al,2004[30]	King et al, 2001[17]	Field et al, 2009[31]	Gurtwitz et al, 2008[32]
Reporting	9	5	9	9	9	8	9	9	9	9	9	7	8	6	9	9
External validity	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Bias	7	4	7	7	7	7	7	5	6	7	6	5	7	1	6	6
Confounding	6	2	6	5	6	4	6	4	6	6	5	5	6	3	6	6
Total	**25**	**14**	**25**	**24**	**25**	**22**	**25**	**21**	**24**	**25**	**23**	**20**	**24**	**13**	**24**	**24**

maximum score for reporting: 11 (10 questions, with one item having a maximum score of 2)

maximum score for external validity: 3 (3 questions); maximum score for bias, 7 (7 questions)

maximum score for confounding: 6 (6 questions); maximum total score, 27

4.3 Results

A total of 512 articles were identified, of which 16 met the inclusion criteria. Studies were conducted in nursing homes, residential homes, long-term care facilities and mixed homes. Overlaps between some of the interventions exist. However, for the purpose of this review, interventions were grouped into one of the following four groups: staff education (prescribers and/or care home staff; n=8), multidisciplinary team (MDT) meetings (usually chaired by the prescribing physician; n=3), pharmacist medication reviews (n=3) and computerised clinical decision support systems (CDSSs; n=2). Mean quality scores are presented in Table 4.1; studies were generally of high quality with mean scores of 20 and above. Two had much lower scores, one due to potential selection bias,[147] and one due to potential confounding in a partially controlled before-and-after study [148]. We could not perform a meta-analysis due to heterogeneity in the outcomes measured.

4.3.1 Staff education

Eight studies (Table 4.2) reviewed the impact of educational interventions; six showed statistically significant improvements in prescribing quality.[148-153] Academic detailing was used in six of the eight studies sometimes combined with additional strategies. This is an educational outreach programme by an expert, involving face-to-face education with prescribers to discuss relevant clinical practice. Fossey et al. (UK), Meador et al. (USA) and Ray et al. (USA) evaluated the effect of enhanced psychosocial care training on neuroleptic use, focusing on behaviour management. [149-151] They reported decreased numbers of residents on neuroleptics, reduced antipsychotic doses and reduced days on antipsychotics, respectively. Eide et al. (Norway), in their before-and-after study with additional post-intervention concurrent controls, described the effects of a pharmacist-led education programme on the prescribing of hypnotics.[148] Of six outcome measures assessed, only one showed a significant improvement. Avorn et al. (USA) focused on geriatric

psychopharmacology, where a comprehensive educational outreach programme led by a pharmacist focused on reducing the overall use of psychotics by improving the selectivity of their use.[152] The intervention resulted in decreased mean psychoactive drug use scores, a scoring tool developed by the authors. Stein et al. (USA) assessed the effect of a 30 min structured training session on non-steroidal anti-inflammatory drugs (NSAIDs) prescribing and found decreased NSAIDs use.[153] Neither the studies of Crotty et al. (Australia),[154] which focused on falls and stroke prevention using pharmacist-led education, or Rovner et al. (USA),[155] which evaluated the effect of educational round by a psychiatrist, resulted in statistically significant changes in prescribing.

4.3.2 Pharmacist medication reviews

Three studies (Table 4.3) investigated the impact of pharmacist-led interventions on prescribing.[63, 156, 157] Various strategies were used: a single medication review plus consultation with carer and patient, and a clinical pharmacy programme utilising a number of different interventions. Only one of the studies reported statistically significant changes: Zermansky et al. (UK) assessed effects of a clinical medication review and reported significant changes in the number and type of medication (medications discontinued and commenced), but the total number of medications used remained the same. [63]

Furniss et al. (UK) examined the effects of medication review by a pharmacist and assessed appropriateness of prescribing of neuroleptics based on the USA's Omnibus Reconciliation Act (OBRA) 1987 guidelines.[156] There was a decline in the number of drugs prescribed with corresponding savings in drug costs, although this was not statistically different. Roberts et al. (Australia) examined the impact of a clinical pharmacy programme.[157] The intervention was threefold; relationship building with stakeholders, nurse education, and medication review by clinical pharmacists. No significant differences in drug use (total drugs and

subcategories) or morbidity indices (hospitalisation rates, adverse drug events) were identified.

4.3.3 Multidisciplinary team meetings

Three studies (Table 4.4) evaluated the effect of MDT meetings on prescribing and two showed statistically significant findings.[158, 159] With a sample representing 5% of Swedish nursing homes, Schmidt et al. examined the impact of monthly MDT meetings on adherence to the 1994 Swedish Medical Product Agency (SMPA) prescribing guidelines.[158] The SMPA guidelines, which provide recommendations on the use of psychotropics, were available to all physicians in Sweden but were actively distributed to physicians in the intervention homes. The intervention resulted in a significant decrease in the prescribing of several psychoactive drugs. Crotty et al. (Australia) conducted MDT meetings in the presence of a representative from the Alzheimer's Association of South Australia. The Medication Appropriateness Index (MAI) was used to assess the appropriateness of medication.[159] A within-facility control was also set up to assess any 'carry-over' effect. A significant improvement in appropriateness of prescribing and no evidence of 'carry-over' effect to other residents were demonstrated in the intervention homes. King et al. (Australia) carried out a controlled before-and-after study where cases for discussion were selected by their GPs who then led a 30 min case discussion and management plan. No significant changes were reported in medication use, cost and mortality.[147]

Table 4.2: Summary of studies within the category of staff education

Author & year (country)	Design & setting	Age	Inclusion & exclusion criteria	Description of intervention	Outcomes	F/up	*Statistically significant findings
Fossey J et al, 2006 (UK) [19]	cluster RCT, 349 NHR; 12 NHs (four each in London, Newcastle & Oxford)	median 82	inclusion: NHs with a minimum 25% of residents with dementia taking neuroleptics	- training & support to NH staff on alternatives to neuroleptic use, behavioural management techniques -led by psychologist/nurse/OT -old age psychiatrist telephoned to provide/ wrote prescribing recommendations	proportion of NHR prescribed neuroleptics	12 mths	-average reduction in proportion of NHR taking neuroleptics (19.1%, 95% CI 0.5-37.7%, p=0.045)
Eide at al, 2001 (Norway)[18]	before-and-after study with additional post-intervention concurrent control, 266 NHR; 5 NHs	mean=86.5	baseline data from 1995's study, post-intervention in 2000 with additional concurrent data from control homes	-results from baseline data on poor use of hypnotics sent to physicians, nurses & directors of the institutions -AD: pharmacists held meetings with physicians & nurses to discuss use of hypnotics; information described as 6 simple 'rules' (eg. avoid administration early in the evening)	change in use of hypnotics	5 yrs	-higher proportion of patients in 2000 vs 1995 who used high dose hypnotics -proportion of patients who received hypnotics before 9pm reduced; 44.3% vs 13.3% in 2000 (p<0.01)
Avorn et al, 1992 (USA)[22]	cluster RCT, 823 NHR; 12 NHs	N/A	exclusion: NHs with atypically high/low levels of psychotropics	- sessions on geriatric pharmapsychology e.g. alternatives to sedation in behaviour problems/insomnia -face to face education to nurses -leaflets to all physicians of NH residents -AD: physicians invited for separate session with pharmacist if their prescribing was above threshold during baseline evaluation	total drug use of hypnotics/ benzodiazepines/ anti- psychotics, psychoactive drug use scores	5 mths	-27% reduction in mean psychoactive drug use (intervention) vs 8% (control) -32% (intervention) vs 14% (control) had antipsychotics discontinued - greater reduction in no. of days of antipsychotics use per patient per month in intervention vs control -greater no. of non-recommended hypnotics discontinued & substituted with acceptable drugs/stopped completely (45% vs 21%)

Rovner et al, 1996 (USA)[25]	RCT, 89 NHRs; 250 bed intermediate care NHs	mean= 81.6	inclusion: residents with both behavioural disorders & dementia	-implementation of new prescribing guidelines according to protocol for psychotropic drug management led by study psychiatrist -weekly 1-hour educational rounds regarding patients medical status/behaviours. lead by psychiatrist	composite behavioural disorder – measured as present/absent , antipsychotics use, restraint use	6 mths	none
Stein et al, 2001 (USA)[23]	cluster RCT, 147 NHR; 10 pairs of NHs	> 65	inclusion: NHs with high proportion of residents on NSAIDS (at least 8% on NSAIDs each month, NHR with > 1.2g ibuprofen dose equivalents per day for at least 4 of the past 7 days	-30 minute structured training session for staff (60-65% attendance) -telephone conversations (n=8)/ primary care physicians visited (n=27) by study physician (educational message included risks & benefits of NSAIDs, algorithm for stopping NSAID treatment, or substituting with paracetamol or topical analgesia & non-pharmacological methods for muscular pain management)	NSAID & paracetamol use	3 mths	-decrease in mean no. of days of NSAID use from 7.0 to 1.9 days (intervention) vs 7.0 to 6.2 days (control) p=0.0001 -increase in paracetamol use by 3.1 days (intervention) vs 0.31 days(control) vs (p=0.0001
Meador et al, 1997 (USA)[20]	cluster RCT, 1311 NHR; 12 NHs	mean=83.5	inclusion: NHs with antipsychotic use prevalence 20%, mean dose ≥100mg thioridazine equivalents, not specialised in psychiatric patients, no program to withdraw antipsychotic drugs , NHR for at least 6 months after date of study	-AD: a 45-60 minute visit by geropsychiatrist to all physicians to discuss risk and benefits of antipsychotic medication, physicians received referral card with summary of key points & flow chart for antipsychotic withdrawal -five to six 1-hour programmes for NH staff over a 1 week period , staffs received professionally designed manuals that described behaviour management program - follow-up session after 4 weeks -evening meeting for families when requested	change in days of antipsychotic use per 100 days of stay, withdrawal from antipsychotics, reduction in antipsychotic dose by 50% or more	6 mnths	decrease in antipsychotic use from 25.3 per100 days to 19.7 per 100 days , 23% NHRs had their antipsychotic dose reduced by 50% relative to control (p=0.014)

Author & year (country)	Design & setting	Age	Inclusion & exclusion criteria	Description of intervention	Outcomes	F/up	*Statistically significant findings
Ray et al, 1993 (USA)[21]	controlled before-and-after, 378 NHR; 4 rural NHs	mean= 81.9	inclusion: 2 homes with point prevalence of antipsychotic use >25% & stable for 6 months, 2 comparable homes as controls	- AD: old age psychiatrist educated physicians on risks/benefits of antipsychotics, reference card with recommendations & flow chart for drug withdrawal given - six 1-hour sessions for NH staff in 3-weeks (held multiple times to enable all staff to attend) -behaviour management program explained via role play & case examples -manual for weekly follow up sessions -a 4- hour consultation by NH management specialist to home's administrator addressing quality care -evening meetings with families to address concerns & explain program -8 weeks' post intervention, meeting held with home medical director, director of nursing, psychiatrist & nurse educator to discuss difficult patients	changes in administration of psychotropic drugs, physical restraint use, frequency of behaviour problems	13 mnths	-days on antipsychotics decreased by 72% (intervention) vs 13% (control)(p<0.001) -intervention: 44 of 63 (70%) patients on antipsychotics attempted withdrawal & successful in 30 (48%); control: withdrawal attempted in 13 of 59 (22%) & successful in 7 patients (12%) (p<0.001)
Crotty et al, 2004 (Australia)[24]	cluster RCT, 715 NHR; 20 residential facilities- 10 hostels (low care) & 10 NHs (high care)	Mean= 84.1	inclusion: each pair matched from different regions in Adelaide to avoid having homes where the same GP was looking after	-AD: intervention physicians received two 30-minutes visits by pharmacists - discussed fall prevention, information from case note audit, benefits of aspirin for those with stroke risk, HTN treatment, use of warfarin for AF - pharmacist visited each facility to speak to staff including physicians re: reducing psychotropic medication, nurses received four 2-hour sessions on management of behavioural symptoms of dementia, medication management & falls prevention	change in percentage of falls, change in psychotropics/ warfarin antihypertensives/ aspirin prescriptions from case notes & medication charts	7 mnths	none

AD: academic detailing **ADE:** adverse drug events **ADLs:** Activities of Daily Living **ADR :** adverse drug reaction **AF:** atrial fibrillation **CDSS:** computerised clinical decision support system **CI:** confidence interval **Cr:** creatinine clearance **GP:** general practitioner **HTN:** hypertension **MAI:** Mean Appropriateness Index **MDT:** multidisciplinary team **NHPBS:** Nursing Home Behaviour Problem Scale **NHR:** nursing home residents **NHs:** nursing homes; **NSAID:** non-steroidal anti-inflammatory drugs **OBRA**: Omnibus Reconciliation Act **OT:** occupational therapist **RCT:** randomised controlled trials **SMPA:** Swedish Medical Product Agency **SSRI:** selective serotonin re-uptake inhibitors **TCA:** tricyclic antidepressants **Mths:** months **Yrs:** years **F/up:** follow up * Only significant improvement in prescribing described

Table 4.3: Summary of studies within the category of pharmacist medication reviews

Author & year (country)	Design & setting	Age	Inclusion & exclusion criteria	Description of intervention	Outcomes	F/up	*Statistically significant findings
Zermansky et al, 2006 (UK)[26]	RCT, 661 residents; 65 homes (13 nursing, 38 residential & 14 mixed)	mean=85.1	inclusion: residents on one or more repeat medicines exclusion: in another trial, terminally ill, already on pharmacist-conducted medication review	- medication review by pharmacist on records -consultation with patient & carer -written recommendations to GP for approval & implementation	no. of changes in medication per participant, no. & cost of repeat medication, mortality, falls, hospital admissions, GP consultations	6 mths	-increase in mean no. of drug changes per patient: 3.1 for intervention vs 2.4 for control ($p<0.0001$)
Furniss et al, 2000 (UK) [27]	cluster RCT, 330 NHR; 14 NHs	mean=81.2	each pair matched from different areas in South Manchester to avoid having homes where the same GP was looking after	-regular review by pharmacist at GPs surgery, NH or over telephone -medical history, current medication details and problems identified by NH staff noted - NHs revisited 3 wks post medicine review to see if there were any problems with medication changes or implementation	type & no. of drugs, appropriateness of prescribing according to OBRA guidelines, use of 1° & 2° care resources, no. of accidents & deaths measured	8 mths	none
Roberts et al, 2001 (Australia) [28]	cluster RCT, 2261 NHR; 52 NHs (1 intervention : 3 control)	mode 80-89	inclusion: at least 20 residents, within 3hr drive from study centre, supply of drugs under government medication subsidy scheme, & centralised hospitalisations, ADE & deaths records	-contact with GPs indirect -problem based education sessions to nurses (6-9 sessions): basic geriatric pharmacology & common problems in long term care e.g. depression -supported by wall charts, telephone consultations, clinical pharmacist visits: approximately 26 hours contact per home -drug regimen review by clinical pharmacist for patients selected by NH staff	mortality rate, no. of hospitalisations, ADE, drug use in terms of total number of drugs and their categories , prescription claims	1 year	none

ADE: adverse drug events **ADR:** adverse drug reaction **Cr:** creatinine clearance **GP:** general practitioner **HTN: h**ypertension **NHR:** nursing home residents **NHs:** nursing homes; **NSAID:** non-steroidal anti-inflammatory drugs **OBRA:** Omnibus Reconciliation Act **OT:** occupational therapist **RCT:** randomised controlled trials **SMPA:** Swedish Medical Product Agency **SSRI:** selective serotonin re-uptake inhibitors **TCA:** tricyclic antidepressants **Mths:** months **Yrs:** years **F/up:** follow up **Wks:** weeks ***only** significant improvement in prescribing described

Table 4.4: Summary of studies within the category of multidisciplinary team meetings

Author & year (country)	Design & setting	Age	Inclusion & exclusion criteria	Description of intervention	Outcomes	F/ up	*Statistically significant findings
Schmidt et al, 1998 (Sweden) [29]	cluster RCT, 1854 NHR; 33 NHs	mean=83.5	inclusion: 2 homes chosen in each area in Sweden with similar NHR & staff characteristics, homes typical for that region, homes supervised by different physicians & separated geographically, physicians who are not geriatricians	-pharmacists arranged monthly MDT meetings -focussed on communication skills, drug use in elderly, networking & problem solving & support -attended by nurses, physicians, pharmacist, nursing assistants all physicians at beginning of intervention -discussed drug use for individual patients	proportion of residents with any psychotropic drug, proportion of residents with 2 or more drug classes, proportion of residents with 2 or more drugs within same class, proportion of residents with any non-recommended & acceptable drugs in each psychotropic drug class using SMPA guidelines	12 mths	-increase in 'acceptable' anxiolytics from 13.9 to 20.8% (p=0.02) - decrease in antipsychotic prescribing by 19% (p=0.007), decrease in non-recommended hypnotics by 37% (p=0.001) -increase in acceptable hypnotic use by 6% (p<0.001) -decrease in non-recommended antidepressants (TCAs) & increase in acceptable antidepressants (SSRIs)
King, 2001 (Australia) [17]	Controlled before-and-after study , 245 NHR;3 NH	mean=79.8	-GP selected NHR to review -31% of baseline residents reviewed	-weekly MDT meetings attended by GP, GP project officer, pharmacist, senior nursing staff, other health care professionals - GP presented patient details, followed by a 30-minute discussion and then formulated a management plan, -questionnaire to GP post-case conference to assess changes & usefulness of review	no. of recommendations & whether beneficial to 1) NHR 2) carers, changes in number of medications prescribed & administered , medication cost, mortality	9 mths	none

Crotty et al, 2004 (Australia) [30]	cluster RCT, 154 residents; 10 residential aged-care facilities	mean=84.5	inclusion: patients prescribed > 5 medicines dependent for ADLs & with challenging behaviour about whom staff want more information & advice	-2 MDT case conferences 6-12 weeks apart - GP, geriatrician, pharmacist, residential care staff & representative from Alzheimer's Association of South Australia attended - independent pharmacist reviewed medication chart pre- & post-intervention using MAI	change in MAI, change in NHPBS, changes in monthly drug costs	3 mths	-change in MAI score improved in intervention : MAI mean change 4.1 (95% CI 2.1-6.1) vs control: MAI mean change 0.4 (95% CI -0.4-1.2) p=0.001

AD: academic detailing **ADE:** adverse drug events **ADLs:** Activities of Daily Living **ADR:** adverse drug reaction **AF:** atrial fibrillation **CDSS:** computerised clinical decision support system **CI:** confidence interval **Cr:** creatinine clearance **GP:** general practitioner **HTN: h**ypertension **MAI**: Mean Appropriateness Index **MDT:** multidisciplinary team **NHPBS:** Nursing Home Behaviour Problem Scale **NHR**: nursing home residents **NHs:** nursing homes; **NSAID:** non-steroidal anti-inflammatory drugs **OBRA**: Omnibus Reconciliation Act **OT:** occupational therapist **RCT**: randomised controlled trials **SMPA:** Swedish Medical Product Agency **SSRI:** selective serotonin re-uptake inhibitors **TCA:** tricyclic antidepressants ***** Only significant improvement

Table 4.5: Summary of studies within the category of computerised clinical decision support system

Author & year (country)	Design & setting	Age	Inclusion & exclusion criteria	Description of intervention	Outcomes	Follow up	*Statistically significant findings
Field et al, 2009 (Canada[31])	cluster RCT, 833 residents; one long term care facility with randomisation of 22 long stay units	mean=86.3	inclusion: patients with renal insufficiency & all units with computerised prescribing order entry	- 62 alerts for maximum recommended daily dose/ frequency of administration, medication to be avoided & missing serum creatinine test results or weight	proportion of alerts that led to an appropriate final drug order, overall rate of prescribing of drugs that should be avoided	12 months	-higher proportion of final drug orders that were appropriate in the intervention units: relative risk 1.2 (95% CI 1.0-1.4)
Gurwitz et al, 2008 (USA & Canada)[32]	cluster RCT, 1118 residents; 2 large long term care facilities	mean=87.2	inclusion: each facility has an existing computerised provider order entry system without clinical decision support system exclusion: patients on short term care	-programmed to identify more than 600 potentially serious drug-drug interactions & display alerts - ADEs identified, determined if they were preventable i.e. if they were errors due to drug-drug interactions etc and then assessed whether any of the alerts included in the CDSS could have prevented the prescribing of these drugs	number of ADEs that could have been prevented by CDSS & number of ADEs preventable by any means & severity of the events	1 year in one facility & 6 months in the other	none

ADE: adverse drug events **ADR:** adverse drug reaction **Cr:** creatinine clearance **GP:** general practitioner **HTN: h**ypertension **NHR:** nursing home residents **NHs:** nursing homes; **NSAID:** non-steroidal anti-inflammatory drugs **OBRA:** Omnibus Reconciliation Act **OT:** occupational therapist **RCT:** randomised controlled trials **SMPA:** Swedish Medical Product Agency **SSRI:** selective serotonin re-uptake inhibitors **TCA:** tricyclic antidepressants **Mths:** months **Yrs:** years **F/up:** follow up **Wks:** weeks *only significant improvement in prescribing described

4.3.4 Computerised clinical decision support systems

Two studies (Table 4.5) evaluated the effects of CDSSs on prescribing in the elderly.[160, 161] One examined the effect of a CDSS on the appropriateness of drug orders in patients with renal insufficiency in Canada, and identified significantly more appropriate drug orders.[160] Gurwitz et al. (USA) identified no effects on the overall number of adverse drug events after implementation of a CDSS for 12 months.[161]

4.4 Discussion

We identified 16 studies, grouped into one of four categories. Only one study used more than one intervention,[157] although we categorised it as pharmacist review since this was the main component of the intervention. Multi-faceted interventions may be expected to be more powerful than using individual tools alone.[162]

4.4.1 Staff education

Staff education, especially academic detailing, has the strongest evidence, with half of the studies having evaluated this intervention strategy and six of eight showing improvements in prescribing. The six 'successful' studies employed interactive techniques: academic detailing with face-to-face interaction between the prescribing physician and a group of experts, workshops for nurses, and family education. This review found that educating both physicians and nurses proved to be effective; previous work demonstrated that educating physicians alone was not as effective.[163] Two studies did not show any significant improvement in prescribing quality.[154, 155] Crotty et al. presented physicians with stroke management and psychotropic use guidelines together with audit results.[154] Other limitations in the study, when compared with the more 'successful' studies, were fewer educational sessions and poor attendance by participating GPs. Rovner et al. had several flaws in their study design. The study had a small sample size and was conducted in a single 250-bed

intermediate-level nursing home with risk of 'cross-over' effects between control and intervention groups.[155]

4.4.2 Computerised clinical decision support systems

There is considerable literature on the value of CDSSs. Evidence from US hospital settings suggests that drug safety can be improved by computerised physician order entry (CPOE) with CDSS.[164] One of the two studies that examined the effect of CDSS showed a positive effect, although the extent of the intervention might have been underestimated as study physicians cared for both control and intervention patients. The Gurwitz study[161] showed no significant difference in the rate of adverse drug events with CDSS; however, adverse drug events are rarer than inappropriate orders and as such differences are likely to be more difficult to detect. The CPOE system was also reported as not able to calculate total daily dose [161] and hence the high number of false alerts in the CPOE system may have led to 'alert fatigue', where the prescriber starts to ignore the alerts.[165]

4.4.3 Multi-disciplinary team meetings

MDT meetings are commonly used to improve communication among healthcare professionals, and to optimise patient care. Of the three studies, those by Crotty et al.[159] and Schmidt et al.[158] found statistically significant changes in medication-related outcomes. Selection bias could have possibly been introduced in King et al.'s [147] study, where patients were selected for MDT discussion by their primary care physician. Staff involved in the MDT meetings also cared for control patients, possibly affecting their care. Moreover, with one month follow-up, this gives no indication of the long-term impact of the intervention.

4.4.4 Pharmacist medication reviews

The UK's National Service Framework for Older People recommends that patients taking four or more drugs be reviewed six-monthly, with the remainder, annually.[36] The value of a pharmacist in conducting regular medication reviews to reduce IP in hospitals is well established [166-168], and similar results were anticipated in care homes. However, only one of three studies demonstrated a significant effect of pharmacists' interventions on prescribing. This may partly be due to the inappropriate choice of outcome measures. Roberts et al. and Furniss et al., for example, used the number of medications as a primary outcome measure. Although with increased number of medications, there is greater likelihood of adverse drug reactions, polypharmacy does not always reflect appropriateness of prescribing, as the initiation of some medications may be clinically indicated.[169]

4.4.5 Choice of outcome measures

Outcome measures varied considerably with a number of authors interpreting a reduction in the total number of medication as an improvement in prescribing, which may not always be true. One of the UK-based studies used the USA's OBRA guidelines to assess appropriateness of prescribing. Others have used national or good practice guidelines. One used the Medication Appropriateness Index (MAI) but interestingly, none used Beer's criteria[71], a USA-based tool commonly used to assess IP in care homes.

4.4.6 Limitations of review

Categorisation of articles was not always straightforward. For instance, academic detailing by pharmacists who reviewed case notes and identified points for discussion as part of an outreach programme was categorised as staff education and not pharmacist medication review.[148, 152, 154] Rovner's study could potentially be classified

as management by a specialist combined with MDT meetings[155], but was classified as an educational intervention. In addition, with a limited number of articles, some of which targeted psychosocial interventions more than pharmacotherapy (e.g. behavioural management more than improving prescribing), it is challenging to synthesise the evidence for improved prescribing in care homes.[149, 151, 155] The limited search terms and limit to the English language mean that this systematic review has its limitations. For instance, unless a quality improvement effort was indexed as an intervention, it would have been missed. The types of studies that we had aimed to retrieve have also been subjected to publication bias. Some studies may be considered 'old', because prescribing guidelines and doctors' training have evolved; however, we believe their strategies are still relevant. Lastly, we acknowledge the difficulty in generalising findings from one country to another, due to differences in definitions, nature of personnel training and supervision of drug therapy.

4.4.7 Implications for policy and practice

For educational interventions to be effective tailored programmes that employ several complementary techniques may be needed; academic detailing with educational reinforcement and follow-up should be directed at all healthcare professionals and possibly family members. Educational interventions can be easy and effective to implement as the knowledge gained is not patient-specific. Sustainability is supported if 'in-house training' is an option, as this will enable GPs to be regularly updated. Conversely, CPOE-CDSS is resource-intensive which may restrict its applicability in care homes. Monthly pharmacist medication review is mandatory in the USA to improve prescribing in care homes; this has also been proposed for the UK.[3] In the UK, the availability of resources for community pharmacist to conduct monthly medication review may be limited and therefore we suggest a six monthly review to

be conducted by GPs. Additional yearly mandatory reviews by pharmacists would instead be more practical and feasible. In our review, MDT meetings[158, 159] as well as staff education[152, 154] involving pharmacists proved successful despite insufficient evidence for pharmacist-led reviews alone. Beneficial effects have been documented in hospitals and may be transferable to care homes, given sufficient pharmacist resource.

With those aged 65 and over predicted to account for 23% of the population by 2035.[1], there needs to be clear guidelines for prescribing. The OBRA 1987 created a set of USA national minimum standards of care and rights for people living in certified nursing facilities.[170] We propose that UK policy be directed to improve the quality of prescribing in care homes based on results of controlled trials. Standardised measurements for measuring IP are also needed to enable effective benchmarking. Finally, we recommend that a combination of two or more interventional strategies is considered to improve prescribing in this population.

4.5 Conclusion

Improving prescribing in care homes is complex and there is limited evidence for effective interventions. This review demonstrated mixed results with substantial evidence and promising options for some of the interventions. Education including academic detailing seems to show most promise. Combinations of intervention strategies are likely to be required; this will be explored in Chapter 5.

Chapter 5

Reducing inappropriate prescribing in nursing homes: a collaborative, general practice-based quality improvement project

5.1 Introduction

In the previous chapter, I described the systematic review which concluded that no one interventional strategy has proven to be exceptionally effective in optimising prescribing in care homes. A few of the studies which employed either of the two interventional strategies, 'pharmacist intervention' or 'multidisciplinary team meetings' demonstrated an overall decrease in inappropriate prescribing. I therefore postulated that these two strategies, if combined, could prove to be successful in optimising prescribing in care homes. In this chapter, I will describe how I incorporated both the strategies in a collaborative quality improvement project which was aimed at reducing inappropriate prescribing. The collaboration was multidisciplinary as it involved staff from an academic institution, two nursing homes, a general practice and a primary care trust.

I have reported here on the background, methods used and main findings based on SQUIRE guidelines for quality improvement studies.[171]

5.2 Background knowledge

5.2.1 Context and problem

The challenges of prescribing for older people, particularly for those in care homes, have been described extensively in Chapter 1. Briefly, inappropriate prescribing is more common in older people living in care homes than those living in their own homes. This is due to: 1) their inherent characteristics of ageing as well as their greater physical and mental impairment; 2) complexities surrounding the governance and management of care homes. Such evidence was clearly illustrated in recent studies that were conducted in Scotland[95] and Bristol[67], where inappropriate and potentially harmful psychotropic medications were more commonly prescribed to older people living in residential or nursing homes than those living in the community. In addition, unnecessary prescriptions have economic, clinical, and public health implications. In Northern Ireland, for instance, the total expenditure in 2007 on potentially inappropriate medications was reportedly €46 million; this was 9% of the overall expenditure on pharmaceuticals for those aged 70 years and above.[99]

In the UK, general practitioners (GPs) are usually responsible for the delivery of medical care to older patients in care homes. There has been increasing concerns in the last 15 years that 'downsizing' of NHS provision and the transfer of residents with high morbidity and disability [141, 172, 173] from NHS hospital care to care homes has resulted in increasing demands on GPs. Consequently, there has also been criticism that delivery of care to care home residents has become inconsistent and idiosyncratic.[174] Concerns have also been raised about the risks of inappropriate prescribing for these residents. This is due to the evidence that poor monitoring and

unnecessary prescribing is more likely to occur in these patients.[67, 175] Nevertheless, very few improvement initiatives have been conducted in general practice that aimed to reduce inappropriate prescribing in nursing and/ or residential homes. Similarly, there are few assessments of interventional programmes to ascertain what works in the real-world general practice.

In the quality improvement project described below, a collaboration between a general practice, two nursing homes, a primary care trust, an academic institution was employed.

5.2.2 Characteristics of organisations involved

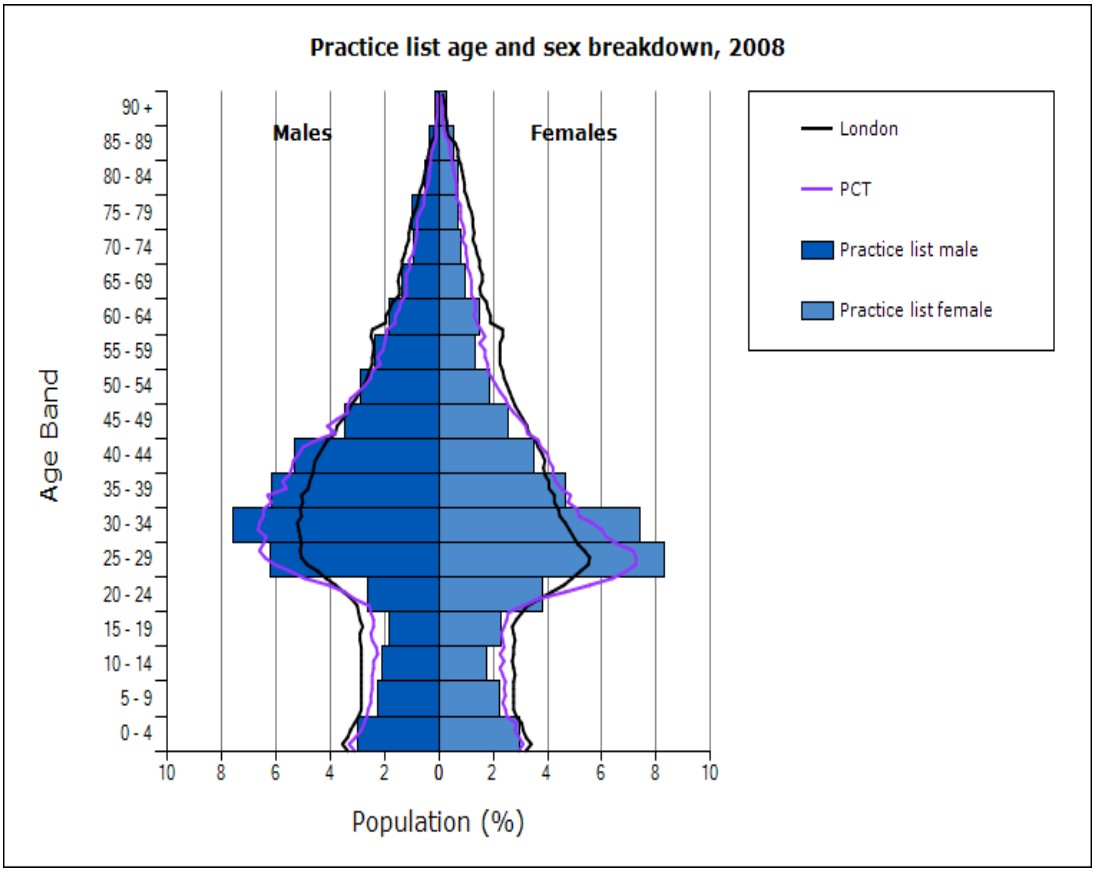
5.2.2.1 General practice

Dr Curran & Partners of Clapham Manor Health Centre is a busy, community-based NHS GP practice providing care to patients living largely in the SW4 postcode area in Clapham, Greater London. There are about 9,400 patients registered with the practice, with a high turnover of around 15% patients annually because of the high degree of population mobility of the people living in the area. The practice has six GPs (four males and two females), three nurses, one manager, a number of receptionists and clerical staff. A number of community trust staff is also attached to the practice. The GPs provide general medical services, as well as specialist services such as child health monitoring, maternity, and contraceptive services. The population served by the practice is drawn from a wide range of socio-economic and ethnic groups.[176]

The London Health Observatory's London Practice Profiles provides an overview of the practice population, which includes its geographic spread, age, sex, ethnicity, and deprivation breakdown.[176] This information is essential in the understanding of the

basic needs of the local population. The published report in June 2009 revealed that patients aged between 25 and 34 represented the largest age group in Dr. Curran & Partners. These figures were in line with those of Lambeth Primary Care Trust (PCT) and only slightly different from the overall distribution of age groups in London (Figure 5.1).[176]

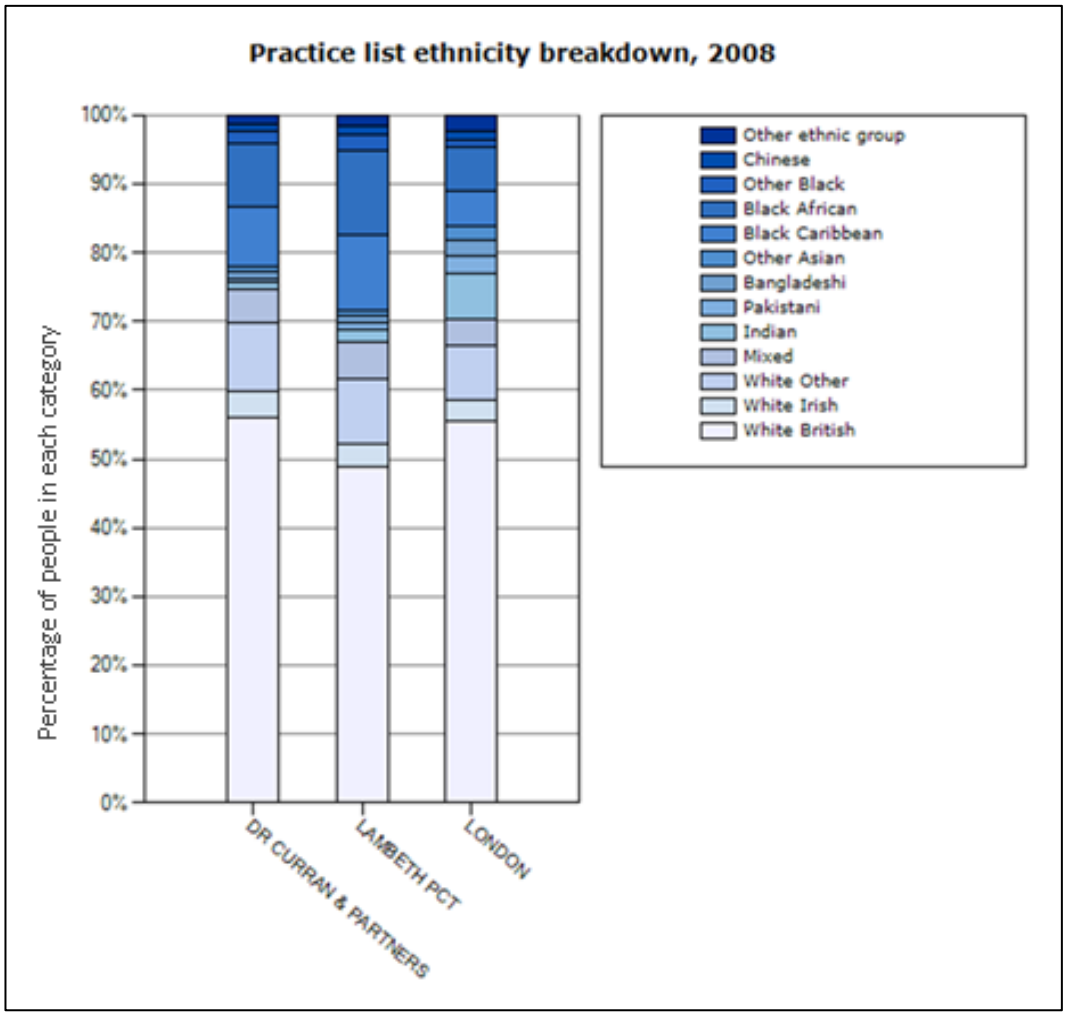
Figure 5.1: Dr. Curran and Partners' age and sex breakdown compared to Lambeth PCT and London (source: London Health Observatory's London Practice Profiles) [176]



The practice's ethnic composition mirrors that of London with the following exception: in London, Indians make up the third largest population, after white British

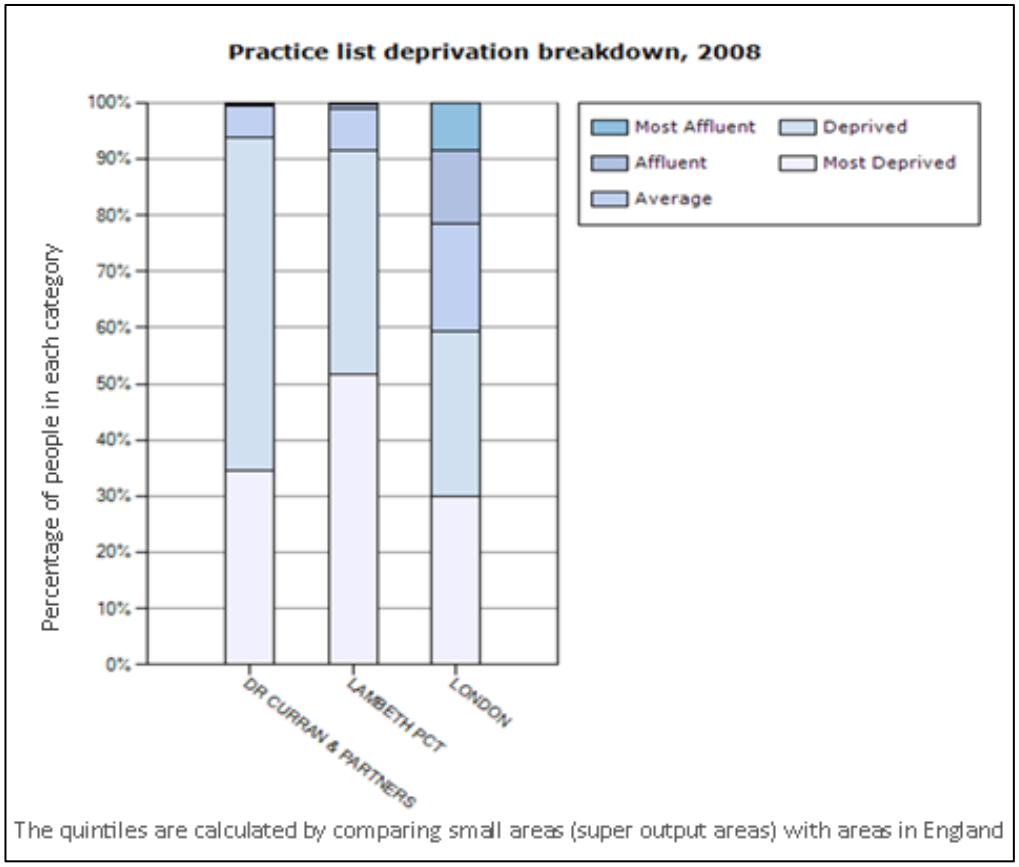
and other white; in the practice, black Africans came in third followed by black Caribbeans (Figure 5.2).

Figure 5.2: Dr. Curran and Partners' ethnicity breakdown compared to Lambeth PCT and London (source: London Health Observatory's London Practice Profiles) [176]



In terms of deprivation, 93.8% of the practice's population was deprived or most deprived compared to 59.4% overall in London (Figure 5.3).[176]

Figure 5.3: Dr. Curran and Partners' deprivation breakdown compared to Lambeth PCT and London (source: London Health Observatory's London Practice Profiles)[176]



In terms of how the practice was performing, indicators for which the practice's scores were statistically different to the overall mean score of practices in London[176] are highlighted in Table 5.1.

Table 5.1: Indicators for which the practice performed better (or had a lower need than the London average) and poorer (or had a higher need than the London average) in 2009 (source: London Health Observatory's London Practice Profiles) [176]

Theme	Indicators for which performance were better	Indicators for which performance were poorer
Context	• patients (%) aged over 65 years	• effective exception rate for 1)hypertension; 2) CHD; and 3) stroke indicators • patients (%) with hypertension in whom the last blood pressure (measured in the previous nine months) is 150/90 or less • patients (%) with CHD whose notes in the previous 15 months have a record of 1) total cholesterol 2) aspirin, an alternative anti-platelet therapy, or an anti-coagulant (unless a contraindication or side-effects are recorded) • patients (%) with CHD who are currently treated with a beta blocker (unless a contraindication or side-effects are recorded) • patients (%) with CHD who have a record of influenza immunisation in the preceding period of 1 September to 31 March • patients (%) with stroke or TIA • patients (%) with stroke or TIA who have a record of blood pressure in the notes in the preceding 15 months
Cardiovascular Disease	• patients (%) with established hypertension • patients (%) with CHD • ratio of stroke/TIA prevalence, as recorded in QOF, to estimated stroke/TIA prevalence (a ratio of above 1 means that the practice has rates of recorded stroke/TIA that are more than estimated in their local population) • patients (%) with AF	
Diabetes	• patients (%) aged 17 years and over with diabetes mellitus	• patients (%) with diabetes who in the previous 15 months, have a record of 1) HbA1c or equivalent; 2) blood pressure; 3) total cholesterol; 4) presence or absence of peripheral pulses; 5) neuropathy testing; 6) micro-albuminuria testing (exception reporting for patients with proteinuria); 7) retinal screening; 8) eGFR or serum creatinine testing • patients (%) with diabetes who have had influenza immunisation in the preceding period of 1 September to 31 March • effective exception rate for diabetes indicators

Theme	Indicators for which performance were better	Indicators for which performance were poorer
Lifestyle and risk factors	• patients (%) aged 16 and over with a BMI greater than or equal to 30 in the previous 15 months	• rate of people admitted to hospital within the specified time period with a condition thought to be 1) directly attributable; 2) directly or indirectly attributable to excessive alcohol consumption per 100,000 population • patients (%) aged over 15 whose notes recorded smoking status in the previous 27 months, except those who have never smoked where smoking status need be recorded only once • patients (%) with any or any combination of the following conditions: CHD, stroke or TIA, hypertension, diabetes, COPD or asthma whose notes record smoking status in the previous 15 months, except those who have never smoked • effective exception rate for smoking indicators
Other conditions	• patients (%) with a diagnosis of 1) cancer excluding non-melanotic skin cancers from 1 April 2006; 2) hypothyroidism • effective exception rate for cervical screening indicators • patients (%) aged 18 years and over with CKD (US National Kidney Foundation: Stage 3 to 5 CKD) • ratio of dementia prevalence, as recorded in QOF, to estimated dementia prevalence (a ratio above 1 means that the practice has rates of recorded dementia that are more than estimated in their local population)	• patients (%) aged from 25 to 64 for whom cervical smear has been performed in the preceding five years • patients (%) diagnosed with dementia • patients (%) with hypothyroidism with thyroid function tests recorded in the previous 15 months • patients (%) with schizophrenia, bipolar disorder or other psychoses • patients (%) with schizophrenia, bipolar affective disorder and other psychoses with a review recorded in the preceding 15 months • effective exception rate for mental health indicators

Theme	Indicators for which performance were better	Indicators for which performance were poorer
Respiratory disease	• patients (%) with asthma, excluding those who had not been prescribed asthma-related drugs the previous 12 months	• patients (%) with COPD in whom diagnosis has been confirmed by spirometry including reversibility testing • patients (%) with COPD with a record of FEV_1 in the previous 15 months • patients (%) with asthma who have had an asthma review in the previous 15 months • effective exception rate for asthma indicators; this is defined as the proportion of patients who were reported as exceptions for indicators in the asthma group
Secondary care use	• rate of admissions per 100,000 patients with a primary diagnosis of cancer (ICD-10 codes C00-C97), indirectly standardised for age and sex.	• rate of admissions per 100,000 patients with a primary diagnosis of COPD (ICD-10 codes J40-J44), indirectly standardised for age and sex. • rate of emergency admissions per 100,000 patients, indirectly standardised for age and sex.

TIA: transient ischemic attack **AF**: atrial fibrillation **CHD:** coronary heart disease **COPD:** chronic obstructive pulmonary disease **CKD**: chronic kidney disease **DM:** diabetes mellitus **eGFR:** estimated glomerular filtration rate **%:** percentage **HbA1c**: glycated haemoglobin **ICD-10**: international statistical classification of diseases and related health problems, 10th revision **QOF**: quality and outcomes framework **BMI:** body mass index **FEV_1**: forced expiratory volume in 1 second

The medical, clinical and senior management staff of Dr. Curran & Partners is all involved in weekly clinical, management and educational meetings. Most of them also have external appointments, in local medical schools, universities, primary care trusts, and nursing homes, amongst others. The practice trains medical students from local medical schools (e.g. King's College, Imperial College and St. George's Hospital) and occasionally have medical students attached to the practice. During the period of this project, a team of GPs from the practice provided medical services to two nursing homes in South London: Collingwood Court Nursing Centre and Manley Court Nursing Centre. Characteristics of these homes are detailed in Table 5.2. The two GPs, with a particular interest in medicine for older people, and who were a part of the team that looked after the nursing homes were Dr. Dev Verma and Dr. Marc Duffield.

5.2.2.2 Primary care trust

Lelly Oboh is a qualified pharmacist who works as a senior prescribing advisor for Lambeth PCT. She is also attached to the East and South East NHS specialist pharmacy services and is the project co-ordinator for the 'London older people's service development programme: the medicines management project'. She advocates the need to develop local health community clinical pharmacy teams to lead joint working initiatives for older people.[177, 178] She was particularly interested in reducing prescribing costs in care homes. As Dr Curran & Partners was identified as having one of the highest prescribing costs within Lambeth, she was keen to embark on this initiative to reduce inappropriate prescribing and prescribing costs in these two nursing homes.

Table 5.2: Characteristics of Collingwood Court Nursing Centre and Manley Court Nursing Centre

Nursing homes / Features	Manley Court Nursing Centre	Collingwood Court Nursing Centre
Number of beds	85 single en-suite bedrooms	80 single en-suite bedrooms
Types of care	Short and long term care, dementia care, respite, palliative, convalescence, nursing, YPD, young chronically sick, specialise in care for those with Parkinson's	Short and long term care, dementia care, respite, palliative, convalescence, nursing
Minimum age for admission	40	Usually 65
Units	Jasmine: frail elderly, palliative care and YPD Lavender: mental health and nursing care Primrose: mental health Hibiscus and Sunflower: frail elderly and palliative care	Diana: care for the frail elderly and palliative care Hazel and Rose: mental health and nursing care
Staffing	Carers: 74, RGNs: 37, activities: 3, catering: 7, housekeeping: 12, maintenance: 1, administration: 2, receptionist: 1, managerial: 2	Carers: 57, RGNs: 21, activities: 2, catering: 7, housekeeping: 7, maintenance: 2, administration: 2, receptionist: 1, managerial: 2
Staff training	Most staff qualified to level 2 i.e. supervised staff	Most staff qualified to level 2 and 3 i.e. supervised staff and supervisor respectively
Number of GPs attached	1 with twice weekly visits	2 with thrice weekly visits
Number of pharmacies that dispense medication	1	2
Sources of funding	Private: 3, LA nursing: 63, Lambeth PCT:11, contract Lambeth PCT: 2	Private:3, LA nursing: 40, contract LA nursing: 15, contract Lambeth PCT: 4 (up to 8), respite: 1 (fully funded by NHS), continuing care: 4 (fully funded by NHS)
Other services available	Occupational therapy, speech therapy and chiropody through residents' own GP, aromatherapy and alternative therapy available on request	Chiropody, aromatherapy available on request

Information correct as of 6 July 2011; **YPD**: young physically disabled
RGN: registered general nurse **LA:** local authority **PCT**: primary care trust

5.2.2.3 Imperial College London

I was pivotal in the planning, conduct and evaluation of the quality improvement project. I also prepared the documentations and attended the interview for ethics approval. My primary supervisor Professor Azeem Majeed is a GP attached to Dr. Curran & Partners. Professor Bryony Dean Franklin and Dr. Alex Bottle, two of my secondary supervisors, as well as Professor Majeed, contributed significantly to this project.

5.2.3 Study questions

The quality improvement project consisted of a multidisciplinary intervention and engaged a researcher, a qualified pharmacist, and two GPs who were responsible for the nursing homes.

As the researcher, I conducted an audit on the general practice's prescribing data to identify inappropriate prescribing for the care home residents. In an audit, prescribing guidelines would normally be used but as there were no mandatory prescribing guidelines for GPs to use in care homes, I used the validated, published sets of criteria. These criteria, introduced in Chapter 2 were designed to be used in tandem (Screening Tool of Older Persons' potentially inappropriate Prescriptions (STOPP) criteria to identify potentially inappropriate medications (PIMs) and Screening Tool to Alert doctors to Right Treatment (START) criteria to identify potential prescribing omission, PPO). In addition to the audit, the pharmacist, Lelly Oboh, conducted an independent medication review on the prescribing data to identify drug-related problems.

Results of the audit which I conducted as well as the drug-related problems identified by Lelly Oboh were relayed to the GPs, who decided if any changes to prescriptions were necessary. I then conducted a post-intervention audit using the same set of criteria. Results of the audit performed pre-intervention (which indicated baseline levels of inappropriate prescribing) and post-intervention were used to assess if the intervention effectuated any change in the prevalence of inappropriate prescribing.

I postulated that, if the multidisciplinary intervention had a positive effect, there would be a significant decrease in inappropriate prescribing scores of the post-intervention dataset. The questions that guided the project or study were:

- To what extent did the multidisciplinary intervention affect inappropriate prescribing?
- Is the explicit review a practical and applicable screening tool for health professionals to use?
- Can the quality improvement project work for nursing homes located in a socially deprived inner London borough?

Everyone involved, including the GPs, practice manager and nursing home staff was actively engaged in this work and played an important role in this quality improvement project.

5.3 Methods

5.3.1 Ethical considerations

After the research ethics committee's initial deliberations on whether or not to classify the study as an audit (which does not require ethics approval), I was invited for an interview for some clarification. As there were no mandatory prescribing guidelines for GPs to use in care homes and as we were using an explicit criteria as well as an implicit method i.e. pharmacist medication review, the committee decided that the project required ethics approval. It was also agreed that consent from the practice and an information sheet for the GPs were appropriate so that an anonymised and non-identifiable version of the patient data could be produced for analysis.

Ethical approval (Appendix II) was subsequently granted for this study by the East Central London Research Ethics Committee. Local research governance approval was granted by the Research Development Centre at Southwark PCT, which provides research governance services for PCTs in South-East London (Appendix III). I was employed by the practice as an audit assistant during the study and therefore had legitimate access to patient medical records. However, only anonymised and non-identifiable data were extracted and taken off-site for analysis.

5.3.2 Setting and subjects

The GP practice provided medical services to Collingwood Court Nursing Centre and Manley Court Nursing Centre. These nursing homes were therefore included for participation in the study.

The inclusion criteria for residents were:

i) residing in Collingwood Court Nursing Centre and Manley Court Nursing Centre

ii) at least aged 65 on 29 June 2010 (pre-intervention)

iii) at least aged 65 on 28 March 2011 (post-intervention)

iv) prescribed at least one regular medicine

Residents were excluded if:

i) they were in a coma

ii) all details about their current medications and/or morbidities were missing

Terminally ill residents were also included if they met the other inclusion criteria and had none of the exclusion criteria. This is because they represented institutionalised older patients. Moreover, STOPP and START criteria take into account of their frailer conditions.

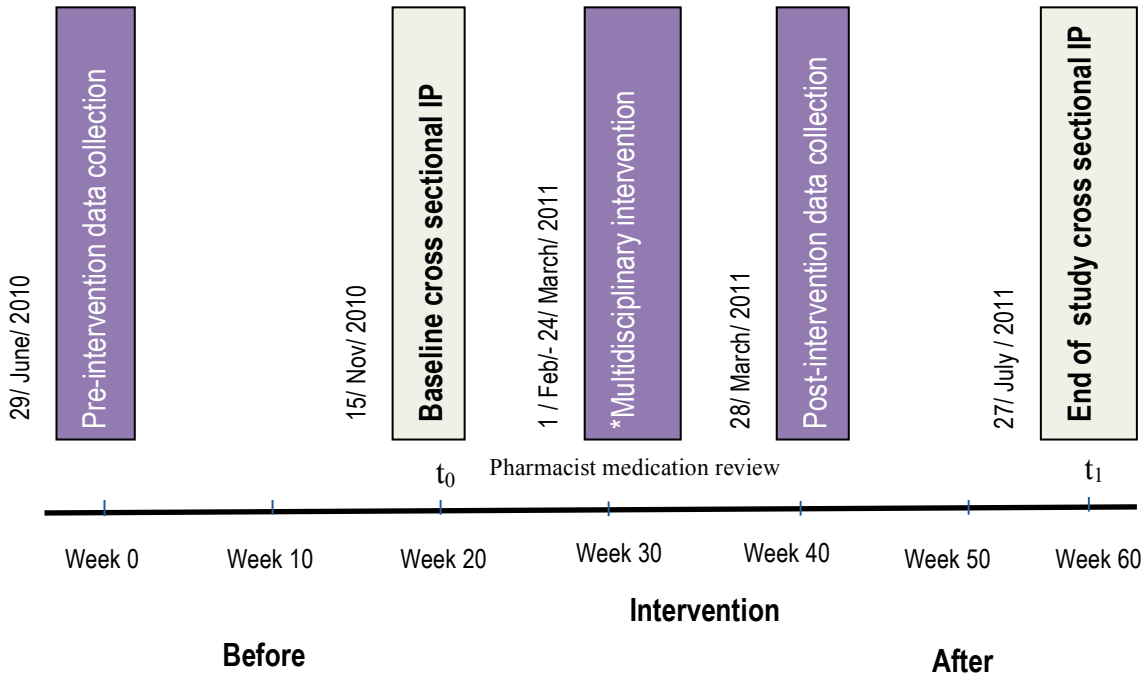
5.3.3 Study design

I employed a before and after study design without concurrent controls (Figure 5.4). Cross sectional data were collected at two instances: before (baseline, t_0) and after the intervention (at 9 months, t_1). I extracted data from both the electronic medical records at the GP practice and paper records at the nursing homes (see details in the following section below). I conducted an audit by evaluating these data for IP using STOPP which identified potentially inappropriate medication (PIM) and START which identified potential prescribing omission (PPO). I conducted these audit at both the instances: at baseline and at 9 months. In addition to the audit, the pharmacist, Lelly Oboh, conducted an independent medication review on the prescribing data to identify drug-related problems.

Results of the baseline audit which I conducted as well as the drug-related problems identified by Lelly Oboh were relayed to the GPs, who decided if any changes to prescriptions were necessary. Results of the post-intervention STOPP-START audit were compared with that of pre-intervention to assess if the intervention effectuated any change in the outcome i.e. prevalence of inappropriate prescribing as determined by STOPP and START. Details of the IP evaluation and multidisciplinary intervention will be described below.

Figure 5.4: Timeline of the study: IP was evaluated at two instances, before (t_0) and after the intervention (t_1) using STOPP and START criteria

IP, inappropriate prescribing; GPs, general practitioners; *multidisciplinary intervention= pharmacist medication review feedback + STOPP/START baseline audit feedback + GPs who made changes to prescriptions based on these feedback



5.3.4 Planning the study

Henry Adewale and I designed the data collection form. I piloted the form (Appendix IV) on 20 residents and subsequently modified it (Appendix V) to improve usability and to capture information needed to accurately apply the audit criteria. I then extracted residents' data from the electronic patient medical record onto the data collection form.

The practice manager provided me with the list of residents who were registered in the two homes a day prior to commencement of the data collection i.e. those who were registered on 29 June 2010 (pre-intervention) and 28 March 2011 (post-intervention). Nursing home residents were identified by the practice manager by either a Read code for nursing home residence or nursing home residence markers (postcode and location of consultation).

5.3.5 Data collection

5.3.5.1 At the practice

Data that I extracted from medical records included basic demographic information and medical history:

i) Demographic data (patient identifier number, age, sex, ethnicity, date of registration)

ii) All clinical data (diagnosis of acute and chronic diseases that were Read coded and year of diagnosis if available)

iii) Laboratory values and physical measurements (e.g. blood pressure, glomerular filtration rate, cholesterol)

iv) Prescribing data (current medication, date started, dose, frequency, and duration)

Medications were grouped into physiological categories, based on the British National Formulary (BNF) classification: gastro-intestinal, cardiovascular, respiratory, endocrine, and central nervous systems; infections; obstetrics, gynaecology, and urinary-tract disorders; malignant disease and immunosuppression; nutrition and blood; musculoskeletal and joint diseases; eye; ear, nose, and oropharynx; and skin. This was done to allow for efficient data management and subsequent analysis of data.

On a twice weekly basis, the pre-intervention data collection period (including piloting) at the practice lasted for about 5 weeks, from 29 June to 5 August 2010 while the post-intervention collection took place for about 6 weeks from 28 March to 10 May 2011. I collected approximately 20 residents' data each day between 9am and 5pm on days pre-determined a week in advance by the practice manager. Total numbers of residents whose data was collected before being subjected to the inclusion and exclusion criteria were 158 (pre) and 161 (post) respectively.

5.3.5.2 At the nursing homes

As some vital information such as ethnicity, mobility status, current medication, details of residents who were in a coma or under palliative care, and latest blood pressure readings were either unavailable or not updated on the Egton Medical Information Systems (EMIS), which is the electronic patient record system used by the practice, I conducted further manual data collection at the two nursing homes. This involved examining medicines administration records, browsing documents in the personal care plan, and speaking to nursing staff. Nursing home visits lasted about 11 weeks, from 10 August until 29 October 2010 with an average of two visits a

week, usually from 3 to 5pm, as this was the time when nurses were more likely to be available. Post-intervention data collection at nursing homes took place from 16 May to 5 July 2011 and consumed lesser time (7 weeks) because by then, I was familiar with the nursing staff, filing and documentation system. Moreover, during this time, the practice had better updated its electronic system due to various reasons (see *Discussions*).

Once all attempts were made to collect complete data, I then screened the residents based on their inclusion and exclusion criteria.

5.3.6 Method of evaluation

5.3.6.1 Application of STOPP-START on pre-intervention dataset

START and STOPP (Appendix VI) were used to screen and identify potential prescribing omissions (PPOs) and potentially inappropriate medications (PIMs) respectively. These sets of criteria were applied to residents' clinical datasheets. Anjali Nayak (another researcher) and I performed this task independently for the pre-intervention dataset over 6 weeks from 15 November 2010 to 31 January 2011. We piloted this on 21 datasets and then held a discussion. This discussion led to interpretations and definitions of several criteria needing to be clarified based on the data sources that we had (Table 5.3). We then had another discussion to agree on a common score for both STOPP and START for each resident. Following this, we proceeded to another 21 datasets.

Several clarifications were needed to accurately apply the criteria: firstly, functional status was an important deciding factor for the applicability of the START criteria (Appendix VI) relating to statin prescribing (CVS, criterion 5). Those who were 'mobile' and 'mobile with assistance' i.e. walking with 'Zimmer' frame were

considered as independent for activities of daily living (ADL) and were therefore deemed appropriate for statin treatment where the medicines' benefits outweighed their risks (details in Table 5.1); and secondly 'current non-smoker' was the status assigned if the nursing home staff had no knowledge of previous smoking history. Smokers or those with smoking histories were considered as having had one of the major cardiovascular risk factors; other risk factors include hypercholesterolemia, diabetes and hypertension. They were therefore appropriately prescribed antiplatelet and statin therapies and if these were found to be omitted from their prescriptions, two accounts of PPOs (endocrine: START criteria 3 and 4 respectively) were documented (Appendix VI).

Results from the pre-intervention audit were used as baseline scores.

Table 5.3: Researchers' interpretations and definitions of some of the STOPP and START criteria based on applicability of data available

STOPP/ START Criteria	Remarks
START, CVS 5: Statin therapy with a documented history of coronary, cerebral or peripheral vascular disease, where the patient's functional status remains **independent for ADL** and **life expectancy is > 5 years**	1) Functional status: Mobile with assistance & mobile: independent for ADL; wheelchair bound, bedbound, palliative care: non-independent for ADL 2) Most nursing home residents have a short life expectancy at the point of admission (a UK and a Swedish study found that from the time of admission, the mean survival time was 5.9 years[179] and 31 months[180] respectively). Therefore, it is common practice that statins are often discontinued by the GPs upon admission. When applying the criterion, we only factored in patients' functional status. GPs decided if patients independent for ADL

	were suitable for statin or not.
START, Respiratory 3: Oxygen	 Not applicable: ordered when necessary
STOPP, Fallers: Drugs that adversely affect those **prone to falls**	 Prone to falls: 1) Documented history of falls/ recurrent falls/ all those who were mobile/mobile with assistance
STOPP, Fallers 1: Benzodiazepines	 PRN benzodiazepines were excluded
STOPP, CNS 4: TCAs with ***constipation***	 While 99% of the residents were on at least 1 laxative, diagnosis of constipation was rarely found in their records. Therefore, when ≥3 laxatives were prescribed, we regarded that they were indicated for chronic constipation in which case TCA would have been a PIM
STOPP, CNS 8: Neuroleptics as long-term hypnotics	 Unless there is a record of schizophrenia or psychosis/ psychotic depression, this would be a PIM
STOPP, CVS 13: Aspirin with no h/o coronary disease, cerebral disease or PVD	 Exclusion if aspirin was indicated for AF
STOPP, Musculoskeletal 2: NSAID with moderate-severe HTN	 Aspirin 75mg was excluded

STOPP: Screening Tool of Older Persons' potentially inappropriate Prescriptions **START**: Screening Tool to Alert doctors to Right Treatment **ADL** activities for daily living **CVS**: cardiovascular **PRN**: "when required" **CNS**: central nervous system **TCAs:** tricyclic antidepressants **PIM:** potentially inappropriate medication **h/o:** history of **PVD:** peripheral vascular disease **AF:** atrial fibrillation **NSAID**: non-steroidal anti-inflammatory drug **HTN**: hypertension

5.3.6.2 Application of STOPP-START criteria: inter-rater reliability

I tested the levels of inter-agreement between Anjali and I, before and after the discussion held to clarify the definitions and interpretations of several criteria in STOPP and START (as above). This was done using κ (Kappa) statistics. Kappa calculations (Table 5.4) demonstrated a better degree of agreement: before (moderate) and after (very good) the discussion. Kappa values after the discussion suggested good agreement and therefore I alone performed scoring of STOPP-START for the post-intervention dataset.

Table 5.4: Kappa statistics before and after discussions on the pilot scoring

Discussions	Reviewer 1	Reviewer 2	Kappa (κ)	Standard Error	Z	Prob> Z
Before	66.7%	31.3%	***0.515**	0.140	3.67	0.0001
After	90.5%	20.6%	***0.880**	0.106	8.30	0.0000

*Poor agreement = less than 0.20, fair agreement = 0.20 to 0.40, moderate agreement = 0.40 to 0.60, good agreement = 0.60 to 0.80, very good agreement = 0.80 to 1.00 [181]

5.3.6.3 Application of STOPP-START on post-intervention dataset

STOPP and START were then again applied after the intervention by one reviewer i.e. myself between 6 July and 27 July 2011 (about 3 weeks) to the post-intervention dataset. The resulting scores were compared with baseline scores. This comparison allowed us to assess the effectiveness of the intervention.

5.3.7 Multidisciplinary intervention

5.3.7.1 Pharmacist medication review and STOPP-START audit

As described in Section 5.3.6.1, Anjali and I conducted the STOPP-START audit.

It was a long-term and on-going plan for Lelly Oboh to independently review residents' medication administration records to ascertain whether all the medications prescribed were essential to residents (e.g. long-term iron therapy). She also assessed if a prescribed treatment could be substituted with a more cost effective and equally safe and effective alternative (e.g. for wound that is not weeping, Sorbsan ribbon was more cost effective than Aquacel silver). She mainly aimed to reduce prescribing costs for the mentioned general practice. During the time frame of this study, she reviewed the medications of Collingwood residents. Manley Court residents were scheduled for the later stages of the review plan.

Lelly and I had discussions spanning 5 hours in total to clarify the drug-related problems she had identified for Collingwood residents. These discussions were held prior to our independent discussions with the GPs to identify any duplication in the drug-related problems identified during her review and my audit. We based our discussions on the assumption that prescribing data on the electronic records (which were my main source of data for the START-STOPP audit) and medication administration records (which were her source of data for medication review) were consistent. Any discrepancies were however documented and confirmed with the electronic records. After having checked the electronic records, prescriptions that were identified to have been still inappropriate were noted and were later discussed with the GPs.

5.3.7.2 Additional issues identified by researcher

Having collected data from both the nursing homes and the general practice, I was aware of the many discrepancies in the records between these two sites. I thus had an additional responsibility to ensure that records were kept accurate and coherent between the homes and the practice. In addition, having qualified as a pharmacist (non-practicing pharmacist in the UK and therefore in my capacity as a researcher performed this additional housekeeping), I used the BNF to identify additional inappropriateness with regards to monitoring of medications (e.g. carbamazepine which requires therapeutic drug monitoring). I also identified some limitations of the STOPP-START criteria (e.g. criteria do not capture under prescribing for schizophrenia) which will be discussed below (see *Discussions*). These issues not captured by the criteria were nonetheless discussed with the GPs in view of optimising residents' treatment.

My role in identifying these additional appropriateness was more focused towards ensuring better record keeping in the nursing homes and the GP practice. It did not contribute significantly to the success of intervention.

5.3.7.3 Feedback and discussions with GPs to make changes

I was responsible for bringing to the attention of the GPs the inappropriate prescriptions identified from the STOPP-START audit and all conflicting records between nursing homes and the practice. Lelly was responsible for providing feedback on the drug-related problems she had identified although she was mainly focussed on reducing prescribing costs.

I held discussions with each of the two GPs, independently, once or twice weekly for about 7 weeks, from 2 February until 24 March 2011. On average, 10 to 15 patients' notes were covered between 1pm and 2.30pm.

Manley Court

Dr. Dev Verma was responsible for residents in Manley Court. Discussions were held to:

- clarify discrepancies, missing and/or ambiguous information
- understand reasons for exception prescribing
- evaluate under prescribing
- provide feedback on the results of the START-STOPP "audit" as well the additional issues that I identified
- make changes to prescriptions if deemed appropriate (changes to prescriptions were all done in the same session)

I documented the course of actions taken forth.

Collingwood Court

Dr. Mark Duffield was one of the GPs responsible for Collingwood Court. Discussions aimed to:

- clarify discrepancies, missing and/or ambiguous information
- understand reasons for exception prescribing
- evaluate under prescribing
- provide feedback on the results of the START-STOPP audit as well the additional issues that I identified
- make changes to some of the prescriptions (in the interest of time, most of the recommendations that were discussed to be appropriate were emailed to him)

The changes that he had made were documented from the electronic medical records 2 weeks later.

5.3.8 Data entry

I entered the data collected pre and post-intervention into a computerised proforma database in Microsoft Access 2010, which was developed in collaboration with Farzan Ramzan. This database is password protected, contained only anonymised data, and can only be accessed when connected to the Imperial College's server. This took place from 28 July 2011 until 1 September (approximately 5 weeks).

5.3.9 Statistical analysis

I collated all data using Microsoft Access 2010 and subsequently transferred to STATA version 10 for statistical analysis.

5.3.9.1 Normality

I established normality of continuous variables: age, number of medicines, and comorbidities by a review of their respective histogram and boxplot, and by performing Skewness-Kurtosis, Shapiro-Wilk, and Shapiro Francia tests. Normality was not very apparent from histograms and box plots. Age and number of medicines were determined to be non-normal while number of comorbidities were considered normal based on the significant outcomes ($p<0.05$) produced by the tests (Table 5.5).

Table 5.5: Outcomes of the tests for normality on pre- and post-intervention dataset

	Shapiro-Wilk		Skewness-Kurtosis		Shapiro-Francia	
	P Value					
	Pre	Post	Pre	Post	Pre	Post
Age	<0.001	<0.001	0.001	<0.001	0.005	0.004
Number of medicines	<0.001	<0.001	0.002	0.002	0.001	<0.001

Comorbidities	0.006	0.356	0.046	0.072	0.126	0.272

5.3.9.2 Comparison of pre and post intervention

Descriptive statistics included mean and standard deviation for normally distributed variables and median and interquartile range for non-normal variables. I compared the corresponding before and after values using: Chi square or Fisher's exact tests for categorical variables, two-sample *t*-tests for normal and non-normally distributed continuous variables, i.e. total number of medicines and total number of comorbidities (*t*-tests are robust to deviations from normal distributions, so long as the samples are sufficiently large), and Wilcoxon rank-sum test (or Mann Whitney) to determine if distributions of non-normal variables i.e. age and number of medicines were different pre and post-intervention.

The population's ethnicity in the pre and post datasets were compared between two groups, non-white British (as some minority groups were too small in numbers) and white British.

5.3.9.3 Pre-intervention dataset analysis

I reported cross sectional inappropriate prescribing prevalence based on PIM and PPO scores. To demonstrate monotonic relationships (if any) between the occurrences of PIMs and PPOs and other predictor variables, i.e. number of medicines prescribed and ages of residents, the Spearman's rho correlation coefficient was used. To demonstrate associations between (if any) the occurrences of PIMs and PPOs and categorical data, i.e. gender, Chi square analysis was used. P values of <0.05 were considered statistically significant.

5.3.9.4 Pre and post-intervention datasets analysis

To assess the effect of the intervention, I used Poisson generalised estimating equations (GEE) regression and modelled the "number of events" i.e. occurrence of PIM and PPO for each resident adjusting for age, sex, number of medicines and number of comorbidities. Results were reported as risk ratios or relative risks. P values of <0.05 were considered statistically significant. This analysis took into account residents that were repeated (n=103), i.e. they were still residing in the nursing homes when post-intervention data collection occurred implying that the majority of residents were followed up after the intervention (although most of their ages had increased by one year). My supervisor, Dr. Alex Bottle assisted me with this analysis.

5.3.9.5 Sample size and power calculation

As there were no similar data from nursing homes available for comparison, I used a PIM prevalence of 51.3% (derived from a study of 900 older people hospitalised in six European hospitals),[182] and a sample size of 143 residents (fixed sample size as all the patients who were registered with the practice would have been screened for inclusion). This would yield a 95% prevalence confidence interval of 41.8-58.2%. Likewise with an estimated PPO of 59.4% (extracted from the same study), this would result a 95% confidence interval of 51.4-67.5%. However, using a conservative estimate of 30% prevalence as the proportion of residents for whom there were PIMs/ PPOs, and assuming an anticipated reduction in that proportion to 15% if the multidisciplinary intervention is used, a sample size of 143 in each of pre and post dataset would ensure 86% power of detecting the difference, if any, as statistically significant at the 5% level.

5.4 Results

5.4.1 Demographics and characteristics

The population comprised 143 residents in the pre- group and 144 residents in the post-group. Of the 144 resident in the post-group, 103 residents were followed up after the intervention. This explained the reasons for non- significant differences in the two datasets in terms of gender, age, functional status, and ethnicity; statistical analyses that were performed to indicate significant differences, if any, between the variables in the pre and post group are presented in Table 5.6. Some highlights include significant reductions in total numbers of medicines prescribed, total comorbidities, total numbers of PIMs and total numbers of PPOs in the post group. The distribution of age and number of medicines in these datasets followed a non-normal distribution while the distribution of number of comorbidities followed a normal distribution. Their corresponding medians and mean are shown in Table 5.6. Both mean and median are reported for numbers of PIMs and PPOs as normality was not determined for these variables.

5.4.1.1 Gender and age

As for gender and age, the 65-69 year old category had the highest proportion of residents i.e. 52 (36.3%) and 43 (29.9%) residents in the pre and post dataset respectively. This was attributed to the high numbers of men (twice the number of women) within this group. The proportions that were men decreased as age increased while the numbers of women in each age category followed a normal distribution (Figure 5.5).

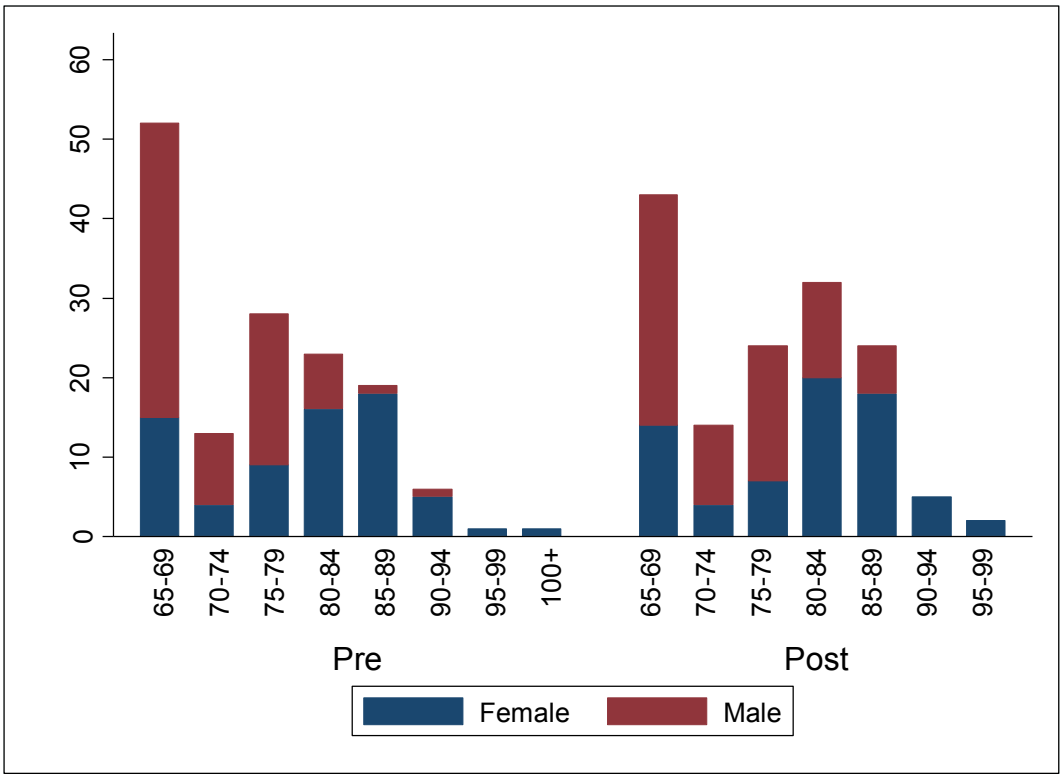
Table 5.6: Characteristics of the study population; corresponding p values signify if there is any statistical significance between pre and post group for each of the variables

Variable	Pre (n=143)	Post (n=144)	P value	Statistical test
Characteristics				
Gender (%)			0.952	Chi square
Men	74 (52)	74 (51)	-	
Women	69 (48)	70 (49)	-	
Age, median (IQR)	77 (67-83)	78 (68.5-84)	0.107	Mann Whitney
Age range (years)	65-100	65-98	-	
Functional status (%)			0.546	Fisher's exact
bedbound	13 (9.1)	17 (11.8)	0.452	Chi square
mobile with assistance	25 (17.5)	33 (22.9)	0.252	Chi square
mobile	28 (19.6)	21 (14.6)	0.261	Chi square
wheelchair bound	67 (46.8)	61 (42.4)	0.444	Chi square
palliative care	10 (7)	12 (8.3)	0.670	Chi square
Ethnicity			0.172	Chi square
White British (%)	104 (72.7)	94 (65.3)	-	
Non-White British (%)	37 (27.3)	50 (34.7)	-	
Caribbean	15	19	-	
Other White	5	10	-	
African	4	6	-	
Other Asian	4	7	-	
White & Black Caribbean	3	2	-	
White Irish	2	3	-	
Indian	2	0	-	
Other Black	2	1	-	
Bangladeshi	1	2	-	
Other Mixed	1	0	-	
Smoking status (%)			0.208	Fisher's exact
Current Smoker	18 (12.5)	11 (7.7)	0.164	Chi square
Never Smoked	39 (27.3)	34 (23.6)	0.476	Chi square
Ex-Smoker	49 (34.3)	47 (32.6)	0.770	Chi square
Current Non Smoker	37 (25.9)	52 (36.1)	0.061*	Chi square

Variable	Pre (n=143)	Post (n=144)	P value	Statistical test
Medication use				
Total medicines prescribed	1276	1218	0.011*	*t*-test
Median drug prescriptions per resident (IQR)	8 (6-12)	8 (5-11)	0.332	Mann Whitney
Range of drug prescriptions	1 to 24	1 to 22	-	
Number of residents with ≤ 4 medicines	23 (78)	23 (77)	0.979	Chi square
Number of residents with 5-12 medicines	778 (93)	756 (96)	0.771	Chi square
Number of residents with ≥ 13 medicines	420 (27)	385 (25)	0.738	Chi square
Comorbidities				
Total comorbidities	546	481	<0.001*	*t*-test
Mean comorbidities per resident (SD)	3.82 (1.92-5.72)	3.34 (1.52-5.16)	0.030*	*t*-test
Range of comorbidities	1-9	0-8	-	
PIMs				
Total PIMs	227	124	<0.001*	*t*-test
Median PIMs per resident (IQR)	2 (1-3)	1 (1-2)	<0.001*	Mann Whitney
Mean PIMs per resident (SD)	2.49 (0.91- 4.07)	1.68 (0.85-2.51)	<0.001*	*t*-test
Number of residents with at least one PIM	91	74	0.036*	*chi square*
PPOs				
Total PPOs	142	51	<0.001*	*t*-test
Median PPOs per resident (IQR)	1.5 (1-3)	1 (1-1)	0.003*	Mann Whitney
Mean PPOs per resident (SD)	1.87 (0.83-2.91)	1.31 (0.70-1.92)	<0.001*	*t*-test
Number of residents with at least one PPO	76	39	<0.001*	chi square

IQR: interquartile range **SD**: standard deviation **ADL**: activities of daily living **PIM:** potentially inappropriate medication **PPO**: potential prescribing omission ***t*-test**= two-sample *t*-test; *statistically significant difference

Figure 5.5: Gender distribution pre and post-intervention



5.4.1.2 Comorbidities

The 17 most commonly diagnosed comorbidities were included in the analysis with hypertension and dementia being the two commonest (Table 5.7). Information collected but excluded in the analysis include conditions such as atrial fibrillation, heart failure, benign prostatic hypertrophy, peptic ulcer, peripheral vascular disease, history of thromboembolism, gout, rheumatoid arthritis, incontinence, history of recurrent urinary tract infections, chronic constipation, hypothyroidism, pacemaker in-situ, and multiple sclerosis.

Table 5.7: Comorbidities and number of residents (n) in the pre and post-intervention data

Comorbidities	Pre (n)	Post (n)
Hypertension	84	77
Dementia	71	66
Depression	55	31
Stroke	52	40
Diabetes	43	42
Schizophrenia	33	37
Osteoarthritis	31	28
Coronary heart disease	28	24
Chronic kidney disease	26	30
COPD (+/- type 1 or type 2 respiratory failure)	23	16
Hypercholesterolemia	22	24
Epilepsy	19	8
History of cancer	17	15
Asthma	15	12
Osteoporosis	15	15
Glaucoma	6	7
Parkinson's disease	6	9
Total	**546**	**481**

COPD: Chronic obstructive pulmonary disease

5.4.1.3 Number of PIMs and PPOs

The number of PIMs and PPOs were significantly lower in the post when compared to the pre-intervention group. Figure 5.6 and Figure 5.7 show the reduced numbers in the post-group, collated by physiological categories as defined by STOPP and START.

Figure 5.6: Number of PIMs by STOPP physiological system

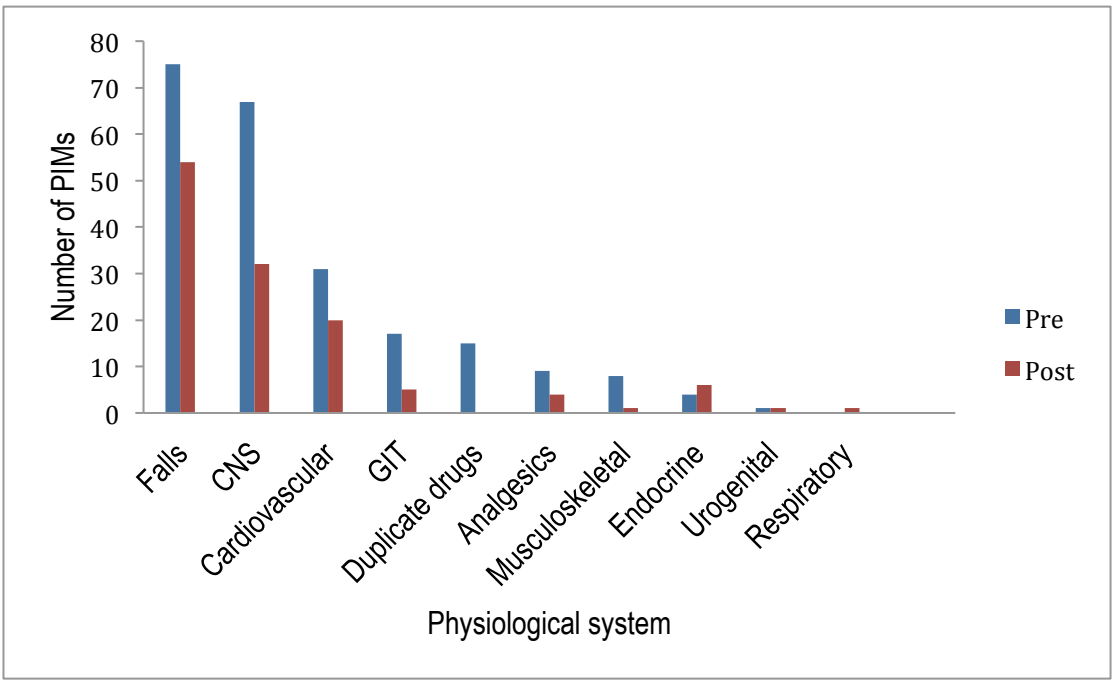
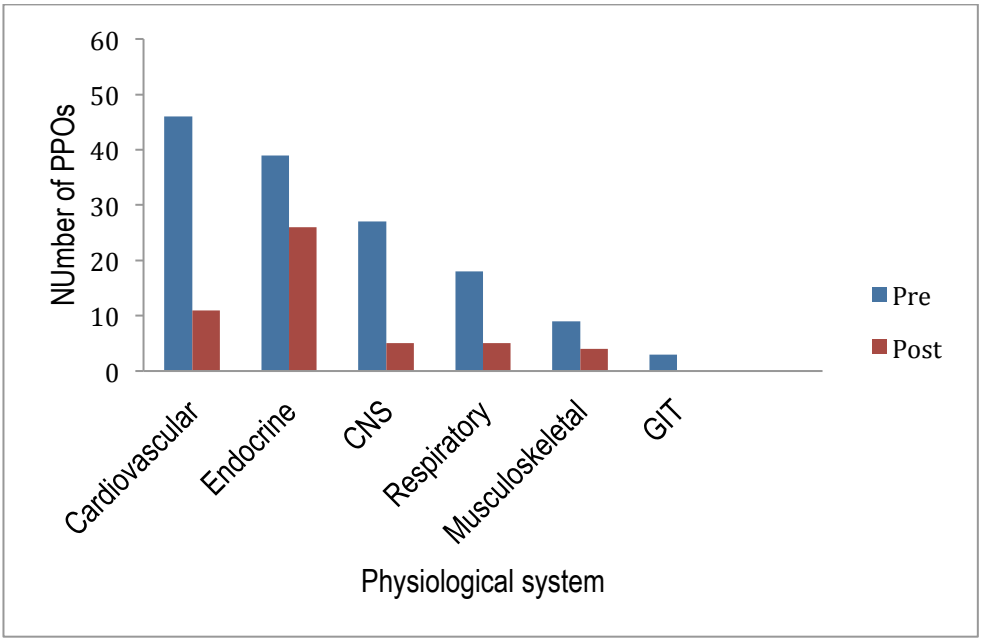


Figure 5.7: Number of PPOs by START physiological system



Their individual criterion and frequency rankings are highlighted Table 5.8 and Table 5.9.

Potentially inappropriate medications

The highest prevalence of inappropriate prescribing in the pre and post-intervention datasets relates to the STOPP criterion 'drugs that adversely affect those prone to falls' had the highest numbers of PIMs within the pre and post groups although the numbers between them reduced by 28% with 19% fewer residents affected in the latter (Table 5.8). There was a 52.2% and 44.9% reduction in the proportions of PIMs and corresponding residents respectively, for the category 'central nervous system'. An 87.5% decrease in the post musculoskeletal system was also recorded although the crude numbers were comparatively small. Respiratory system had one PIM in the post but none in the pre group. No resident had a PIM within the category 'duplicate drugs' after the intervention.

Potential prescribing omissions

The START criteria related to cardiovascular and endocrine systems had higher numbers of PPOs within the pre and post group; there were 76% and 33% declines of PPO numbers respectively in their post groups (Table 5.9). Numbers for central nervous system also reduced substantially by 81.5% (84.6% residents). In the respiratory category, there was a 72.2% decline although the baseline counts were relatively low. No resident had a PPO within the category gastrointestinal system after the intervention.

Table 5.8: Frequency of potentially inappropriate medications for each STOPP criterion and the number of residents (n) affected in pre and post groups

STOPP Criteria	Pre (n)	Post (n)
Drugs that adversely affect those prone to falls	**75 (58)**	**54 (47)**
Dru1: Benzodiazepines	16	10
Dru2: Neuroleptics	42	38
Dru3: First generation antihistamines	5	2
Dru4: Vasodilators known to cause hypotension	4	3
Dru5: Long-term opiates with recurrent falls	8	1
CNS	**67 (49)**	**32 (27)**
CNS1: Tricyclic antidepressants with dementia	5	2
CNS10: Phenothiazines with epilepsy	1	1
CNS11: Anticholinergics to treat extra-pyramidal side effects of neuroleptics	9	9
CNS12: Selective serotonin re-uptake inhibitors with history of clinical hyponatraemia	6	
CNS13: > 1 week of first generation antihistamines	5	2
CNS2: Tricyclic antidepressants with glaucoma	1	
CNS3: Tricyclic antidepressants with cardiac conductive abnormalities	1	
CNS4: Tricyclic antidepressants with constipation	4	
CNS5: Tricyclic antidepressants with opiate/calcium channel blockers	5	4
CNS6: Tricyclic antidepressants with prostatism/ history of urinary retention		1
CNS7: > 1 month long-acting metabolites & long-acting benzodiazepines	6	
CNS8: > 1 month neuroleptics as long-term hypnotics	21	10
CNS9: Long-term neuroleptics (> 1 month) with parkinsonism	3	3
Cardiovascular	**31 (26)**	**20 (18)**
Car1: Digoxin dose > 125µg/day with GFR<50 ml/min	1	
Car10: Dipyridamole as monotherapy for secondary cardiovascular prevention	1	1
Car12: Aspirin at dose > 150mg per day	4	1
Car13: Aspirin with no coronary, cerebral or PVD or occlusive arterial event history	13	8
Car2: Loop diuretic for dependent ankle oedema only	5	3

STOPP Criteria	Pre (n)	Post (n)
Car3: Loop diuretic as first-line monotherapy for hypertension	4	5
Car5: Non-cardioselective beta-blocker with COPD	1	
Car8: Calcium channel blockers with chronic constipation	2	1
Car9: Aspirin + warfarin without H_2 antagonist or PPI		1
GIT	**17 (17)**	**5 (5)**
GIT1: Diphenoxylate, loperamide or codeine phosphate for diarrhoea	1	2
GIT3: Prochlorperazine or metoclopramide with parkinsonism		1
GIT4: PPI for peptic ulcer at full dose for > 8 weeks	15	2
GIT5: Anticholinergics with chronic constipation	1	
Duplicate drugs	**15 (15)**	**-**
Analgesics	**9 (8)**	**4 (4)**
Ana1: Use of long-term powerful opiates	5	3
Ana2: Opiates for > 2 weeks with chronic constipation without laxatives	2	
Ana3: Opiates with dementia unless for palliative care or moderate/ severe chronic pain	2	1
Musculoskeletal	**8 (6)**	**1 (1)**
Mus2: NSAID with moderate-severe hypertension	1	
Mus4: Long-term use of NSAID (>3 months) in osteoarthritis	3	
Mus5: Warfarin + NSAID		1
Mus6: NSAID with chronic renal failure (GFR<50)	4	
Endocrine	**4 (4)**	**6 (6)**
End2: Beta-blockers with diabetes (and frequently hypoglycaemic)	4	6
Urogenital	**1 (1)**	**1 (1)**
Uro1: Bladder antimuscarinics with dementia	1	
Uro6: Alpha-blockers with urinary catheter in situ		1
Respiratory	**-**	**1 (1)**
Res3: Nebulised ipratropium with glaucoma		1
Total	227	124

PPI: proton pump inhibitor **GFR:** glomerular filtration rate **PVD:** peripheral vascular disease **COPD:** chronic obstructive pulmonary disease **NSAID**, non-steroidal anti-inflammatory drugs **H_2 receptor antagonists:** are a class of drugs used to block the action of histamine on parietal cells in the stomach, decreasing the production of acid by these cells;
>: greater than; <: less than

Table 5.9: Frequency of potential prescribing omissions for each START criterion and the corresponding number of residents (n) in pre and post-intervention

START Criteria	Pre	Post
Cardiovascular	**46 (36)**	**11 (10)**
Car1: Warfarin in chronic atrial fibrillation	9	2
Car3: Aspirin or clopidogrel with coronary, cerebral or PVD	10	3
Car4: Antihypertensives if blood pressure>160 mmHg	10	
Car5: Statin in coronary, cerebral or PVD if independent for ADL & not on palliative care	8	6
Car6: ACE I in chronic heart failure	4	
Car7: ACE I in acute myocardial infarction	1	
Car8: Betablocker in chronic stable angina	4	
Endocrine	**39 (24)**	**26 (20)**
End1: Metformin with type 2 diabetes±metabolic syndrome (GFR>50)	5	4
End2: ACE I or angiotensin blocker in diabetes with nephropathy	10	6
End3: Antiplatelet in DM if >1 co-existing CV risk factors (HTN, hypercholesterolaemia, smoking hx)	14	8
End4: Statin in DM if >1 co-existing CV risk factors	10	8
CNS	**27 (26)**	**5 (4)**
CNS1: L-DOPA in Parkinson's	3	2
CNS2: Antidepressant in moderate-severe depression	24	3
Respiratory	**18 (13)**	**5 (5)**
Res1: Beta 2 agonist or anticholinergic for mild-moderate asthma or COPD	11	5
Res2: Corticosteroid for moderate-severe asthma/ COPD	7	
Musculoskeletal	**9 (9)**	**4 (4)**
Mus1: Disease-modifying antirheumatic drugs with moderate-severe rheumatoid arthritis	1	
Mus2: Bisphosphonates with corticosteroids	3	
Mus3: Calcium and Vitamin D with osteoporosis	5	4
GIT	**3 (3)**	**-**

GIT1: PPI with severe gastroesophageal reflux disease / peptic stricture	3	
Total	**142**	**51**

PPI: proton pump inhibitor **GFR**: glomerular filtration rate **PVD**: peripheral vascular disease **COPD**: chronic obstructive pulmonary disease **NSAID**: nonsteroidal anti-inflammatory drugs; **ADL**: activities of daily living **ACEI**: angiotensin-converting enzyme inhibitors **DM**: diabetes mellitus **CV**: cardiovascular **HTN**: hypertension **hx**: history **L-DOPA**: levodopa; **>**: greater than; **<**: less than

Comparison between pre and post groups

Table 5.10 demonstrates that, after the intervention, total numbers of PIMs decreased by almost half (45.4%) while PPO reduced by 64.1%; there were greater reductions of these PIMs and PPOs in women than in men (22.5% vs. 15.7% for PIMs and 61.9% vs. 32.4%). Total residents with one or more instances of inappropriate prescribing reduced significantly, with 18.7% (in PIMs) and 48.7% (in PPOs) having none after the intervention. The percentages of residents without any inappropriate prescribing (PIM and PPO=0) increased (33.5% without any PIM and 55.4% without any PPO) in the post group when comparing to numbers of those in the pre group. With the exception of residents with one instance of PIM where there was a 30.8% rise, numbers in the post group reduced from residents having had two, three, four, five, six and nine instances of inappropriate prescribing to having no more than four and three PIMs and PPOs respectively.

Table 5.10: Changes in prevalence of potential inappropriate prescribing, the corresponding number of residents and gender in pre and post groups as determined by STOPP and START

Number of PIMs/PPOs	STOPP					START				
	Pre (n=143)	%	Post (n=144)	%	Pre-Post Pre (%)	Pre (n=143)	%	Post (n=144)	%	Pre-Post Pre (%)
0	52	36.4	70	48.6	-33.5	67	46.9	105	72.9	-55.4
1	27	18.9	39	27.1	-44.4	38	26.6	30	20.8	21.1
2	31	21.7	22	15.3	29.0	17	11.9	6	4.2	64.7
3	15	10.5	11	7.6	27.6	15	10.5	3	2.1	80.0
4	5	3.5	2	1.4	60.0	5	3.5	0	0.0	100.0
5	8	5.6	0	0.0	100.0	1	0.7	0	0.0	100.0
6	4	2.8	0	0.0	100.0	0	0.0	0	0.0	0.0
9	1	0.7	0	0.0	100.0	0	0.0	0	0.0	0.0
Total residents affected	91	63.6	74	51.4	19.2	76	53.1	39	27.1	48.7
Male (n, pre=74, post=74)	51	68.9	43	58.1	15.7	34	45.9	23	31.1	32.4
Female (n, pre=69, post=70)	40	58.0	31	44.3	23.6	42	60.9	16	22.9	61.9
Total PIMs	227		124		45.4%	142		51		64.1%

5.4.2 Pre-intervention dataset analysis

An analysis of the pre-intervention dataset alone revealed a cross sectional inappropriate prescribing prevalence of 63.6% residents for PIMs and 53.1% residents for PPOs.

5.4.2.1 Potentially inappropriate medications

STOPP identified a total of 227 PIMs prescribed for 91 (63.6%) residents, with a higher proportion of the men (68.9%) taking one or more PIM than the women (58%). The difference between men and women was not statistically significant ($\chi 2$= 1.85, P= 0.174). Twenty seven (18.9%) residents had one PIM while 64 (44.8%) residents had more than one PIM prescribed. One resident had nine PIMs (Table 5.8).

Of the 65 criteria in STOPP, 36 were used to identify PIM. The highest prevalence of PIMs was in relation to: (i) "drugs that adversely affect those prone to falls" (n=75) particularly, neuroleptics (n=42), followed by (ii) drugs whose primary effect is on the central nervous system (n=67) particularly, neuroleptics that are used as long-term hypnotics (n=21), (iii) cardiovascular system (n=31) particularly, aspirin used without any history of coronary, cerebral or peripheral vascular disease or occlusive arterial event (n=13), and (iv) gastrointestinal system (n=17) particularly, proton pump inhibitors used for peptic ulcer at full dose for more than 8 weeks (n=15). Prescribing of duplicate drug classes accounted for a total of 15 PIMs, analgesics for nine, musculoskeletal drugs for eight, endocrine drugs for four, and only one was identified for drugs affecting the urogenital system. No PIMs were identified under the respiratory system (Table 5.6).

A significant positive correlation was found between the number of medicines prescribed and the occurrence of PIM (r_s =0.23, P=0.028) using Spearman's rho correlation. However, there was no significant monotonic relationship found between age and PIM (r_s= -0.11, P= 0.292). Similarly, as stated above, there was no significant association between gender and an occurrence of PIM using Chi Square test for independence ($\chi 2$= 1.85, P= 0.174).

5.4.2.2 Potential prescribing omissions

START identified a total of 142 PPOs in 76 (53.1%) residents, with more proportions of the women (60.9%) having one or more PPOs than the men (45.9%). This difference between women and men was not statistically significant ($\chi 2$= 3.19, P= 0.074). Thirty eight (26.6%) residents had one PPO and another 38 (26.5%) residents had more than one PPO prescribed. One resident had five PPOs (Table 5.8).

The highest prevalence of PPOs was in relation to drugs whose primary effect is on: (i) cardiovascular system (n=46) particularly, use of aspirin or clopidogrel with coronary, cerebral or peripheral vascular disease and antihypertensive if blood pressure is above 160mmHg (n=10 each), followed by (ii) the endocrine system (n=39) particularly, antiplatelet in diabetes if one or more co-existing cardiovascular risk factors were present (n=14), (iii) central nervous system (n=27) particularly, antidepressants in depression (n=24), (iv) respiratory system (n=18) particularly, beta agonist or anticholinergic for mild-moderate asthma or chronic obstructive pulmonary disease, and v) musculoskeletal system (n=9) particularly, calcium and vitamin D in residents with osteoporosis (n=5). Only three was identified for drugs affecting the gastrointestinal system (Table 5.7). Of the 22 criteria in START, 19 were used to identify PPOs i.e. "applicable but not prescribed" in 142 prescriptions. A further analysis revealed that in 328 prescriptions, 19 of the START criteria were found to be "applicable and prescribed" indicating that these 328 medicines were appropriately prescribed according to START (except for one, all the other 18 criteria were the same ones used to identify the "applicable but not prescribed" PPOs).

There was no significant relationship found between number of medicines and PPO (r_s= 0.06, P= 0.625). Similarly, no correlation was found between age and PPO (r_s= -0.095, P= 0.415). Similarly, as stated above, there was no significant association between gender and an occurrence of PPO using Chi Square test for independence ($\chi 2$= 3.19, P= 0.074).

5.4.3 Pre and post-intervention dataset analysis

The Poisson GEE regression adjusted for other variables, demonstrated that after the multidisciplinary intervention, there was a statistically significant decrease ($p<0.0001$) in the risk ratios of PIM and PPO occurrence. These effects were also evident in the unadjusted models, i.e. other variables and repeat patients were not specified. Similar risk ratios and low p values were obtained. In the adjusted models, the standard errors were in fact lower (which we would expect, because intra-resident variation is less than inter-resident variation) and hence their p values were even lower in these models.

Apart from the intervention, other factors which influenced the occurrence of a PIM were age, and number of medicines (Table 5.11) whilst PPO were predicted by age and number of comorbidities (Table 5.12).

5.4.3.1 Potentially inappropriate medications

The number of PIMs in the post group was about half the number of PIMs pre-intervention, i.e. the risk ratio of the number of PIMs was 0.52 (Table 5.11). Compared with the 65 to 69 age group, those aged 80 to 84 and those aged 90 and above had about half the mean numbers of PIMs, risk ratio 0.56 ($p=0.0211$) and risk ratio 0.43 ($p=0.0064$) respectively. While gender and number of comorbidities were not associated with the number of PIMs, number of medicines were (each extra medicine raised the mean number of PIMs by a factor of 1.12, $p<0.0001$).

Table 5.11: Predictive factors and effect of the intervention on PIM occurrence after adjusting for age, gender, number of medicines and number of comorbidities

PIM	Risk ratio	Standard. error	P value	95%Confidence Interval	
Pre_Post (pre as r.g)	0.52	0.127	**<0.0001***	0.41	0.67
65-69 years (r.g)	1	-	-	-	-
70-74 years	1.22	0.392	0.6188	0.56	2.62
75-79 years	0.62	0.270	0.0712	0.36	1.04
80-84 years	0.56	0.252	**0.0211***	0.34	0.92
85-89 years	0.84	0.307	0.5692	0.46	1.53
90+ years	0.43	0.306	**0.0064***	0.23	0.79
Female gender (men as r.g)	1.19	0.213	0.4127	0.78	1.81
Comorbidities	1.00	0.048	0.9731	0.91	1.10
Medicines	1.12	0.026	**<0.0001***	1.7	1.18

*statistically significant difference; r.g, reference group

5.4.3.2 Potential prescribing omissions

Compared with those aged 65 to 69 (reference age group), a significantly lower incidence of PPO was observed in residents aged 70-74 (relative risk 0.6, 95% CI 0.43 to 0.85, p=0.0039). While gender and number of medicines were not associated with the number of PPOs (Table 5.12), number of comorbidities were i.e. each additional comorbidity increased the mean number of PIMs by a factor of 1.19, p<0.0001).

Table 5.12: Predictive factors and effect of the intervention on PPO occurrence after adjusting for age, gender, number of medicines and number of comorbidities

PPO	Risk ratio	Standard error	P value	95%Confidence Interval	
Pre_Post (pre r.g)	0.58	0.092	**<0.0001***	0.48	0.69
65-69 years (r.g)	-	-	-	-	-
70-74 years	0.60	0.176	**0.0039***	0.43	0.85
75-79 years	0.75	0.185	0.1283	0.52	1.09
80-84 years	0.77	0.198	0.1832	0.52	1.13
85-89 years	0.82	0.229	0.3990	0.53	1.29
90+ years	0.72	0.198	0.1008	0.49	1.07
Female gender (men as r.g)	1.27	0.135	0.0796	0.97	1.65
Comorbidities	1.19	0.043	**<0.0001***	1.09	1.3
Medicines	1.00	0.017	0.9717	0.97	1.04

*statistically significant difference; r.g, reference group

5.4.3.3 Multidisciplinary intervention

Pharmacist medication review

Of those reviewed by Lelly, only results for residents (n=13) who were identified to have scored higher in the pre-intervention audit (PIMs or four and above and similarly PPOs of four and above) will be presented in Table 5.13. These 13 residents had 4 and more instances of IP, i.e. at least 4 instances of PIM and/or at least 4 instances on PPO. She identified a total of 61 drug related problems (mean of 4.7 problems for each resident) and took an average of about 5 minutes (ranging 1-15 minutes) to review the MAR of each resident. The problems identified were related to monitoring, duplicate drug classes, contraindications, unnecessary treatment,

'cheaper alternatives available', 'use with caution' drugs and inappropriateness in indication, formulation, dose, and/ or frequency (Table 5.13).

5.4.3.4 Feedback and discussions with GPs

Lelly and I independently discussed a total of 273 inappropriateness and problems with the two GPs. These include drug-related problems identified by Lelly, the pharmacist (data presented for the 13 Collingwood residents), the additional record-keeping and monitoring issues identified by myself, the researcher, as well as the PIMs, and PPOs identified using the STOPP and START criteria. These were collectively categorised into 14 domains. These domains were 1) monitoring; 2) no clear indication; 3) prescribing omission; 4) inappropriate formulation; 5) record discrepancies; 6) duplicate drug classes; 7) safer alternative available; 8) drug-drug and/or disease interactions; 9) adverse reactions or allergies or contraindications; 10) inappropriate dose; 11) unnecessary treatment; 12) inappropriate frequency; 13) cheaper alternatives available; and 14) use with caution (Table 5.13).

5.4.3.5 General practitioners decision-making

The GPs responsible for the two homes took the following actions: they 1) clarified discrepancies, missing and/or ambiguous information; 2) provided reasons for exception prescribing; 3) evaluated results of the START-STOPP audit, of the pharmacist medication review and they noted discrepancies in record keeping identified by the researcher; and 4) made changes to prescriptions when deemed appropriate. During the discussions, they had: 1) ordered levels for drugs which required monitoring, requested for renal, blood and lipid profiles(e.g. ordered blood profile to determine renal function prior to commencement of angiotensin converting enzyme inhibitors), and they ordered latest BP readings from nursing home; 2) commenced residents on new medications; 3) changed dose and/ or frequency and/or preparations (i.e. switched from tablet to topical); 4) discontinued treatment; 5) requested for

community psychiatry nurses to review residents' dementia statuses; and 6) switched to cheaper alternatives that were appropriate to the resident (Table 5.13).

Table 5.13: Outcomes from the multidisciplinary intervention: STOPP identified potentially inappropriate medications; START identified potential prescribing omission; researcher identified record discrepancies and additional inappropriateness using the BNF; pharmacist identified drug related problems; GPs made changes to prescriptions

Domain	Problem identified			GP comments	Changes
	STOPP	Researcher	Pharmacist		
Monitoring (n=56)	SSRIs + hyponatraemia (6)			Not common practice to check Na levels prior to tx	Levels corrected in latest reading
	Loop diuretic for ankle oedema (5)			Hosieries less efficacious	Tx continued
		Carbamazepine reduces plasma [C] of valproate, also plasma [C] of active metabolite of carbamazepine increased			Ordered levels
		Levetiracetam increases risk of carbamazepine toxicity			Ordered levels
		Very high BP reading (5), low BP reading (3)			Requested latest reading from NH
		Hyperkalaemia in renal impairment	Frusemide 40mg + spironolactone OM=>HF?	H/o HF ('07) & K^+ disturbances	Ordered K^+ levels
		Recent renal/ lipid/blood profile (32)	Recent renal/ lipid profile (8)		Ordered
			Magnesium glycerophosphate (costly and requires monitoring)	Received letter from hospital requesting GP to review MG levels and need for drug	Ordered levels then stopped
			Azathioprine- blood profile	Add warning re: bone marrow suppression	Ordered levels

Domain	STOPP	Researcher	Pharmacist	GP comments	Changes
No clear indication (n=54)	Cocodamol (2)				Not on repeat Rx
	Cyclizine-risk of sedation and anticholinergic SE (5)			Prescribed by specialist	Stopped
	Ibuprofen/ diclofenac sodium (3)			Osteoarthritis	Switched to topical ibuprofen
	Orphenadrine/ procyclidine/ trihexyphenidyl (9)			To treat extrapyramidal SE	Tx continued
	Aspirin (9)	Aspirin+ diipyridamole (2)		Head injury (2), others have DM	Stopped (2)
	TCA C/I in dementia, glaucoma, constipation, opiate, calcium channel blocker, h/o urinary retention (15)	Avoid TCA	TCA	Old fashioned method of treating sleeping problems by psychiatrist– prescribe low dose neuroleptics (e.g. 25/50mg amitriptyline) to treat rather than give “sleeping tablets”	CPN to review
		? Haloperidol/ amisulpride for depression (5)		“Psychotic depression”	Tx continued
		Olanzapine-no psychosis			To titrate to stop
		Metronidazole and flucloxacillin		Antibiotic prophylaxis- urinary catheter	Tx continued
			Diclofenac 50mg BD-risk of bleeding, review need	Fracture pain	Stopped and switched to tramadol
			Laxatives	Prefers to have bowel movement at least OD	Tx continued

Domain	START/STOPP	Researcher	Pharmacist	GP comments	Changes
Omission (n=71)	Fibre supplement in diverticular disease with chronic constipation (2)				Unsure if constipated but certain that NH staff would have alerted
	Aspirin in DM + high lipids + smoking hx (14)			C/I in h/o falls or bleeding	Started otherwise (5)
	Asthma- no beta 2 agonist (11)	No PEFR reading		Possibly not required	No action
	Statin in DM (10) or statin in mobile with CVS events (8)			Avoided in muscle wasting/ frail	Otherwise started (3)
	Metformin in type 2 DM (5)	Some on insulin (4)		One resident has no DM	No action
	ACEI in DM (10)			Contraindication possible although no documentation	Otherwise ordered renal function before starting tx
	Loop diuretic as monotherapy in HTN (4)			BP controlled by diet and lifestyle changes in NH	No action
	Calcium and Vit D in osteoporosis (5)	On either calcium or vit D			Combination started
		No tx for schizophrenia		Recently on modecate	Continue modecate
		No tx for schizophrenia (11)		-More likely to have “dementia” -Because of tardive dyskinesia	No action
Formulation (n=1)			Irbesartan		Changed to losartan because they can be crushed
Record discrepancies		ACEI C/I			Records updated

Domain	START/STOPP	Researcher	Pharmacist	GP comments	Changes
(n=9)		Egg allergy (2), C/I to beta blocker (4), haloperidol (1), chlorpromazine (1)			Records updated
Duplicate drug classes (n=15)	Antidepressants: -Venlafaxine+ mirtazapine (4) -Two SSRIs (3)			On psychiatrist recommendation	Venlafaxine stopped One SSRI stopped
	Two opiates (6)			Required by patient	No action
	Antipsychotics: Amisulpride+ quetiapine (2)			On psychiatrist recommendation	CPN to review
			Letrozole OM (duplication on MAR chart)		One stopped
			Ramipril 10mg OD + amlodipine 10mg + bendroflumethiazide 2.5mg =>last BP 118/90		Tx continued
			Doxazosin 2mg OD + perindopril 20mg OM-last BP 111/61		Tx continued
Safer alternative available (5)	Clonazepam has a long half-life-sedation	? Indication		Indicated as muscle relaxant	No action
	Nicorandil worsen constipation			Unsure if other antihypertensives will work	No action
		Mirtazepine for agitation - suggest lorazepam			Changed to lorazepam

Domain	START/STOPP	Researcher	Pharmacist	GP comments	Changes
		?Clopidogrel - can increase existing high lipids levels			Changed to aspirin
		Codanthramer- carcinogernic and limited to terminally ill			Switched to lactulose
Drug-dug/ disease interaction (n=14)	Loperamide in bowel disease (1)				Changed to "PRN"
	TCA in combination with calcium channel blocker possibly causing chronic constipation (3)			-TCA on psychiatrist recommendation - Primary objective is to treat HTN	Continue calcium channel blocker as it works for these residents
	TCA with dementia, glaucoma, constipation (10)			On psychiatrist recommendation	CPN to review
Adverse reactions/ allergies/ CIs (n=4)		Record of ramipril ADR but now on it		Possibly only one episode	Tx continued
		Allergy to Ventolin but on salbutamol		Not allergic with latter	Tx continued
			Amisulpride 150mg and alcoholic liver disease		CPN to review
		Clopidogrel+ PPI - very high risk of thrombosis	Combination can increase CVS events - suggest ranitidine		Switched to ranitidine 150mg BD
Dose (n=8)			Reduce omeprazole 40mg for NSAID-associated ulcer		Reduced to 20mg
	Aspirin >75mg	Aspirin 150mg	Aspirin= 150mg	H/o stroke	No action
		Mirtazepine high dose		Dose reduction	Dose titrated down

Domain	START/STOPP	Researcher	Pharmacist	GP comments	Changes
			Simvastatin 40mg- last TC?		Tx continued
			Trifluoperazine 3mg OM		CPN to review
			Losartan 100mg - last BP 95/54		Reduced to 50mg OD
			Tramacet (tramadol+ paracetamol) 1-2 TDS PRN, 4 doses on 16th- unclear if 1 or 2- prescribe individually to optimise dose		Changed to tramadol
	Digoxin=250μg OD (>125μg) (3)		Digoxin 250μg OM		Reduced to 125μg

Domain	STOPP	Pharmacist	Pharmacist comments	Changes
Unnecessary (n=17)		Voltarol gel PRN, diethylamine salicylate cream PRN, macrogol OM-	No longer taken/used	Stopped
		Quetiapine 50mg M/R OM 100mg ON	?MR => give 3x 50mg OD instead	Worse at night so BD dosing-tx continued
		Aquacell silver, allevyn	If wound no longer weeping	Stopped
		Alendronate	Not routine to give bisphosphonates unless on >1000mg fluticasone/steroids per day	Stopped
		Donepezil 5 mg OD- last dementia review to assess progression	-	GP will review MMSE
	Antimuscuranic with dementia (oxybutinin)	Oxybutynin-it's an antimuscuranic		Stopped
		Ferrous sulphate (7)	Iron levels? Hb= 8.9 (1)	Stopped
	Prochlorperazine/ metoclopramide with Parkinsonism (2)	Prochloperazine 3mg	Already on metoclopramide	Both stopped
		Gabapentin	From pain clinic, should be titrated slowly up or down; if helps continue if not stopped	Stopped
		Dipyridamole	Prescribed for 2 years so can now stop	Stopped
		Adcal-D3 effervescent tablets (3)	Difficulty in swallowing/ refusal so non-dissolvable tablets not an option	Tx continued
		Aquacel silver and Allevyn dressing recommended by TVN	Suggest Sorbsan ribbon and review in one month	Switched
		Omeprazole 40mg (3)	Suggest lansoprazole 30mg	Switched
		Seretide 250 Accuhaler, 2 puffs BD	Suggest Seretide Accuhaler 500 (£70 vs £41/month)	Switched
Frequency (n=2)		Rx: Buprenorphine patch OW	Should be given on 26th not 27th	Changed on notes
		Movicol OM PRN	Taking OD-may upset U&E	Stopped then restarted after a while

Cheaper alternative (n=16)		Adcal-D3 effervescent tablets (3)	Difficulty in swallowing/ refusal so non-dissolvable tablets not an option	Tx continued
		Aquacel silver and Allevyn dressing recommended by TVN	Suggest Sorbsan ribbon and review in one month	Switched
		Omeprazole 40mg (3)	Suggest lansoprazole 30mg	Switched
		Seretide 250 Accuhaler, 2 puffs BD	Suggest Seretide Accuhaler 500 (£70 vs £41/month)	Switched
		Metformin M/R 500mg BD- ?M/R	No adherence/ GI problems	Tx continued
		Metformin 500mg/500ml 8.5ml TDS	Suggest to change to sachet	Changed to 1g BD sachet
		Gliclazide solution 80mg/5ml 2.5ml BD- ?solution	No swallowing problems, non-adherent with tablets but will take liquid with persuasion	No action
		Risperidone liquid 1mg/ml 2ml OD- ?solution (2)	-Suggest tablets (£59.70/100ml vs £1.8) - On GP records-tablets, liquid from hospital; no swallowing problems	Switched back to tablets
		Nifedipine M/R- why M/R?	On normal release previously but sudden drop in BP	Changed to amlodipine 5mg OD
		Mixtard discontinued		Switched to humulin
		Simvastatin special liquid		Changed to tablet
Use with caution (n=1)		Finasteride	Avoid handling by women (NH staff) of child-bearing age	Review in 1 month

(n):number of occurrences **[c]:** concentration **tx**: treatment **OM**: in the morning **HF**: heart failure **h/o**: history of, **K^+**: potassium **MG**: magnesium glycerophosphate **re:** regarding **SSRI**: selective serotonin reuptake inhibitor **NH**: nursing home **TCA**: tricyclic antidepressant **DM**: diabetes mellitus **CPN**: community psychiatry nurse **OD**: once daily **Rx**: prescription **SE**: side effect **hx**: history **PEFR**: peak expiratory flow rate **CVS**: cardiovascular **ACEI**: angiotensin converting enzyme inhibitor **HTN**: hypertension **MAR**: medication administration record **ADR**: adverse drug reaction **µg**: microgramme **MMSE**: mini mental state examination **Hb**: haemoglobin **TVN**: tissue viability nurse **OW**: once a week **PRN**: as required **U&E**: urine and electrolyte **M/R**: modified release **GI:** gastrointestinal **BP**: blood pressure

5.5 Discussion

5.5.1 Implementation: successes and constraints

5.5.1.1 Successes

The study demonstrated that a multidisciplinary intervention consisting of feedback from both audit and pharmacist medication review and followed by customised changes to prescriptions by general practitioners (GPs) resulted in improved prescribing quality. Upon completion of the one year and one month study, a significant reduction in the baseline level of inappropriate prescribing (IP) as evaluated by the explicit criteria was evident. Throughout this period, the team of researchers, pharmacist, GPs and nursing home staff, addressed several medicines management issues. We particularly focussed on medication omission, appropriateness, effectiveness, cost and adherence by reducing frequency or substituting with a more suitable formulation.

The intervention assisted the practice to achieve several QOF targets. The Quality and Outcomes Framework (QOF) is part of the general practice contract and was introduced in April 2004. The QOF rewarded practices for the provision of 'quality care' and helped fund further improvements in the delivery of clinical care.[183] The practice had a 5-year history of achieving 90% and above QOF points, with the percentage of patients above the threshold for many clinical indicators higher than average for the primary care trust (PCT).[183] This is specifically true for the indicators dementia and palliative care. QOF has four main components, known as domains. In the interest of the practice, conducting a medication review for nursing home residents every 6 months supported achievements of the domain ‘medicines management’ in the QOF targets while maximising prescribing efficiency. The

main domain in QOF, 'clinical', consisted of 86 indicators and had routine monitoring mechanisms built in them. The intervention prompted GPs to initiate clinical investigations and the results updated subsequently in the electronic medical records. The results of the clinical investigations was important as it facilitated the practice to achieve several indicators such as 'percentage of patients with diabetes and had a record of glycated haemoglobin (HbA1c) or equivalent, blood pressure, total cholesterol, retinal screening, peripheral pulses, and estimated glomerular filtration rate (eGFR) or serum creatinine in the previous 15 months'. At the time of writing this thesis, the latest figure for 2011/2012 for achieving QOF targets had not been published and hence comparison could not be made to assess improvements; although none of the indicators distinguished older people, clinical indicators pertaining to palliative care and dementia, for instance, could be used to assess improvements to a certain extent.

The collaboration also facilitated enthusiasm and enhanced communication between nursing home staff and the GP practice. Nurses and managers of the nursing homes in particular demonstrated increased interest and awareness regarding residents' well-being. Nurses were also observed to have kept records in a more orderly manner as well as ensuring that accurate details were written on the medication administration records (MAR) charts (e.g. proper recording of 'when required' medications). Informal interviews conducted by the researcher and pharmacist with nurses regarding residents' medication prompted them to highlight more drug-related problems to the GPs (e.g. alerted GPs that a change in regular treatment occurred after hospitalisation). At the start of the interviews, there was commonly a curiosity about the nature of visits, and a predictable level of suspicion as to biases or lack of independence from regulatory bodies. However, following several visits, the view that medication errors

involving residents could be made by any healthcare professional was emphasised and reinforced. The check and balance mechanism for prescribing and monitoring practices was effectively valued and appreciated by all those involved.

Feedback provided from both the Screening Tool of Older Person's Prescriptions and Screening Tool to Alert doctors to Right Treatment (STOPP-START) audit as well as pharmacist medication review enabled GPs to further identify areas for improvement, and ascertain best practices in the prescribing and monitoring processes. There was clearly an element of continuous learning and upgrading for the researcher and GPs, especially when reviewing new evidence for use of certain medications in treating certain chronic illnesses. A good example was in the indication of antidepressants for agitation and psychosis in dementia. Use of antipsychotics in dementia with Lewy Bodies (diagnosed as dementia along with any two of the following symptoms: complex visual hallucinations, fluctuating cognitive impairment, or spontaneous Parkinsonism) were of specific interest to the GPs as these treatments were usually initiated and the subsequent baseline monitoring would usually be carried out by the neurology, dementia or psychiatry secondary care teams.

The GPs expressed their appreciation for these discussions as this process of a case by case resident review assisted significantly in reducing their workload. They otherwise would not have been able to allocate much time to review each resident’s medicine in detail, because these residents had on an average of nine medicines each. These discussions also assisted in the practice’s medicines reconciliation process, which involved GP computerised patient records, hospital letters and nursing home MAR charts. Vital information that could have

caused harm such as severe allergic reaction to eggs which could be a contraindication with seasonal influenza vaccine, had now been documented.

5.5.1.2 Constraints

Owing to busy schedules and surgery commitments of the GPs, some difficulties were experienced in confirming appointments with them to provide feedback and discuss residents' medications. Despite these initial glitches, their willingness to meet and discuss during their lunchtime proved their dedication, support and commitments towards this collaborative effort.

Another constraint that we faced revolved around the shared care protocol, which was effectively in place to facilitate the sharing of care and prescribing in chronic diseases between hospital consultants and GPs. Because of this shared responsibility and not having specialists' from the mental health, pain management and epilepsy teams, for instance, present at our meetings, it made it quite difficult to assess the need for certain drugs. One example is the prescribing of long-term hypnotics as tranquilisers where decisions could not be made by GPs as to whether the prescribing was appropriate. In such cases, a review by was psychiatrist or community psychiatric nurse was requested.

5.5.2 Relationship to other evidence

Existing research on prescribing quality in UK nursing homes is limited while prescribing quality improvement initiatives are scarce. Our prescribing quality improvement intervention was aimed primarily at reducing inappropriate prescribing for older people. It highlights the involvement of the general practice, PCT, nursing homes and researchers.

5.5.2.1 Evaluation tool

From a research perspective, the study was one of the first to use STOPP-START criteria as an evaluation tool in nursing homes. As mentioned in Chapter 2, although substantial research pertaining to prevalence and intervention on inappropriate prescribing had been previously described in care homes; the use of STOPP-START criteria as an evaluation tool was rarely reported. This was surprising given that the criteria were applied for older people in various other settings such as in hospitals and in primary care.[184, 185] The limited use of STOPP-START could be ascribed to the criteria being only fairly recently validated (2008) as a relevant and applicable IP screening tool. [78]

Review of published literature revealed that there was only one published study which used STOPP and START hand-in hand as they were designed for use, to identify IP prevalence in nursing homes; this research was carried out in Spain.[186] The study reported a higher prevalence, with STOPP having identified 79% and START 74% residents with at least one inappropriate prescription.[186] The higher prevalence was likely contributed by the inclusion of residents who were directly discharged from hospitals. It is well known that patients who were discharged from hospitals pose greater risks of polypharmacy, which has been postulated as a risk factor for potentially inappropriate medication (PIM)[187, 188] Another study by the Centre for Ageing Research and Development in Ireland [97] reported that when using STOPP criteria, 73.0% of residents had at least one PIM identified while the Beers' criteria identified 54.3%. The research, however, used STOPP criteria in isolation and did not use the START criteria to address potential prescribing omissions (PPO), which is an important component of IP.

We estimated a PIM prevalence of between 41.8% and 58.2%, and a PPO prevalence of between 51.4% and 67.5% using STOPP-START data from a large sample of hospitalised older people. Our findings were higher for PIM (63.6%) while PPO's was within the estimation (53.1%) value. The higher figure in our study could be attributed to nursing homes residents being frailer, and hence having more comorbidities and requiring more prescriptions than hospitalised or community- residing elderly. Increased numbers of prescribed medicines have been associated with increased occurrences of PIM.

5.5.2.2 Multidisciplinary intervention

Pharmacist medication review and feedback

Our intervention incorporated a medication review whereby the pharmacist identified a mean value of 4.7 drug-related problems (DRPs) per resident. In comparison, a pharmacist medication review in Switzerland nursing homes found an average of 3.7 DRPs in 332 residents.[189] Although this is a small difference, it is worth mentioning that our representative sample was likely subjected to selection bias, i.e. the 13 residents reviewed were already identified by STOPP-START to have had high baseline inappropriate prescribing (PIMs of four and above and/or four PPOs). As such, higher frequencies of DRPs were expected. Similar to our intervention, DRPs were discussed with their responsible physician and medication interventions proposed. However, their outcomes were economical endpoints, i.e. savings in annual drug cost and such results and conclusions cannot be extrapolated to our findings. One study that had a very similar intervention to ours was reported in the Netherlands. Participants from residential home had their prescriptions reviewed by a pharmacist who then chaired a multidisciplinary team meeting; the intervention was later evaluated by another set of explicit criteria, the Medication Appropriateness Index (MAI).[190] In light of the PINCER trial where a pharmacist-led information technology intervention

included feedback and educational outreach, the elements of education outreach together with the use of information technology were found to contribute significantly to the success of the trial. Findings from the newly published PINCER trial are significant and applicable to our study; future research could combine the data collection and audit stages (independently performed in our study) into a more simplified process by embedding STOPP-START criteria into the practices' information technology system.[191]

In this thesis, I have only presented results of the 13 residents identified to have had high risk inappropriate prescribing. In actual fact, the pharmacist reviewed medications of all residents' in stages. Therefore, I believe that the contribution of the pharmacist medication review is somewhat underestimated in the data presented here.

There are no doubts that there will be considerable evidence that will support the effectiveness of pharmacist medication review and multidisciplinary interventions in care homes internationally.[144, 158, 159]

STOPP/ START audit feedback

The success of our intervention as well as the overall quality improvement initiative could not have been achieved without the recommendations and feedback provided to GPs based on the STOPP-START audit. I believe this face-to-face approach played the most significant role in the success of the intervention. In addition, one of the GP made changes to prescriptions during the feedback session itself which further increased the likelihood of correcting an error identified. Similar to our approach, one randomised controlled trial carried out in Ireland hospitals provided STOPP-START recommendations to physicians and also achieved a

positive outcome where authors found a significantly lower absolute risk reduction of MAI scores in the intervention group.[192]

The limitations of our study are described below.

5.5.2.3 Study design

While randomised controlled trials are considered the gold standard in evaluating interventions, randomisation is not always possible for either practical or ethical reasons.[193] In these circumstances non-randomised designs have been used. Similar to much quality and safety improvement research in single institutions (one GP practice in our case), we adapted the non-randomised, before and after without concurrent control study design. Such study designs may provide convincing evidence of effectiveness, particularly when interventions have large effects.[194] In contrast, if the effects are small, these studies are considered a relatively weak method to distinguish cause and effect, since any observed change might plausibly be attributed to secular trends (for example, due to other service developments). Nevertheless, this design may be the only feasible option in some circumstances, for example, when service managers wish to evaluate a local initiative, policy makers introduce an intervention across an entire service, or safety incidents are very rare.[195] In our study, it is reasonable to assume that inappropriate prescribing would have reduced to a certain extent regardless of the intervention, because the practice has taken positive efforts recently to improve its management and services. One way to better understand evidence of cause and effect is to use a series of observations (time series, control chart) to observe significant interruption in this series rather than a single before and after study observation. Such an approach was used to track the quality of primary care in England before and after the introduction of a system of financial incentives in 2003 and revealed that quality was already

improving before the intervention.[196] Although we did not use such an approach, our results demonstrated that our intervention had approximately halved the odds of receiving an inappropriate prescription. We are certain that such a success would not have materialised if the intervention had not been implemented.

In addition, our study design had two stages of data collection

5.5.3 Limitations

5.5.3.1 Internal validity

Here, I will consider possible sources of confounding, bias, or imprecision in design, measurement, and analysis that might have affected our study outcomes. As seen in *results*, there were significant differences in the baseline characteristics of the residents in terms of number of medicines and number of comorbidities, pre and post-intervention.

There were higher number of medicines in the pre group compared to the post groups; similar correlations were also evident in the number of PIMs. This reiterated the point in the previous section, *Relation to other evidence,* that number of medicines were positively associated with PIMs i.e. when GPs corrected PIMs as part of the intervention, medications were discontinued. One point worth mentioning was that in parallel, prescribing omission rates had significant improvement post-intervention, i.e. number of medicines were expected to rise as prescribing omissions were corrected but a net decreased effect still persisted.

We noted that the number of comorbidities, particularly depression, decreased slightly but significantly post intervention, and therefore could have been a source of confounding. We

were made to understand during meetings with the GPs, that the practice had experienced some QOF coding issues with regards to differentiating "neurotic depression" and "psychotic depression" and as such some of this information may have been wrongly coded. It is possible that the researcher, having learnt this, could have arrived at a diagnosis based on medications prescribed, during the post-intervention data collection. These diagnoses were important in determining whether antidepressants were omitted if it was a case of "neurotic depression" or long-term neuroleptics were prescribed as hypnotics in "psychotic depression". Nevertheless, statistical analysis demonstrated a significant decrease in PIMs and hence a successful intervention even after adjusting for the variables: number of medicines and number of comorbidities.

There were other instances when self-judgement was evident, for example, although some residents were "diagnosed" with hypertension, they were not prescribed any antihypertensives as lifestyle modifications in nursing homes had improved their conditions. Under such circumstances, many of the residents in the pre group would have had an incorrect antihypertensive omission, according to the START criteria.

In addition, during post-intervention data collection, the practice was gearing towards achieving its annual QOF targets review. This led to increased efficiency in updating patients' demographic (smoking status, ethnicity etc.) and clinical details (laboratory, BMI, blood pressure recordings). The process led to a more complete post-intervention data collection which assisted in applying individual STOPP-START criteria.

Finally, we found that STOPP-START criteria had several limitations in its applicability: it did not address underprescribing in schizophrenia or psychosis, it only considered dosage for

only digoxin; it captured the combination of aspirin and warfarin but not aspirin and digoxin prescribed without proton pump inhibitors. One criterion of the STOPP criteria was also found to be outdated. The criterion, 'dipyridamole as monotherapy for cardiovascular secondary prevention' was made invalid after the National Institute for Health and Clinical Excellence (NICE) updated its guidance following review and re-appraisal of clopidogrel and modified-release dipyridamole for the prevention of occlusive vascular events. This guidance issued in December 2010 replaced the 2005 'NICE technology appraisal guidance 90' and stated that modified-release dipyridamole alone was then recommended as an option to prevent occlusive vascular events.[197] We took this change into account during meetings with the GPs but applied the criterion as it was to both pre and post-intervention datasets.

Lastly, the researchers took an average of 10-12 minutes to apply the criteria depending on the nature and complexity of residents' medications. The criteria would be best used by responsible GPs or nurses in nursing homes who knew better the conditions and well-being of residents. When deciding if a resident had chronic constipation, for instance, an in-house nurse would be in the best person to be consulted.

5.5.3.2 External validity

To extrapolate findings of this study to the general population, we need to explore factors that could affect generalisability.

The study was sufficiently powered (86%) to detect a reduction in the proportion of residents who had inappropriate prescribing post-intervention and as such the results can be inferred to the nursing home population. In terms of representativeness, although "samples" were drawn from two nursing homes that were looked after by one general practice, residents of the two

homes were diverse, multicultural and were representative of the general London population. As our "samples" were institutionalised residents who were rather frail and most having had dementia, they were incapable of making accurate decisions for themselves and therefore relied on healthcare professionals or families to a certain extent for the choices of their medications. As such the influences of their cultural and health beliefs were less likely to have affected the outcomes of our intervention although in some cases residents' families would have been involved. In addition, to reflect current practice, all residents were eligible for inclusion into the study; this included both palliative care and terminally ill patients. As such, the findings from our study may not be generalisable to older people who were living in the community as they were probably not as frail as those included in our study.

One other factor which is highly likely to cause deviation in the outcomes from that seen with our intervention is the health systems and working ethics in other countries that may vary from that practiced in the UK. GPs as well as nursing home staff involved in this study were highly trained and proficient with their day-to-day tasks and when handling queries with regards to residents' statuses and medications. The same levels of health care cannot be generalised to other primary care settings internationally. Bindman and colleagues, for instance, in their study of differences in primary care systems in the UK, US and Australia found that consultation times varied significantly between these countries and so did contribution of primary care to the healthcare system within each country.[198] As our GP practice has had a history of continuous and consistent good performance, we cannot generalise these findings to "poorer" performing practices nationwide.

Although we did not perform a qualitative "satisfaction" evaluation, the general view was

that multidisciplinary approach facilitated improvements in the PCT-GP-nursing home staff collaboration. This had a long term impact, especially through improved knowledge updating. Everyone involved in the study demonstrated a very positive appreciation of the study. As such, we cannot suggest that practices that do not volunteer for such initiatives will achieve the same results as we did.

5.5.4 Implications for practice

This study is an excellent example to illustrate that collaboration from general practice and primary care trust is fundamental for achieving success especially in areas pertaining to prescriptions, improving prescribing quality, and medication safety for nursing home residents. Previously, a quality improvement programme in palliative care, Gold Standards Framework for Care Homes (GSFCH), listed lack of cooperation from GPs as a barrier to the successful implementation of the programme.[199] It was evident in our study that without the involvement of the GPs, changes to prescriptions of residents would not have been made. Without support from GPs responsible, it would certainly be very difficult for any initiative involving healthcare of residents in care homes to achieve its desired effect. In our study, one GP spent five hours in total making changes to prescriptions, communicating with nursing home staff and attending the four feedback sessions. In the PINCER trial, pharmacists were involved in making agreed interventions to tackle the detected prescribing problems;[191] this approach could help facilitate quality improvement projects where GPs are often not be able to allocate more of their time towards such initiatives.

There are many ways in which similar quality improvement initiatives can be improved. The collaboration would have been enhanced if specialists from secondary care were involved in the multidisciplinary discussions. Impact on economic outcomes as a result of the

intervention would have added value to the project. Finally, future research into quality improvement interventions should also be directed at understanding the determinants of effectiveness besides evaluating whether they can be successfully carried out. Impact of the individual components of this multifaceted intervention could therefore be further explored so that this information can be used to further improve the systems for improvement. Qualitative evaluations would have certainly provided a better insight to this. Recommendations for the methods of evaluation adopted, system improvements and policy implications will be discussed in Chapter 6.

5.6 Conclusions

Our multidisciplinary quality improvement intervention demonstrated that reducing inappropriate prescribing levels for nursing homes residents located in a multicultural and socially deprived inner city borough is achievable. While the principal aspects of the intervention that contributed to its success were not established, collaborative effort of such has proven beneficial to the overall communication amongst the trust, nursing home staff and GPs. We hope that initiatives similar to ours where, GPs, nursing home staff and primary care trust play a central role will be implemented in other care homes throughout the UK.

There is huge potential and value for improving the management of chronic diseases in these homes. From a public health standpoint, these types of initiatives will be of great healthcare value and will benefit this subgroup of vulnerable people. Continuous effort should hence be directed towards improving prescribing quality, specifically for older people in general practices and these initiatives continuously monitored to assess sustainability. Quantifying the degree of improvement or the lack of it can then have considerable impact on future policy directives and public health implications.

Chapter 6

Reflections, recommendations and conclusion

In this chapter, I will present an overall conclusion, some reflections and recommendations arising from the previous chapters. In particular, I will address directions for future research, regulatory and best management practices. I will discuss according to five thematic areas: directions for future research; policy, legislation and directives; education and training; integrated healthcare services; and information technology. These recommendations are intended for and are aimed mainly at, researchers, policymakers, and regulators, and other related institutions that will be responsible for research and development, national planning or commissioning health related services. Most importantly, these guidelines will benefit the NHS (including NHS Wales, Scotland, England and Northern Ireland), which is the primary national body responsible for the provision of medication-related services to care homes in the UK.

6.1 Directions for future research

6.1.1 Clarity in definitions of appropriateness in prescribing

With a myriad of definitions being employed to describe prescribing quality, it is important that a specific and uniform terminology is used. The phrases 'appropriateness in prescribing' and 'inappropriate prescribing' in the context of older people were used throughout in my thesis. The former, in my opinion, is inclusive of all domains necessary in the decision-making process: 1) "appropriateness"; 2) accounting for the different domains related to the decision, i.e. meets patients' needs and consideration of prescribing to patients' family; and 3) prescribing on a scientific basis.[41, 44, 52] Theoretically, "optimum" prescribing quality

would be preferred instead of "appropriate". However, in practice, an "optimum" medication, which has clinically proven to have optimum benefits and minimal side effects may not be the best option in the interest of cost consideration, and therefore may not be "appropriate" to the patient. No doubt, the first two domains of 'appropriateness in prescribing' are difficult to measure quantitatively; the last domain, 'prescribing on a scientific basis' is easier to be measured via the clinical pharmacology of drugs. While this approach has its merits, it may not be considered as a holistic approach because it disregards the other two domains. The second domain, in my view, could be easily evaluated using methods such as surveys and interviews with patients.

Although the literature did not explicitly state the rationale for its use or that it is associated only to the scientific aspect of appropriate prescribing, I rationalised from its definition that the term 'inappropriate prescribing' was derived from a pharmacological perspective because it had an advantage as a parameter which is measurable and verifiable in practice. In fact, some critiques have proposed that measurement tools of inappropriate prescribing be termed measures of 'pharmacological inappropriateness'.[44] Other terms associated with IP included misprescribing, under prescribing, and overprescribing.

6.1.2 Use of appropriate parameters for evaluating inappropriate prescribing

The value and the methodology of evaluating inappropriate prescribing is often a topic of debate because there are many facets in its approach and interpretation.

6.1.2.1 Process and outcome measures

One argument is that appropriateness can be assessed by process or outcome measures. Process measures are more commonly used because they are direct indications of performance.[70, 71, 73-75, 77, 78, 121, 130, 200] Outcome measures such as the explicit, preventable

drug-related morbidity indicators have been developed.[107-110] The main challenge with process measures, as illustrated in Chapter 3 systematic review, is that we cannot be certain that it is a good measure to indicate causality to important outcomes. It may only have very weak causal links with important outcomes such as mortality, morbidity, adverse drug events and quality of life. These outcomes are especially difficult to ascertain in older people. We nevertheless used it in our quality improvement initiative described in Chapter 5 as measuring the process meant that we could directly assess performance of the practice. We did propose that future research should focus on the links and association between inappropriate prescribing, cost effectiveness and adverse drug events. This will require greater funding and research carried out on a long term basis, which were addressed as limitations in our study. I would suggest that more research be directed towards outcome measures because although they are secondary to IP, they are indicators of adverse outcomes. Furthermore, outcome measures will assess the predictive validity of process measures.[201]

6.1.2.2 Explicit and implicit process measures

Another issue is that, process measures of appropriateness can be assessed explicitly using criterion-based [70, 71, 73-75, 77, 78, 121, 130, 200] or implicitly by judgment-based assessment tools.[100] The former could be applied with little or no clinical judgement. In the latter, using a set of guidance criteria, an individual expert decides what is considered inappropriate based on his or her clinical judgement. Depending on what criteria is selected, any or all of these situations, such as under prescribing (or prescribing omission); misprescribing (e.g. considering or independent of diagnosis); and over prescribing, can be addressed. Implicit judgement-based criteria have often been criticised for being non-reproducible and non-reliable but have the advantage of having a customised approach towards identifying inappropriate prescribing for each individual patient. Reliability of judgement-based criteria

could be improved with detailed specifications, instruments to obtain data, and by training data collectors[201] as that carried out in the Medication Appropriateness Index.[100] This will add value and result in a comprehensive and systematic evaluation of inappropriate prescribing that can assist in the identification of areas which require improvements.

In the context of research, where neither explicit nor implicit criteria were used and where no data on validity or reliability of measurements were provided, [202, 203] the findings might be non-valid, not reproducible, or not generalisable. Firstly, end-points (herein, "end-point" instead of "outcome" is used to avoid confusion with the context it was used as above in *process and outcome measures*), should be scrutinised carefully if they are to be meaningful to other researchers. Some studies, for instance, had employed reduction in numbers of medications as a positive end point. This argument is a reasonable assumption given that reduced numbers of medication will present lesser exposure and hence reduced likelihood of inappropriate medication, drug–drug interactions, adverse drug events, and hospitalisations. However, if prescribing omission is also considered, medications may be initiated. This means that number of medications may be a good end-point to measure for example, hypnotic overprescribing, but not an accurate measure when under prescribing is also measured. Secondly, it would be useful if end-points measured are common amongst studies. Only then can other researchers consolidate research findings and evidence to arrive at an overall conclusion. I personally faced this challenge when attempting to conclude the findings of the Chapter 4 systematic review where some studies reported a decrease in the number of medications whiles others reported number of medication changes per patient. Providing a common end-point would also be of much benefit to other researchers evaluating systematic reviews and considering a meta-analysis only to find that the results of each study

were unable to be pooled due to the lack of a common outcome measure in all the relevant studies.

6.1.2.3 My experience with STOPP-START

I used the STOPP-START criteria as an explicit process measure to identify and measure IP for older people in nursing homes (as described in Chapter 5). Our study was a pioneer initiative and has now confirmed its validity for use in nursing homes in the UK, and provided useful baseline prevalence which could be used as guidance and reference materials for future sample size calculations on a similar topic. Due to time constraints, we did not assess IP and its relationship to hospitalisation or cost-effectiveness which would have provided valuable information to STOPP-START's predictive validity. During the study, there were no doubts that the STOPP-START criteria proved to be a sensitive and specific screening tool. Of the 65 criteria, 36 of the STOPP's criteria and 19 of 22 START criteria were used to identify PIM and PPO respectively. Prescribing one high-risk medication can lead to several instances of inappropriate prescribing because one medication can sometimes be linked to several PIM criteria. Furthermore, 19 of the START criteria (one criterion uncommon from the ones that identified that PPO) identified 328 prescriptions that were appropriately prescribed. Twenty-seven of the STOPP-START criteria were considered highly relevant to general practice and many of these were employed in a set of 34 prescribing-safety indicators that will be used for the purposes of revalidation of GPs in the UK.[58]

For future research, I recommend that STOPP-START be applied by a healthcare professional who has prior knowledge about patients' conditions. For example, results could be compared when a researcher, who has no knowledge of the resident's condition, applies the criteria as opposed to a similar application by a physician, nurse or pharmacist who has

prior knowledge about patients' conditions. Although START-STOPP was designed to be used explicitly, i.e. its application does not require expert judgement, I expect STOPP-START to be more accurately and quickly applied when prior knowledge is available (e.g. knowledge regarding smoking status and functional status). There certainly are justifications and evidence for the routine application of the STOPP-START tool by healthcare professionals for different groups, i.e. hospitalised older people[182], community-dwelling elderly[184] and institutionalised older people[97, 186], in the UK and in Europe.[80, 204] However, its use as a practical and reliable screening tool needs to be further evaluated on its repeatability and consistency of results in institutionalised settings such as care homes.

6.2 Policy, legislation and regulatory directives

In the UK, there are many institutions and sectors that are directly involved in the provision and regulation of healthcare for care home residents. My thesis has focussed on provision of medication-related services for these residents, focussing on NHS primary care in England. The relevant establishments that are responsible for provision of medical services in England are: 1) Care Quality Commission (CQC) which regulates services by NHS, local authorities, private companies or voluntary organisation; 2) NHS primary and secondary care which provide clinical and medical services; 3) PCTs or local commissioners who assess and commission care; and 4) local authorities who manage, monitor and improve local services.

This section describes the necessary national interventions that need to be taken by the national government and similarly by local authorities, NHS commissioners and commissioning boards to improve the quality of health care specifically in areas related to prescribing.

6.2.1 Government support

Findings from large scale studies in the UK can be used by the relevant UK government bodies and various ministries in England, Northern Ireland, Wales, and Scotland to plan, formulate and execute national policies that are more current and relevant to NHS medical services for the elderly in care homes. There is new information on lessons learnt and recommendations for care homes' medicines management systems and innovative models of clinical management in Europe [3, 9, 20, 205, 206] that can be used by policy makers and the NHS to better support care home residents. Greater support is specifically needed with prescribing regulations; relevant audits should include care home residents to support NICE guidance,[207] National Service Frameworks[36] and Quality and Outcomes Frameworks.[183] In addition, current legislation for monitoring rely on the CQC, which may not have the expertise to identify drug related problems. The QOF guidance for the General Medical Services contract 2011/12 stated that a medication review be conducted by GPs every 15 months for all patients prescribed four or more repeat medications, regardless of age.[208] The UK's National Service Framework for Older People recommends that older patients taking four or more drugs be reviewed six-monthly, with the remainder, annually.[36] To improve the situation, one alternative is to make annual medication review by community pharmacist mandatory for care home residents. The idea of regular medication review was also proposed earlier by another large scale study to quantify medication errors.[3]

Utmost key concern with regards to clinical management is the lack of a defined regulatory mechanism to assess appropriateness and rationale for prescribed medication in the UK.[9] I would also suggest that initiatives be taken by the Department of Health to fund the preparation of a document on appropriate prescribing guidelines for older people that are applicable to nursing home residents. These guidelines can then be used for auditing and

evaluation purposes. Prescribing guidelines for chronic diseases are presently available but often do not address the more complex needs such as dose alterations for older people.[207] From a clinical research perspective, collaboration with the NICE, NHS Commissioning Board, and the Royal Pharmaceutical Society of Great Britain (RPSGB) to provide updated information about the risks and benefits of drugs in older patients is urgently needed. Although information is available from clinical trials, the type of evidence that these trials provide is restricted because trials often exclude older, frail patients, and even when a trial targeted older people, the population enrolled is usually highly selected.[209] Instead of relying on clinical trials, future evidence of pharmacotherapy in older people should also involve well-designed non-experimental studies that estimate causal effects; this could address the issue of inequity towards this vulnerable group.[44]

6.2.2 Financial incentives from commissioners and local authorities

At the NHS commissioners' level, service specifications that reflect quality of prescribing should be agreed and detailed in contracts with local NHS providers. Primary care organisations are usually commissioned for Local Enhanced Services (LES) where GP practices are paid more to provide a higher than usual level of care to care home residents. This agreement and the associated payments recognise that working in care homes can be labour intensive. In addition, it also stipulates a degree of accountability and provides a framework for the monitoring of performance (largely at process levels rather than that of clinical governance).

At present, older residents of care homes are not fully identified or monitored in the UK primary care electronic patient record systems or in QOF; this could possibly be because not all GP practices provide services to care homes. There is also evidence to suggest that residents of care homes were more likely to be identified by their GPs as unsuitable or non-

consenting for QOF indicators that allow exclusions.[210] One strategy for improving prescribing and monitoring quality in care homes is through a distinct pay for performance system which reflects the specific needs of older people in care homes, for instance, a system that addresses the different levels of care needed as dementia progresses or support in palliative care (with support from secondary care specialists such as old age psychiatrists and pain management consultants). This system can then be monitored more efficiently as numbers of patients with exception reporting would have reduced due to the specificity of indicators.

Needless to say, the above recommendations require greater financial and human resources, and particularly in the current economic climate, the government will need to justify increases in provision of public funds for quality medical services in care homes. It certainly will need to clarify the additional responsibilities and commitments of the NHS including enforcing new statutory obligations.

6.3 Education and training

Education and training for prescribers or potential prescribers in care homes are two key areas that need to be further strengthened. Unlike in some countries, such as in the Netherlands where doctors are trained to be care home physicians, UK general practitioners do not generally undergo such a specialist training programme. Many GPs with special interest (GPSI) in older people are working on a contract within a locally enhanced service to meet prescribing needs and medical care for care home residents. As such, there would be great value for academic institution and GP practice collaboration on prescribing improvement initiatives to promote, share and transfer knowledge and information pertaining to prescribing in older people. In addition, educational support programmes could be

provided for these GPs by education commissioners such as the Medical Education England (MEE) for regular updates on such information.[211] Training courses or continuing professional development courses addressing pharmacotherapy in older people can greatly add value to such initiatives.

Apart from training GPs and specialists, pharmacists and trained nurses can be appointed as independent prescribers for care home residents as they can be considered as invaluable assets for the improvement of evidence-based clinical medicine and new clinical research appraisal. Elderly care trainees who would usually be trained to work in secondary care should also be exposed to prescribing systems in care homes. This could be one way of encouraging them to be proactive in prescribing and carefully scrutinising medical data and be mindful of prescribing errors that can pose serious harm to residents.

Care home staff should be adequately trained in effective record keeping and medicine management by their primary care organisations. This is important so that they can provide accurate information when GPs perform their visits once to thrice weekly with very limited time to attend to many residents.

There should be greater support, commitment and involvement of NHS commissioners, commissioning boards, and local authorities as well as the statutory health and well-being board (the body which will also commission future local NHS services). These institutions can fund and support long term educational and training partnerships for specialist teams and GP services (Personal Medical Services). Local commissioners themselves should also be equally equipped with the knowledge and plans for delivery of the Department of Health policy; the department facilitated best practice in commissioning, delivery and education by publishing guidance on its National End of Life Care Programme.[212]

6.4 Integrated healthcare services

It is a well-known phenomenon that the concept of integration provides synergy and thus often brings upon an improvement to any system. Likewise, there are sufficient research findings to suggest that new models for health care should be directed towards the promotion and collaboration of multidisciplinary team work. A good example is the contribution of a secondary care consultant to the medical and multidisciplinary management of common clinical challenges faced by GPs in care home residents. Likewise, in order for GPs to maintain clinical care of patients, an effective partnership with the care home staff is of paramount importance. Any clinical governance framework should be established in a partnership program with care home staff, other healthcare professionals (e.g. rehabilitation and mental health team) and involving GPs and consultants from secondary care. Other multidisciplinary care which can successfully operate in the care home setting should include a combination of the following: 1) regular sessions with inputs provided by secondary care specialists (geriatricians, rehabilitation medicine and old age psychiatrists; 2) older people' specialist nurses, including those with expertise in case management and mental health problems; 3) palliative care specialists; 4) community pharmacists; and 5) mental health services specialists.

6.5 Information technology

Residents' information is sometimes difficult to access using the current information systems that are available in care homes. Examples of these are when a patient has moved to another care home, is discharged from the hospital or when the patient has changed GP. It takes time for the paper records to be updated. Although such cases are relatively few, GPs in some rural areas have reported that they were prescribing in care homes without the expected support of

their computerised prescribing and patient record system.[9] Hence, the patient history was usually missing, as was the drug interaction alert system at the time of prescribing. However, it must be noted that most prescriptions for residents in a home were not hand written, as doctors often made notes and prescribed later on their return to the GP practice.

In some circumstances, out-of-hours GPs have little or no information about care home residents, even though paper records exist in the care home. It is therefore suggested that a more effective data retrieval information system be made available rather than relying on paper records "that follows the patient" for easy access and sharing of patient data. Paper records are unfortunately still used to contain patients' information, especially for older patients who would have had a long history of medical data prior to the information technology period. To improve the situation, it is suggested that one GP practice should be responsible for one home and that the home should ideally be equipped with a computer and be linked to their practice' prescribing system.[3]

At the inception of the NHS in 1948, there was no widespread availability of computing technology and a paper-based system of records was used and the records maintained. However, during the last twenty years, computers have been used worldwide to update, store, manage and retrieve data with greater efficiency. The use of the computer as an effective tool for the enhancement in the administrative and operational management of health services is currently being enhanced in the UK. Although the 'Connecting for Health' programme[213] is now being restructured, work will continue to implement many of its objectives. A Department of Health review of the National Programme for IT had concluded that a centralised, national approach to patients' records is no longer required.[214] A more locally operated system would be in place, whilst national applications already procured would

continue. This would nevertheless assist and support communication between GP, care home and pharmacy in the same areas (should all parties be able to access the same records).

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Appendix I: Definitions of care home

Care homes in the UK can be divided into nursing, residential and mixed homes. However, as these definitions vary from country to country, the definitions of these homes are listed below. Since April 2002 all homes in England, Scotland and Wales are known as 'care homes', but are registered to provide different levels of care.

The Care Standards Act 2000 (UK) defines a care home as:

> An establishment is a care home if it provides accommodation, together with nursing or personal care, for any of the following persons. They are:
>
> Persons who are or who have been ill;
> Persons who have or have had a mental disorder;
> Persons who are disabled or infirm;
> Persons who are or who have been dependent on alcohol or drugs.
>
> But an establishment is not a care home if it is:
>
> A hospital;
> An independent clinic; or
> A children's home

Previously known as "residential home" a home registered simply as a 'care home providing personal care' will provide personal care only - help with washing, dressing and giving medication.

"Nursing home" or a home registered as a care home providing nursing care will provide the same personal care but also have a qualified nurse on duty twenty-four hours a day to carry out nursing tasks.

"Mixed home" or dual registered homes no longer exist, but homes registered for nursing care may accept people who just have personal care needs but who may need nursing care in the future.

Appendix II: Approval by the East Central London Research Ethics Committee

NHS
National Research Ethics Service
East Central London REC 1
Royal Free Hospital
Pond Street
London
NW3 2QG

Telephone: 020 7794 0552

Miss Mathumalar Loganathan
Doctoral Researcher
Imperial College, Charing Cross
Campus3rd Floor, Reynolds Building
St Dunstan's Road London W6 8RP
W6 8RP

21 April 2010

Dear Miss Loganathan

Study Title:	**Assessing Appropriate Prescribing in UK Care Homes: Using Local Data to Examine Cross Sectional Prevalence of Inappropriate Prescribing and to Recommend Optimal Prescribing Strategies**
REC reference number:	**10/H0721/23**
Protocol number:	**1**

Thank you for your letter of 19 April 2010, responding to the Committee's request for further information on the above research and submitting revised documentation.

The further information has been considered on behalf of the Committee by the Chair.

Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised, subject to the conditions specified below.

Ethical review of research sites

The favourable opinion applies to all NHS sites taking part in the study, subject to management permission being obtained from the NHS/HSC R&D office prior to the start of the study (see "Conditions of the favourable opinion" below).

Conditions of the favourable opinion

The favourable opinion is subject to the following conditions being met prior to the start of the study.

Management permission or approval must be obtained from each host organisation prior to the start of the study at the site concerned.

For NHS research sites only, management permission for research ("R&D approval") should be obtained from the relevant care organisation(s) in accordance with NHS research governance arrangements. Guidance on applying for NHS permission for research is available in the Integrated Research Application System or at http://www.rdforum.nhs.uk. *Where the only involvement of the NHS organisation is as a*

This Research Ethics Committee is an advisory committee to London Strategic Health Authority
The National Research Ethics Service (NRES) represents the NRES Directorate within the National Patient Safety Agency and Research Ethics Committees in England

Appendix III: Local research governance approval was granted by the Research Development Centre at Southwark PCT

Southwark
Public Health Department
Hub 2 1st Floor
PO Box 64529
London
SE1P 5LX
Tel: 020 7525 0289
Fax: 020 7525 0318
email: anne.grant@southwarkpct.nhs.uk
www.researchdevelopmentcentre.nhs.uk

Miss Mathumalar Loganathan
Imperial College, Charing Cross Campus
3rd Floor, Reynolds Building
St Dunstan's Road London
W6 8RP

23/08/2010

Dear Miss Loganathan,

Project Title: Assessing Appropriate Prescribing in UK Care Homes: Using Local Data to Examine Cross Sectional Prevalence of Inappropriate Prescribing and to Recommend Optimal Prescribing Strategies.
R & D Reference: RDLam 550

Thank you for your assistance providing the documentation for the scrutiny of this project.

I am satisfied that this study meets with the requirements of the Research Governance Framework. It has been approved by the research lead for the respective NHS organisation.

Approval is given on behalf of NHS Lambeth on the understanding that you adhere to the conditions on the attached document. The end date of the project is listed as **23/04/2011**.

If you require any further information, please contact Ali Alshukry on 020 7525 0264.

Yours sincerely

Dr Anne Grant
RG & M Manager
South East London NHS
Bexley, Bromley, Greenwich, Lambeth, Lewisham & Southwark

AUDIT OF PRESCRIBING AMONG OLDER PATIENTS IN NURSING HOMES

Pilot Data Extraction Sheet

Date: / /

Demographic details

Patient identifier number: ..... Age (years): ..... Sex: M ☐ F ☐

Nursing home: Collingwood Court ☐ Manley Court ☐

Ethnicity (Enter letter appropriate to category in the box): ☐

White	Mixed Race	Asian or Asian British	Black or Black British	Other Ethnic groups
A. British **B.** Irish **C.** Other White	**D.** White & Black Caribbean **E.** White & Black African **F.** White & Asian **G.** Other Mixed	**H**. Indian **J.** Pakistani **K.** Bangladeshi **L.** Other Asian	**M.** Caribbean **N.** African **P**. Other Black	**R**. Chinese **S**. Any other **Z**. Not stated

Smoking Status: Current smoker ☐ Ex-smoker ☐ Never Smoked ☐

Past Medical History:

	YES	**NO**
Hypertension		.....
Heart failure		.....
Coronary heart disease		.....
Atrial fibrillation		.....

Other arrhythmias .....

Pacemaker in-situ .....

Persistant postural hypotension .....

History of thromboembolism (DVT/PE) .....

Bleeding disorders .....

Stroke .....

Dementia .....

Depression .....

Parkinson's disease .....

Schizophrenia .....

Multiple sclerosis .....

Epilepsy .....

History of peptic ulcer .....

History of upper GI bleed .....

Chronic constipation .....

Chronic diarrhoea .....

COPD (+/- type 1 or type 2 respiratory failure) .....

Asthma .....

Rheumatoid arthritis .....

Osteoarthritis .....

Gout .....

Osteoporosis .....

Chronic kidney disease .....

History of urinary retention .....

Incontinence .....

History of recurrent UTIs .....

Urinary catheter in-situ .....

Benign prostatic hypertrophy .....

Diabetes .....

Hypothyroidism .....

Hyperthyroidism .....

History of falls .....

History of cancer .....

Glaucoma .....

Others
.....
.....
.....
.....

Allergies: Yes ☐ Not known ☐

.....

List of Current Medications

Current medication & dose	START/STOPP / BNF Code	Date of initiation	Initiated by	Indication	Last reviewed on
*Cardiovascular system					
*Central nervous system and psychotropic drugs					
*Gastro-intestinal system					
*Respiratory system					
*Musculoskeletal and joint disease					
*Obstetrics, gynaecology & urinary tract disorders					
*Endocrine					

....					
*Analgesics					
Infections					
Malignant disease and immunosuppresion					
Nutrition and blood					
Eye					
Ear, nose and oropharynx					
Skin					
Immunological products and vaccines					
Anaesthesia					
OTC medications					

Recent blood pressure recording

Date: .....

Systolic: ..... Diastolic: .....

Recent urinalysis

Date: .....

Protein .....

Nitrites .....

Blood .....

Recent blood test results

Date: ..... Full blood count: Hb ..... WCC ..... Plat .....

Date: ..... Renal Profile: Na ..... K ..... Ur ..... Cr .....

Date: ..... Liver Profile: Alb ..... AST ..... ALT .....

ALP ..... GGT ..... Bili .....

Date: ..... Bone Profile: Corrected Ca .....

Date: ..... TFT: TSH ..... T4 .....

Date: ..... Lipid Profile: Total Cholesterol ..... HDL .....

LDL ..... Triglycerides .....

Date: ..... INR:……

Date: ..... HbA1c: .....

Date: ..... Glucose: .....

Date: ..... PEFR: .....

AUDIT OF PRESCRIBING FOR OLDER PATIENTS IN NURSING HOMES

Data Extraction Sheet

Date: / / **Registration date:** / /

Demographic details

Patient identifier number: ..... Age (years): ..... Sex: M ☐ F ☐

Nursing home: Collingwood Court ☐ Manley Court ☐

Ethnicity (Enter letter appropriate to category in the box): ☐

White	Mixed Race	Asian or Asian British	Black or Black British	Other Ethnic groups
H. British **I.** Irish **J.** Other White	**K.** White & Black Caribbean **L.** White & Black African **M.** White & Asian **N.** Other Mixed	**H**. Indian **O.** Pakistani **P.** Bangladeshi **Q.** Other Asian	**R.** Caribbean **S.** African **P**. Other Black	**R**. Chinese **S**. Any other **Z**. Not stated

Smoking Status: Current smoker ☐ Current non-smoker ☐ Ex-smoker ☐ Never smoked ☐

Mobility: Mobile/ with assistance ☐ Bedbound ☐ Wheelchair ☐ Palliative ☐

Past Medical History:

	Date/ Details
Hypertension	.....
Heart failure	.....
Coronary heart disease	.....
Atrial fibrillation	.....
Other arrhythmias	.....
Pacemaker in-situ	.....
Persistant postural hypotension	.....

History of thromboembolism (DVT/PE) .....

Bleeding disorders .....

Stroke .....

Dementia .....

Depression .....

Parkinson's disease .....

Schizophrenia .....

Multiple sclerosis .....

Epilepsy .....

History of peptic ulcer .....

History of upper GI bleed .....

Chronic constipation .....

Chronic diarrhoea ……..

COPD (+/- type 1 or type 2 respiratory failure) .....

Asthma .....

Rheumatoid arthritis .....

Osteoarthritis .....

Gout .....

Osteoporosis .....

Hypercholesterolemia .....

Chronic kidney disease .....

History of urinary retention .....

Incontinence .....

History of recurrent UTIs .....

Urinary catheter in-situ .....

Benign prostatic hypertrophy .....

Peripheral vascular disease .....

Diabetes .....

Hypothyroidism .....

Hyperthyroidism .....

History of falls .....

History of cancer .....

Glaucoma .....

Others

....
....
....
....

Allergies: Yes ☐ Not known ☐

....

List of Current Medications ***Last medication review:*** ***Last home visit:***

Current medication & dose			
*Cardiovascular system			
....			
....			
....			
....			
....			
....			
*Central nervous system and psychotropic drugs			
....			
....			
....			
....			
....			
....			
*Gastro-intestinal system			
....			

.... *Respiratory system .... *Musculoskeletal and joint disease .... *Obstetrics, gynaecology & urinary tract disorders .... *Endocrine .... *Analgesics .... Infections .... Malignant disease and immunosuppresion .... Nutrition and blood .... Eye .... Ear, nose and oropharynx .... Skin .... Immunological products and vaccines .... Anaesthesia .... OTC medications			

Recent blood pressure recording

Date: .....

Systolic: .....

Diastolic: .....

Recent weight & BMI recording

Date: .....

Weight: .....

BMI: .....

Recent urinalysis

Date: ..... Protein ..... Nitrites ..... Blood .....

Recent blood test results

Date: ..... Full blood count: Hb ..... WCC ..... Plat .....

Date: ..... Renal Profile: Na ..... K ..... Ur ..... Cr .....

Date: ..... Liver Profile: Alb ..... AST ..... ALT ..... ALP ..... GGT ..... Bili .....

Date: ..... Bone Profile: Corrected Ca .....

Date: ..... TFT: TSH ..... T4 .....

Date: ..... Lipid Profile: Total Cholesterol ..... HDL ..... LDL ..... Triglycerides .....

Date: ..... INR:……

Date: ..... HbA1c: .....

Date: ..... Glucose: .....

Date: ..... PEFR: .....

Date: ..... GFR: .....

Others:

……..

……..

Audit of prescribing for older patients in nursing homes

Screening Tool to Alert doctors to Right Treatments (START)

Patient identification number.....

Medication Category	Criteria	Tick as appropriate		
		Applicable & prescribed	Applicable but not prescribed	Not applicable
Cardiovascular	1.Warfarin in the presence of chronic atrial fibrillation			
	2. Aspirin in the presence of chronic atrial fibrillation, where warfarin is contra-indicated, but not aspirin			
	3. Aspirin or clopidogrel with a documented history of atherosclerotic coronary, cerebral or peripheral vascular disease in patients with sinus rhythm			
	4.Antihypertensive therapy where systolic blood pressure consistently>160 mmHg			
	5. Statin therapy with a documented history of coronary, cerebral or peripheral vascular disease, where the patient's functional status remains independent for activities of daily living and life expectancy is >5 years			
	6.Angiotensin converting enzyme (ACE) inhibitor with chronic heart failure			
	7.ACE inhibitor following acute myocardial infarction			
	8. Betablocker with chronic stable angina			
Respiratory	1.Regular inhaled beta 2 agonist or anticholinergic agent for mild to moderate asthma or COPD			
	2.Regular inhaled corticosteroid for moderate-severe asthma or COPD, where predicted FEV1<50%			
	3. Home continuous oxygen with documented chronic type 1 respiratory failure (pO_2 <8.0 kPa, pCO_2 <6.5 kPa) or type 2 respiratory failure (pO_2 <8.0 kPa, pCO_2 >6.5 kPa)			
CNS	1. L-DOPA in idiopathic Parkinson's disease with definite functional impairment and resultant disability			
	2. Antidepressant drug in the presence			

	of moderate-severe depressive symptoms lasting at least 3 months			
GIT	1. Proton pump inhibitor with severe gastro-oesophageal acid reflux disease or peptic stricture requiring dilatation			
	2. Fibre supplement for chronic, symptomatic diverticular disease with constipation			
Musculoskeletal	1. Disease-modifying antirheumatic drug (DMARD) with active moderate-severe rheumatoid disease lasting>12 weeks			
	2. Bisphosphonates in patients taking maintenance oral corticosteroid therapy			
	3. Calcium and vitamin D supplement in patients with known osteoporosis (radiological evidence or previous fragility fracture or acquired dorsal kyphosis)			
Endocrine	1. Metformin with type 2 diabetes ± metabolic syndrome (in the absence of renal impairment [a])			
	2.ACE inhibitor or angiotensin receptor blocker in diabetes with nephropathy i.e. overt urinalysis proteinuria or micoralbuminuria (>30mg/24hours) ± serum biochemical renal impairment [a]			
	3. Antiplatelet therapy in diabetes mellitus if one or more co-existing major cardiovascular risk factor present (hypertension, hypercholesterolaemia, smoking history)			
	4. Statin therapy in diabetes mellitus if one or more co-existing major cardiovascular risk factor present			

a=GFR≥50 mL/min

Audit of prescribing for older patients in nursing homes

Screening Tool of Older Persons' Prescription (STOPP)

Patient identification number .....

Medication Category	Criteria	Tick as applicable	
		Yes	No
Cardiovascular	1. Digoxin at a long-term dose > 125µg/day with impaired renal function *(increased risk of toxicity).*		
	2. Loop diuretic for dependent ankle oedema only i.e. no clinical signs of heart failure *(no evidence of efficacy, compression hosiery usually more appropriate).*		
	3. Loop diuretic as first-line monotherapy for hypertension *(safer, more effective alternatives available).*		
	4. Thiazide diuretic with a history of gout *(may exacerbate gout).*		
	5. Non-cardioselective beta-blocker with Chronic Obstructive Pulmonary Disease (COPD) *(risk of bronchospasm).*		
	6. Beta-blocker in combination with verapamil *(risk of symptomatic heart block).*		
	7. Use of diltiazem or verapamil with NYHA Class III or IV heart failure *(may worsen heart failure).*		
	8. Calcium channel blockers with chronic constipation *(may exacerbate constipation).*		
	9. Use of aspirin and warfarin in combination without histamine H2 receptor antagonist (except cimetidine because of interaction with warfarin) or proton pump inhibitor *(high risk of gastrointestinal bleeding).*		
	10. Dipyridamole as monotherapy for cardiovascular secondary prevention *(no evidence for efficacy).*		
	11. Aspirin with a past history of peptic ulcer disease without histamine H2 receptor antagonist or Proton Pump Inhibitor *(risk of bleeding).*		
	12. Aspirin at dose > 150mg day *(increased bleeding risk, no evidence for increased efficacy).*		
	13. Aspirin with no history of coronary, cerebral or peripheral vascular symptoms or occlusive arterial event *(not indicated).*		
	14. Aspirin to treat dizziness not clearly attributable to cerebrovascular disease *(not indicated).*		
	15. Warfarin for first, uncomplicated deep venous thrombosis for longer than 6 months duration *(no proven added benefit).*		
	16. Warfarin for first uncomplicated pulmonary embolus for longer than 12 months duration *(no proven benefit).*		
	17. Aspirin, clopidogrel, dipyridamole or warfarin with concurrent bleeding disorder *(high risk of bleeding).*		
CNS	1. Tricyclic antidepressants (TCA's) with dementia *(risk of*		

	worsening cognitive impairment).		
	2. TCA's with glaucoma *(likely to exacerbate glaucoma).*		
	3. TCA's with cardiac conductive abnormalities *(pro-arrhythmic effects).*		
	4. TCA's with constipation *(likely to worsen constipation).*		
	5. TCA's with an opiate or calcium channel blocker *(risk of severe constipation).*		
	6. TCA's with prostatism or prior history of urinary retention *(risk of urinary retention).*		
	7. Long-term (i.e. > 1 month), long-acting benzodiazepines e.g. chlordiazepoxide, fluazepam, nitrazepam, chlorazepate and benzodiazepines with long-acting metabolites e.g. diazepam *(risk of prolonged sedation, confusion, impaired balance, falls).*		
	8. Long-term (i.e. > 1 month) neuroleptics as long-term hypnotics *(risk of confusion, hypotension, extra-pyramidal side effects, falls).*		
	9. Long-term neuroleptics (> 1 month) in those with parkinsonism *(likely to worsen extra-pyramidal symptoms)*		
	10. Phenothiazines in patients with epilepsy *(may lower seizure threshold).*		
	11. Anticholinergics to treat extra-pyramidal side-effects of neuroleptic medications *(risk of anticholinergic toxicity).*		
	12. Selective serotonin re-uptake inhibitors (SSRI's) with a history of clinically significant hyponatraemia *(non-iatrogenic hyponatraemia <130mmol/l within the previous 2 months).*		
	13. Prolonged use (> 1 week) of first generation antihistamines i.e. diphenydramine, chlorpheniramine, cyclizine, promethazine *(risk of sedation and anti-cholinergic side effects).*		
GIT	1. Diphenoxylate, loperamide or codeine phosphate for treatment of diarrhoea of unknown cause (risk of delayed diagnosis, may exacerbate constipation with overflow diarrhoea, may precipitate toxic megacolon in inflammatory bowel disease, may delay recovery in unrecognised gastroenteritis).		
	2. Diphenoxylate, loperamide or codeine phosphate for treatment of severe infective gastroenteritis i.e. bloody diarrhoea, high fever or severe systemic toxicity (risk of exacerbation or protraction of infection)		
	3. Prochlorperazine (Stemetil) or metoclopramide with Parkinsonism *(risk of exacerbating Parkinsonism).*		
	4. PPI for peptic ulcer disease at full therapeutic dosage for > 8 weeks *(earlier discontinuation or dose reduction for maintenance/prophylactic treatment of peptic ulcer disease, oesophagitis or GORD indicated).*		
	5. Anticholinergic antispasmodic drugs with chronic constipation *(risk of exacerbation of constipation*		
Respiratory	1. Theophylline as monotherapy for COPD. *(safer, more effective alternative; risk of adverse effects due to narrow*		

	therapeutic index)		
	2. Systemic corticosteroids instead of inhaled corticosteroids for maintenance therapy in moderate-severe COPD *(unnecessary exposure to long-term side-effects of systemic steroids).*		
	3. Nebulised ipratropium with glaucoma *(may exacerbate glaucoma).*		
Musculoskeletal	1. Non-steroidal anti-inflammatory drug (NSAID) with history of peptic ulcer disease or gastrointestinal bleeding, unless with concurrent histamine H2 receptor antagonist, PPI or misoprostol *(risk of peptic ulcer relapse).*		
	2. NSAID with moderate-severe hypertension (moderate: 160/100mmHg – 179/109mmHg; severe: ≥180/110mmHg) *(risk of exacerbation of hypertension).*		
	3. NSAID with heart failure *(risk of exacerbation of heart failure).*		
	4. Long-term use of NSAID (>3 months) for relief of mild joint pain in osteoarthtitis *(simple analgesics preferable and usually as effective for pain relief)*		
	5. Warfarin and NSAID together *(risk of gastrointestinal bleeding).*		
	6. NSAID with chronic renal failure *(risk of deterioration in renal function).*		
	7. Long-term corticosteroids (>3 months) as monotherapy for rheumatoid arthrtitis or osteoarthritis *(risk of major systemic corticosteroid side-effects).*		
	8. Long-term NSAID or colchicine for chronic treatment of gout where there is no contraindication to allopurinol *(allopurinol first choice prophylactic drug in gout)*		
Urogenital	1. Bladder antimuscarinic drugs with dementia *(risk of increased confusion, agitation).*		
	2. Bladder antimuscarinic drugs with chronic glaucoma *(risk of acute exacerbation of glaucoma).*		
	3. Bladder antimuscarinic drugs with chronic constipation *(risk of exacerbation of constipation).*		
	4. Bladder antimuscarinic drugs with chronic prostatism *(risk of urinary retention).*		
	5. Alpha-blockers in males with frequent incontinence i.e. one or more episodes of incontinence daily *(risk of urinary frequency and worsening of incontinence).*		
	6. Alpha-blockers with long-term urinary catheter *in situ* i.e. more than 2 months *(drug not indicated).*		
Endocrine	1. Glibenclamide or chlorpropamide with type 2 diabetes mellitus *(risk of prolonged hypoglycaemia).*		
	2. Beta-blockers in those with diabetes mellitus and frequent hypoglycaemic episodes i.e. ≥ 1 episode per month *(risk of masking hypoglycaemic symptoms).*		
	3. Oestrogens with a history of breast cancer or venous thromboembolism *(increased risk of recurrence)*		
	4. Oestrogens without progestogen in patients with intact		

	uterus *(risk of endometrial cancer)*		
Drugs that adversely affect those prone to falls	1. Benzodiazepines *(sedative, may cause reduced sensorium, impair balance).*		
	2. Neuroleptic drugs *(may cause gait dyspraxia, Parkinsonism).*		
	3. First generation antihistamines *(sedative, may impair sensorium).*		
	4. Vasodilator drugs known to cause hypotension in those with persistent postural hypotension i.e. recurrent > 20mmHg drop in systolic blood pressure *(risk of syncope, falls).*		
	5. Long-term opiates in those with recurrent falls *(risk of drowsiness, postural hypotension, vertigo).*		
Analgesics	1. Use of long-term powerful opiates e.g. morphine or fentanyl as first line therapy for mild-moderate pain *(WHO analgesic ladder not observed).*		
	2. Regular opiates for more than 2 weeks in those with chronic constipation without concurrent use of laxatives *(risk of severe constipation).*		
	3. Long-term opiates in those with dementia unless indicted for palliative care or management of moderate/severe chronic pain syndrome *(risk of exacerbation of cognitive impairment).*		
Duplicate drugs	Any duplicate drug class prescription e.g. two concurrent opiates, NSAID's, SSRI's, loop diuretics, ACE inhibitors *(optimisation of monotherapy within a single drug class should be observed prior to considering a new class of drug). Excluding duplicate prescribing of inhaled beta2 agonists (long and short acting) for asthma or COPD*		

Summary: scores of inappropriate prescribing

Medication Category	**Total instances**	
	START	STOPP
Cardiovascular		
CNS		
GIT		
Respiratory		
Musculoskeletal		
Urogenital		
Endocrine		
Drugs that adversely affect those prone to falls		
Analgesics		
Duplicate drugs		
Total		

Appendix VII: Publication and output from thesis

Journal Article

Loganathan M, Singh S, Franklin BD, Bottle A, Majeed A. Interventions to optimise prescribing in care homes: systematic review. Age and Ageing. March 1, 2011;40(2):150-62.

Loganathan M, Hockley K, Franklin BD, Bottle A, Majeed A. Association between inappropriate prescribing and adverse drug events: systematic review. Drug Safety. (Under submission)

Loganathan M, Nayak A, Franklin BD, Oboh L, Bottle A, Majeed A. Reducing inappropriate prescribing in nursing homes: a collaborative, general practice-based quality improvement project. BMJ Quality and Safety. (Under submission)

Loganathan M, Franklin BD, Bottle A, Majeed A. Recommendations to optimise quality of prescribing in UK care homes. Journal of Public Health. (Under submission)

Abstracts

Loganathan M, Franklin BD, Majeed A (2009). Assessing appropriate prescribing in care homes: explicit versus implicit indicators. Abstract presented at the 3rd Annual Patient Safety Research Workshop, London, 16 December.

Loganathan M, Majeed A, Franklin BD (2010). A systematic review - the association between inappropriate prescribing in care homes and adverse patient outcomes. Abstract presented at the 7th Health Services Research Europe conference, The Netherlands, 8-9 April (panel speaker in session addressing the usefulness and transferability of systematic reviews)

Loganathan M, Majeed A, Franklin BD (2010). A systematic review - the association between inappropriate prescribing in care homes and adverse patient outcomes. Abstract presented at the 39th Annual Scientific Meeting of the Society for Academic Primary Care, Norwich, 7-9 July.

Loganathan M, Singh S, Bottle A, Franklin BD, Majeed A (2010). Interventions to optimise prescribing in care homes: systematic review. Abstract presented at the 39th Annual Scientific Meeting of the Society for Academic Primary Care, Norwich, 7-9 July.

Loganathan M, Singh S, Bottle A, Franklin BD, Majeed A (2010). Interventions to optimise prescribing in care homes: systematic review. Abstract presented at the 54th Society of Social Medicine Annual Scientific conference, Belfast, 6-8 September.

Loganathan M, Nayak A, Bottle A, Franklin BD, Majeed A (2011). A cross sectional study of inappropriate prescribing for older people living in South London nursing homes using STOPP and START criteria. Abstract presented at the 40th Annual Scientific Meeting of the Society for Academic Primary Care, Bristol, 6-8 July.