Supporting safe medicines transition for residents entering care homes

Master thesis in Pharmacy

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May 2021

Abstract

Background:

Following the setup of a national service to provide medicines review and reconciliation to patients discharged to their home, the government has started to pilot a similar service for care home residents. The aim of such a service would be to reduce medicines related errors and possible harms post transition. The evidence from the pilot service has not been evaluated. Furthermore, the pilots were set up without an initial systematic review of the literature to inform its design.

Objective: Using evidence from a systematic review and the pilot services, to describe how to optimally design a medicine-related care home transition service.

Method: A scoping review was conducted to develop our systematic review protocol. The systematic review with narrative synthesis was performed December 2020 to find evidence currently available regarding supporting new residents to safely transition into the care home environment. Studies were included for analysis following screening of titles, abstracts and papers by two independent reviewers. Data regarding study design, outcomes, barriers and enablers were extracted and summarised.

The pilot care home transition medicines support services were delivered across two sites in the United Kingdom by primary care network pharmacists. Data regarding nature of interventions and perceived clinical impact from June 2020 to March 2021 was analysed descriptively.

Results: The systematic review identified 9 low to medium quality service evaluations which varied with respect to who delivered the service, what it included, when and how it was delivered. The enablers for the service delivery were appropriate workforce in place, effective communication strategies, well designed systems and financial incentives. The barriers were lack of communication between both health professionals and the facilities, inappropriate workload and insufficient staff, not having an appropriate organisational structure and insufficient knowledge regarding medication and medication safety.

188 patients were referred to receive the discharge service, where 95(95) were completed for Shropshire hospitals and 37(42) for Shrewsbury and Telford hospital. At one site residents received medicines reconciliation mainly, the other additionally included medication review. The main interventions recorded were medication stopped: 18(17.9) and 2(5.4), change of dose: 12(12.6) and 2(5.4), and Prescribing errors: 6(6.3) and 1(2.7). Providing medication review

resulted in more interventions regarding identifying and preventing medication and prescribing related errors.

Conclusion: Evidence suggests that performance of medicine-related interventions during transition to care homes can identify medication discrepancies and reduce medication errors. Additionally, there is weak evidence that it may prevent hospital readmission. The evidence does not provide clarity with respect to who, where, what, how and when to deliver the service. For such a service to be successful it is however important to consider the identified barriers and enablers. With no strong evidence for the impact of such service or its potential value, future high quality studies are warranted.

Keywords: Medicines/medication reconciliation, medicine-related intervention, pharmaceutical service, medicine/medication review, medication errors, care transition

Acknowledgements

Firstly, I would like to acknowledge the support I have received from my supervisor, Professor David Wright (School of Pharmacy, the University of East Anglia (UEA)). I wish to thank you for all the guidance, encouragement, discussions, regular meetings along with the close follow up and the great feedback throughout my whole thesis process.

I would like to thank Dr Hamde Nazar (School of Pharmacy, Newcastle University) for helping me with my online registrations and for giving me detailed feedback and suggestions on my reviews, which improved my thesis.

I would also like to thank Dr Emma Suggett and her team from the Academic Health Science Networks (AHSNs) for supporting me with information and data from the pilot service to be used in my thesis.

I am grateful to all the staff and fellow researchers at the Pharmacy programme at the University of Bergen (UiB) and UEA for the outstanding learning that enhanced my academic life and for their contribution to my thesis. A sincere thanks goes to Jeanette Blacklock (Senior Research Associate, School of Pharmacy, UEA) for your support and involvement throughout the systematic review process.

I wish to thank all my friends for their support and motivation throughout the years, especially during the final year when the pandemic caused many difficulties.

A special thanks to the pharmacy class of 2016 for supporting me during my student years at UiB and thank you for all the great memories.

I would also like to give a special thanks to my cousin, Yathusaa Arudkumar, for supporting me throughout the thesis process. I would not have been able to complete my academic year in the United Kingdom without your advice, especially during this challenging time.

Lastly, I am grateful for the support, encouragement and unconditionally love from my family. You are the reason I am where I am today, and without you, none of this would have been possible.

Janani Kandiah

London, May 2021

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Abbreviations

ADEs:	Adverse Drug Events
ADRs:	Adverse Drug Reactions
CYP:	Cytochrome
CP:	Community Pharmacist
GP:	General Practitioner
HMR:	Health professional responsible for Medicines Reconciliation
TP:	Transition Pharmacist
EHR:	Electronic Health Record
EMR:	Electronic Medical Record
EPA:	Electronic Prescription Application
SNF:	Skilled-Nursing Facility
AHSNs:	Academic Health Science Networks
CCG	Clinical Commissioning Group
DMS:	Discharge Medicines Service
NHS:	National Health Services
NPSA:	National Patient Safety Agency
MOCH:	Medicines Optimisation in Care Homes
NICE:	National Institute for Health and Care Excellence
NPC:	National Prescribing Centre
PCNE:	Pharmaceutical Care Network Europe
PCN:	Primary Care Network
TCAM:	Transfer of Care Around Medicines
WHO:	World Health Organization
US/USA:	United States of America
UK:	United Kingdom
MMAT:	Mixed Methods Appraisal Tool
PRISMA:	Preferred Reporting Items for Systematic reviews and Meta-Analysis

1 Introduction

1.1 Background

An elderly person has been defined by the World Health Organization (WHO) as a person with a chronological age of 65 years or more [1]. At the age of 65, they would be referred as "early elderly" and those over 75 years old as "late elderly" [2]. In the United Kingdom (UK), approximately 400, 000 of the older population live in care homes [3].

Care homes, also called nursing homes, residential homes, skilled-nursing facilities (SNFs), assisted-living facilities, or aged-care facilities, are accommodation for people unable to live safely alone in their own homes. Even with help from family, friends, or home care workers, they will find it challenging to live by themselves [4, 5]. Therefore, they will be transferred into a care home which is staffed with nurses or personal carers, 24 hours a day. The staff will have a range of qualifications, but most of the staff would be care assistants with limited education beyond school level. Their primary role is to provide support with the residents' daily life activities [6, 7].

In the United Kingdom, care homes are divided into care homes (previously known as residential homes) and care homes with nursing (previously nursing homes). Many homes have mixed registration where they provide care for both residents who do and don't require nursing care. In care homes (without nursing), there will be personal care providers but no nurses. Trained healthcare professionals will only visit care homes without nursing when the resident requires medical care. In a care home with nursing there will be one or more nurses on duty 24 hours a day who will provide nursing care and care assistance in order to help them with personal care [5, 8, 9].

The age of residents in care homes can vary significantly (20-30 years) as can the range of chronic conditions experienced. Commonly found chronic diseases in care homes are dementia, diabetes mellitus, cardiovascular diseases and chronic respiratory diseases[10]. In the present, more than half of the older people have more than one chronic disease, and to compare, multimorbidity has shown to have a negative impact on the residents health [11, 12]. Multi-morbidity is defined as:

"*The coexistence of two or more long-term medical conditions or diseases*." [13]. Residents facing multimorbidity are likely to be prescribed multiple medicines, which results in polypharmacy [11, 14, 15].

1.2 Polypharmacy

The WHO defines polypharmacy as:

> "*The administration of many drugs at the same time or the administration of an excessive number of drugs*." [16].

Polypharmacy is described as appropriate when the medicines are prescribed for an individual's medical conditions, which aims to achieve specific therapeutic objectives and reduce the chances of adverse drug events. The prescribed medicines are included according to the best evidence-based indication, and the patient has agreed to the treatment.

Inappropriate polypharmacy is when one or more of the prescribed medicines are deemed unnecessary because: there is no evidence-based indication, or the indication has expired. It will lead to adverse drug-related events or the medicines will fail to achieve the therapeutic objectives [17]. The term, inappropriate polypharmacy is also used when risks overweigh the potential benefits [18].

It has been reported that consequences associated with polypharmacy include increased risk of adverse drug events (ADEs), drug-interactions, medication non-adherence, hospitalization, medication errors, reduced functional capacity and multiple geriatric syndromes. Symptoms of polypharmacy are often similar to the signs of ageing, such as tiredness, sleepiness, or decreased alertness, constipation, diarrhoea, or incontinence, loss of appetite, confusion, falls, depression or lack of interest in your usual activities, weakness, tremors, visual or auditory hallucinations, anxiety or excitability, and/or dizziness [19].

Polypharmacy is of concern among elderly people, as they often have more longstanding illness and chronic comorbid conditions that are age-related. Studies has shown that between 40 to 50% of older adults are affected by polypharmacy[20]. A study by Barber *et al*. found that in England, the average care home resident was prescribed eight medications a day and over two-thirds of these residents experienced one or more medication errors [21]. A multi-centre study in eight European countries reported that more than half of the residents used six or more medicines [22]. Another study undertaken by the National Institute of Health in the USA stated that "nearly 50% of older adults are prescribed one or more medications which are not medically necessary". The authors state that, to improve polypharmacy, the best intervention(s) is to involve an inter-professional approach which often includes a clinical pharmacist [23, 24].

1.3 Challenges for medicine treatment

Polypharmacy is not the only concern when it comes to treatment of elderly people. Medicines have different mechanisms, and they have different effects on elderly people compared to other age groups. Older people can be more or less sensitive to medication changes due to age-related and disease-related changes, and therefore they can respond differently to medicines compared with younger age groups [25]. Age-related changes, inadequate prescribing and incorrect use would cause many challenges regarding the quality of prescribing and medication use and might therefore reduce overall patient outcomes.

As the body ages its composition changes in terms of creatinine production, body mass, skeletal mass, total body water and tissues percentage. This leads to pharmacological changes which affect a medicines' pharmacokinetic properties; absorption, distribution, metabolism and elimination. The pharmacokinetic properties will also be affected if organ functionality is reduced. To specify, with age, organs such as liver or kidney can have a reduced functionality or in worst case, no functions. If kidney function declines, it will reduce the renal blood flow, the renal tubular secretion and reabsorption, and the glomerular filtration. Cytochrome P450(CYP) are a group of enzymes primarily found in the liver. The enzymes are central to the metabolism of many drugs, steroids and carcinogens. If liver problems occur, the activity of the CYP enzyme system will be reduced and the hepatic blood flow. The CYP-enzymes. Overall, the kidney and liver have an influence on the elimination system. Therefore, there will be reduced elimination of the drug, and the drug tends to stay in the body for a longer time and it will induce changes in drug levels [26-29]. In addition, the proportion of water in the body reduces whilst the fat percentage increase with ageing changing the distribution of drugs within the body. Medicines which are sequestered in fat will accumulate for a longer time [20-23]. Simultaneously, pharmacodynamic alterations such as changes in the number of receptors, changes in the binding affinity, chemical interactions and deficits in homeostatic mechanisms also affect the mechanism and the effect of the medicine [30, 31]. Therefore, these changes can require a dose alteration.

1.4 Medication errors and Adverse drug events

More than 237 million medication errors are made in England every year, which cost around 1700 lives [32]. In the USA, Medical errors are the third leading cause of death[33].

A medication error is defined by the National Coordinating Council for Medication Error Reporting and Prevention as:

> "*Any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient, or consumer. Such events may be related to professional practice, health care products, procedures, and systems, including prescribing, order communication, product labelling, packaging, and nomenclature, compounding, dispensing, distribution, administration, education, monitoring, and use." [34].*

This definition is broad, and errors can be made in any stages during this process. The errors that occur can be classified by the cause, such as wrong medication, monitoring, dose and administration, and if it is a knowledge-based errors, rule-based errors or action-based errors. In England, 54% are made at the point of administration, 21% are made during prescribing and 16% during dispensing [32]. Around 20% of medication errors are made in the hospital, 38% are made in the primary care, and the highest error rate is in the care homes with 42%. Overall, 72% have the potential to cause minor harm, 26% to cause moderate harm, and 2% could cause serious harm. In primary care, around 34% of potentially harmful medication errors are prescribing errors [32]. These numbers are comparable with numbers in the USA and other European countries [35].

It is estimated that 25% of all Adverse Drug Events (ADEs) happens because of medication errors [36]. ADEs are defined as *"*an injury resulting from the use of a drug. Under this definition, the term ADEs includes harm caused by the drug (adverse drug reactions and overdoses) and harm from the use of the drug (including dose reductions and discontinuations of drug therapy" [37]. ADEs results from the use of drugs and therefore does not have to be a result of medication errors, as it includes errors from when the drug is produced until it is taken by the person. Serious ADEs would be life-threatening and in the worst case lead to death. ADEs can be permanently/significantly disabling, require or prolong hospitalization, causes congenital anomalies and require intervention to prevent permanent impairment or damage [38, 39].

The rates of ADE in nursing home residents are stated to be twice as high in residents taking nine medicines or more compared to residents who take less [23, 39]. Older people are affected by ADEs as they often have to take multiple medications for their chronic health conditions, and the risk of ADEs increase with polypharmacy [40].

In addition to challenges at the individual level they can also occur at the organisational level. Miscommunication between care-facilities and reduced flow of information between different health care levels will lead to medication discrepancies. At the same time, it could also be

challenging when the residents use different medication from the medication list provided by the GP. In addition, a lot of people use over-the-counter medication as self-medication without advice from the GP. This will increase the risk of ADEs and other challenges can occur for the treatment [41].

1.5 Medication review

Approximately 50% of the prescribed medication is taken as directed [42] and are believed to contribute to between 5-17% of hospital admissions [43]. To reduce problematic polypharmacy and its associate ADEs, medication reviews can be an important intervention, especially for elderly people [42, 44-46].

National Institute for Health and Care Excellence (NICE) defines medication review as:

> "*A structured, critical examination of a person's medicines with the objective of reaching an agreement with the person about treatment, optimising the impact of medicines, minimising the number of medicine-related problems and reducing waste."* [47].

A similar definition is stated by the Pharmaceutical Care Network Europe (PCNE):

> "*A structured evaluation of a patient's medicines with the aim of optimising medicines use and improving health outcomes. This entails detecting drug related problems and recommending interventions."* [48].

In 2002, the Taskforce on Medicines Partnership, The National Collaborative Medicines Management Services programme published a guideline for medication review, called Room for Review[43]. The guidelines consist of suggested principles for medication review which is summarised BOX 1. 1

BOX 1. 1. Suggested principles of medication review

- All patients should have a chance to raise questions and highlight problems about their medicines.
- Medication review seeks to improve or optimise impact of treatment for an individual patient.
- The review is undertaken in a systematic way, by a competent person.
- Any changes resulting from the review are agreed with the patient.
- The review is documented in the patient's notes.
- The impact of any change is monitored.

The guideline also presented levels of medication review and BOX 1. 2 describes the different levels of medication review.

BOX 1. 2. Levels of medication review

Level
0: AD-HOC – unplanned, opportunistic, unstructured review and patient may or may not be present.
1: Prescription review – Technical of list of patient´s medicines and patient may or may not be present.
2: Treatment review – Review of medicines with patient´s full notes. And the patient is often not present
3: Clinical medication review – Face-to-face review of medicines and condition and patient is present.

The National Service Framework for older people stated in 2001 that "*all people over 75 years should normally have their medicines reviewed at least annually and those taking 4 or more medicines should have a review 6 monthly."* [49, 50]. Studies have reported that medication review can identify medication-related problems and enhance medication care[51, 52]. And it can be performed by different health professionals working in different settings. However, a consultation with a clinical pharmacist is an appropriate and efficient method to review care home residents medication [50, 53]. The pharmacist often recommend important changes to the treatment, which in most cases will be accepted by the patients General Practitioner (GP) [50, 54, 55].Studies have also reported that the pharmacist reduced the odds of ADE from admission prescribing errors by doing medicines reconciliation compared with a medicines reconciliation initiated by a physician [50, 56].

1.6 Transition

Transition into a care home is a significant life transition for people, and it can be perceived as a positive or negative, depending on the purpose of the move and their perception of independence and care homes. Definition of transition is:

> "*Passage from one life phase, condition or status to another, a multiple concept embracing the elements of process, time span, and perception."* [57].

Admission into a care home is based on their health condition and is a process which involves health carers, family situation, social services, and financial resources [58]. This process could

be planned or unplanned, and people could move in for a short or long stay, depending on the circumstances. A planned transition will give them time to reflect on the decision to move into a care home and decide which care home to consider based on social, physical and mental needs. It is also dependent upon financial support and location. An unplanned transition is often a result of a sudden change in life, such as health status, hospitalization, or other life-changing events[59, 60].

If a person needs to be in a care home, they would either be transferred from the hospital or their own home. From the hospital, they would bring necessary documents about their current health situation. According to the Care Quality Commission, which is the independent regulator of health and social care in England, medicines reconciliation should be conducted every time a person is discharged from the hospital or when they are transferred from the place of residence, such as care home or their home.

When they perform a medicines reconciliation, a pharmacist or a qualified member of the team will be identifying the current medication list with prescribed medicines, over the counter medicines and complementary medicines. They will also review previous medicines, discontinued medicines, and it would be a discussion with the patients to complete the picture [61]. Therefore, when they are transferred between the care systems, they would have an updated medicine list, upon the arrival at the care home. This should minimize the work for the care home and there would be fewer errors.

When residents transfer from their own home, the essential paperwork about their health conditions will usually be sent to the care home. The care home will also be provided with the current medication list, but the list would only contain the medication prescribed by the GP. As there could be discrepancies between the medication residents take, the GP's referral letter and the medicines recorded on the medical list [62], the pharmacist or the person in charge of the medicines reconciliation -process would undertake it when admitted [28, 41, 63-65]. It is also known to occur medication discrepancies during transitions in between care, as a medication used at home was not recorded when they were admitted or medication changes made by others is not recorded [66].

1.7 Definitions of medicines reconciliation

In the UK, the National Patient Safety Agency (NPSA) and the National Institute for health and Care Excellence (NICE) issued a patient safety guidance based on one randomised controlled trial, which demonstrated that when a pharmacist is involved in the medicines reconciliation process, the number of discrepancies between hospital and home medication fell

from 44% to 19% [67, 68]. The definition of medicines reconciliation varies among health professionals. According to the Joint Commission which is a United States of America(USA/US), based non-profit organization that accredits health care organizations [69], medicines reconciliation is defined as:

> *"The process of comparing a patient's medication orders to all of the medications that the patient has been taking. This reconciliation is done to avoid medication errors such as omissions, duplications, dosing errors, or drug interactions. It should be done at every transition of care in which new medications are ordered or existing orders are rewritten. Transitions in care include changes in setting, service, practitioner, or level of care. This process comprises five steps: (1) develop a list of current medications; (2) develop a list of medications to be prescribed; (3) compare the medications on the two lists; (4) make clinical decisions based on the comparison; and (5) communicate the new list to appropriate caregivers and to the patient."*

The UK National Prescribing Centre (NPC) has a similar definition but describes the process in two discreet stages, basic reconciliation and full reconciliation [70]. Stage one, Basic reconciliation, is defined as:

> *"Basic medicines reconciliation involves the collection and accurate identification of a patient's current list of medicines. An example of basic medicines reconciliation would include medication history-taking in secondary care, where a complete and accurate list of a patient's current medication regimen would be documented within 24 hours."*

Stage 2 of this process, Full reconciliation, is defined as:

> *"Full medicines reconciliation builds on stage 1 of the process and involves taking the basic reconciliation information, comparing it to the list of medicines that was most recently available for that patient. In addition, it involves identifying any discrepancies between the two lists and then acting on that information accordingly. In other words, interpreting the outcome of the basic reconciliation in light of a patient's ongoing care plan; resolving any discrepancies and accurately recording the outcome."*

The NPC adopts a 3C's approach which includes the main steps of collecting, checking and communications. The collecting step involves taking a medication history and collecting relevant information from different sources. The information should be collected from the most recent and reliable sources and should be verified, and cross-checked if it is possible. The

checking step involves securing that the patient was prescribed the correct medication and doses. The communication step involves ensuring that changes made in this process are documented, dated and ready to be sent to the next care provider who is in charge for the management of the patients medications [70].

The WHO states that "*medication reconciliation is the formal process in which health care professionals partner with patients to ensure accurate and complete medication information transfer at interfaces of care.*" [71].

By undertaking a medicines reconciliation at all transition points, the patient should receive the correct medication. Medicines reconciliation has been evaluated across different settings such as ambulatory settings, acute inpatients settings, transitions between care facilities and transfer from the emergency department [66].

In 2018, a study was performed on 200 patients to determine the impact of a pharmacy-led Medication Reconciliation Program, demonstrated that potential errors were reduced through the involvement of pharmacy personnel [72]. A systematic review by Redmond et al reported [73] that pharmacist-mediated intervention led to a reduction in medication discrepancies when the patient is transferred between different healthcare settings. The study was in favour of the pharmacist who performed the intervention, but the quality of the evidence was very low. A systematic review of hospital based medication reconciliation practices undertaken by Mueller et al. [74] and Kwan et al. [75] found that pharmacist-led medicines reconciliation significantly improved the transfer of medication information. Mueller et al. also showed that after medication reconciliation, there was a reduction in medication discrepancies that could have led to potential adverse effects and ADEs, and the success was most seen in patient with polypharmacy [74]. Another study from the USA stated that appropriate medicines reconciliation will reduce medication errors, ADEs and therefore reduce discrepancies and unnecessary hospitalizations [65]. Studies have also shown that medicines reconciliation has been reducing the occurrence of ADEs in long-term care settings [76].

Pharmacist-led medicines reconciliation intervention is a well-recognised strategy for safe patient transition [77] and proved that a clinical pharmacist would be useful in reducing medication errors and providing medication reconciliation intervention by being a transition pharmacist coordinator [78-82]. Whilst many studies have evaluated the pharmacist role in medicines reconciliation and performance of medicines reconciliation, there is no systematic review considering medicines reconciliation when residents are transferred into care homes.

Most of the studies across the UK is based on medicine review and medicine-related intervention when they are transferred in between care facilities. What has not formally been

addressed is medicine -elated interventions when they are transferred into care homes. The increased use of medicines among elderly people and errors previous mentioned shows the need to inform the national service design; for improvement of medicine-related intervention; to support the impact of health personnel; reducing errors and possible harms during transition and stay. Furthermore, it shows a need for developing a standardised approach to implementing medicines reconciliation [66, 71, 83, 84] and medicines-related intervention.

1.8 Services

Over the years, Academic Health Science Networks (AHSNs) has been piloting/developing a Transfer of Care Around Medicines (TCAM) programme by working with NHS hospitals. The program has been supporting patients discharged home from hospital by organising a meeting with their community pharmacist. This has evolved into a national Discharge Medicines Service (DMS) [85]. While DMS has been introducing a community pharmacy-led medicines reconciliation service for general members of the population referred by hospital pharmacist; the service is now been considered to be extended for individuals transferred into care homes. The idea is to let pharmacist undertake the reconciliation within Primary Care Networks (PCN) who are aligned with medical practises.

In England, PCNs assume responsibility for provision of pharmaceutical care to residents in care homes [86] and consequently the discharge service has focussed on transferring information to PCN pharmacists. The problem occurs when a large number of elderly were discharged to care homes, and the staff could not identify which community pharmacy the residents belonged to. The main problem was that the resident did not know it because of age, confusion or their condition. Therefore, the key stakeholders: Shropshire community trust, Shropshire and Telford clinical commissioning group (CCG), West Midlands AHSN had an aim to ensure they can support the residents when they return to care homes from hospital.

The medicines optimisation in care homes team (MOCH-team) were an initiative by National Health Services(NHS) England to train pharmacy personnel to support care homes[87], and the care homes is supported by a pharmacy team which consist of PCN-pharmacist and practise based pharmacist. West Midlands AHSNs wanted to reach out to this team within care homes and set up a service similar to DMS. The service is being piloted across the UK but has not been evaluated yet.

2 Thesis purpose

The aim of the scoping review was to inform the feasibility and design of a systematic review designed to synthesise current evidence to identify the characteristics of medicines related services for care home residents when transitioning from hospital or their own home and describe the barriers and enables to their implementation.

Care home discharge services, which are currently being piloted, have not been evaluated, and the service is not underpinned by the literature. By combining and comparing the data from the services provided by AHSNs and the findings from the systematic review, this study aims to describe how to optimally design a medicine-related care home transition service.

3 Methods

This study consisted of three elements: A scoping review to inform the design and implementation of the systematic review (3.1). A systematic review with narrative synthesis to characterise previously reported services designed to improve medicines related transition (3.2) and an evaluation of two pilot services set up to develop a model for supporting safe transition into care homes (3.3). We evaluated the local pilot services and described the activities resulting from performing medication review and reconciliation on transition and relate them to the service design. The services were evaluated from June 2020 to March 2021 and all the intervention were recorded.

3.1 Method scoping review

The methodological framework devised by Arksey and O'Malley was used to undertake the initial scoping review with a purpose of: [88]

1) Developing the search strategy, defining the inclusion criteria, identifying the search terms, databases of inclusion and types of study for inclusion.
2) Examining the extent, range and nature of research activity related to research question.
3) To determine the feasibility of a full systematic review (Does any literature exist?) and relevance (Has a systematic review already been conducted?)

3.1.1 Search strategy

The Cochrane acronym PICO, 'population, intervention, comparison, outcomes' were used to identify key components when undertaking the scoping review[89]. The search terms were defined by finding synonyms for the PICO elements, population and intervention (Table 1. PICO-elements.

Table 1. PICO-elements

Population	Transfer to care homes
Intervention	Medicines reconciliation provided by a healthcare professional
Comparator	Not applicable
Outcome	Not applicable

To identify the search terms for the PICO element population (care homes), articles from PubMed was screened by undertaking a search by using known synonyms for care homes with systematic review and scoping review. The process was repeated with the new terms until there were no new terms for care homes. Found synonyms for care homes was nursing homes, residential homes, SNF, assisted-living facilities, aged-facilities, residential facilities and care (Appendix 1).

A new search was undertaken by using the new terms for population with the intervention, reconciliation. The articles were screened to find additional search terms for the intervention, and relevant terms were included when repeating the process. The process was repeated twice until there were no new articles with the used search term. Relevant terms from the reviewed articles were included, and a draft of search terms was built up. To finalise the search term, a new search was undertaken in PubMed (Appendix 2). To capture as many studies as possible, final changes were made to the search terms, and the search was repeated in PubMed with the new terms:

(Care or nursing or residential or skilled-nursing or assisted-living or Age)
AND (Facili or Home or Long term or Old Age)
AND (reconciliation or Review or counselling or History)
AND (Admission or Admit or transfer or transition* or Discharge or entry or enter*)
AND (Drug* or Medicine* or Medication* or Pharmaceutical)

The further process included deciding which database to use and to define the criteria for the inclusion and exclusion of studies (Table 3). Based on the PICO-elements, the inclusion and exclusion criteria was developed.

3.1.2 Inclusion criteria

Study Design/Characteristics:

- Medication Reconciliation conducted by any healthcare professional when transferring into care homes
- All study designs
- No limitation for publication date
- Restricted to English language

Participant:

- Nursing/ care/ residential homes residents
- Elderly people, mainly people over 65
- Any healthcare professional involved in the care of residents stated above

Intervention:

- Medicine/Medication reconciliation
- Admission, Transition or entry processes
- Pharmaceutical care, Any healthcare-led medicines reconciliation

Setting:

- Nursing/ care/ residential homes

Outcome:

- Factors which promote/support clinical and technical intervention for medicines reconciliation
- Factors that support safely transfer and healthcare utilization (length of stay, unplanned readmissions, emergency visit or other visits in other care facilities.)
- Factors which promote/support clinical and technical intervention for medicines reconciliation

3.1.3 Exclusion criteria

Study Design:

- Published in a non-English language
- Unable to retrieve full text, abstracts only

3.1.4 Information Sources

Common databases were retrieved when screening papers from PubMed while building and identifying the search terms. Databases identified whilst screening were Ovid MEDLINE and Embase, AMED (Allied and complementary medicine databases), PsycINFO, CINAHL

Complete, Web of Science, Scopus and The Cochrane Database of Systematic Reviews[78, 90].The databases, MEDLINE and Embase[91], were verified by using the Cochrane Handbook recommendation of most important sources to identify relevant report of studies[91]. PsycINFO and CINAHL Complete were chosen to be used because they are subject-specific bibliographic. CINAHL Complete consists of nursing allied health related topics and PsycINFO consists of studies about behavioural sciences and Psychology and Psychiatry topics[91]. To identify which database to use, included articles from the search terms processes were included to search through different databases. After running through the search in different databases, the databases to include where decided after discussion with David Wright (DW).

3.1.5 Data collection process and methods for identification of studies

The scoping scope was undertaken by screening original articles from databases including PubMed, Ovid MEDLINE and Embase, PsycINFO, CINAHL complete (EBSCOhost). The search strategy was developed in PubMed and established search terms were used in different databases in November 2020 (Appendix 3).

No limits on date, language, subject or type were placed on the database search. Duplicate studies were detected by using EndNote X9 and deleted by reviewer one, Janani Kandiah (JK). The titles were exported into a Microsoft Excel spreadsheet and were screened independently by two reviewers, the main reviewer and the second reviewer, DW. Both reviewers were required to agree on included and excluded titles before continuing with screening the abstract. Cohen's Kappa was calculated to provide a measurement of agreement between the two reviewers with the aim of identifying any major problems between agreement at an early stage. Reviewer 1 located 30% of the abstract for all included titles and exported these into a Microsoft word document. The selection process continued with both reviewers screening the included abstract independently. Both viewers had to agree on included and excluded abstracts against the inclusion criteria to determine whether to retrieve the full text for review.

Reviewer 1 retrieved full texts for abstracts agreed by both reviewers. Then both reviewers examined each full text against the inclusion criteria for determining eligibility. Cohen's Kappa was also calculated after this stage. The details of the selection process is shown in the Preferred Reporting Items for Systematic reviews and Meta-Analysis (PRISMA) flow diagram (Figure 1. PRISMA flow diagram of included studies in the scoping scope) [92].

The bibliographies of all the final papers were selected for data extraction and were screened by reviewer 1 to see if any additional papers suitable. From the included full texts, the used

search terms were viewed to identify any final amendments were required for the final search terms.

Data collection process

The data extraction sheet was developed using the Cochrane Consumers and Communication Review Group's data extraction template as a basis[93] (Appendix 4). The data extraction sheet was reviewed and checked by DW, for appropriateness and completeness before it was used by the authors to extract data from the included studies.

Extraction

The lead review author (JK) and the second review author (DW) independently undertook the data extraction, to identify whether there would be enough information to undertake a systematic review. Extracted data included study details (such as year, aim, research question, study setting); study design (recruitment and sampling procedures used, enrolment start end date, selection bias, study quality); participant details(characteristics); intervention details (Description of interventions, components and factors that affect the intervention); Outcomes (measurement tools used and time (intervention duration), clinical outcomes and evidence that the outcome domain was assessed).

3.1.6 Quality assessment

Assessing the quality of included studies is an important component of systematic review [91]. To identify which appraisal tool to use, the Cochrane handbook for systematic review of interventions stated that published articles are the most frequently used sources for informing quality assessment tool selection. Systematic reviews identified within the scoping review process and excluded from the final data extraction process, were used to inform the selection of the most appropriate quality assessment tools for use within our systematic review protocol. These were summarised to enable the research team to make the final decision.

3.2 Method systematic review

The PRISMA checklist was used to frame the methodology and reporting of this review[94]. Prior to initiating searches, the protocol of the review was registered with the international prospective register of systematic reviews (PROSPERO register reference CRD42020221536).

3.2.1 Eligibility criteria

The Cochrane acronym PICO, 'population, intervention, comparison, outcomes' were used to identify key components for the systematic review(Table 2) [89, 91].

Table 2. PICO-elements for the systematic review

Population	People being transferred into care homes from hospital
Intervention	Medicines-related intervention provided by a healthcare professional during transition
Comparator	Not defined
Outcome	Barriers and facilitators (processual outcomes)

Types of studies: Any study including medicines-related intervention provided by a healthcare professional during transition. All study designs were of interest, but protocols, conference documents and ongoing researches were excluded. There was no limitation of publication date, but only studies in English were included.

Types of participants: Studies where the study population included people transferred into Nursing/ care/ residential homes were considered. It was restricted to elderly people, mainly those over 65. There were no restrictions of gender or country on the search.

Types of interventions: Any study implementing healthcare professional's involvement in admission or transfer processes was included. Interventions which included medicine-related intervention conducted by a healthcare professional were considered but mainly focus on processes in care homes settings.

Types of comparison: Studies with comparator groups were not defined.

Types of outcome measures: Studies reporting qualitative and quantitative data was of interest. Processual outcomes relating to the design and delivery of the intervention was sought, e.g. barriers and facilitators.

Table 3. Inclusion and exclusion criteria

Inclusion criteria	• Any article including medicines-related intervention provided by any healthcare professional during transition. • Studies where the interventions are conducted in Nursing/ care/ residential homes settings • Studies whose study population includes people over 65 years transferred into nursing/ care/ residential homes • Studies reporting qualitative and quantitative data related to rehospitalisation, the economic, clinical and humanistic parameters. • Outcomes related to design and delivery of the intervention and which promote/support or challenge clinical and technical intervention related to medication • All types of study design • All articles written in English with no date restriction
Exclusion criteria	• Published in a non-English language • Unable to retrieve full text, abstracts only • Studies reporting data not related to the outcomes • Study protocols, conference documents and ongoing research

3.2.2 Information Sources

The literature search strategy was developed in consultation with an academic supervisor during the scoping stage. Databases used in the systematic review was PubMed, Ovid MEDLINE and Embase, PsycINFO, CINAHL complete (EBSCOhost).

3.2.3 Search strategy

The following search terms for the PICO elements were used in the systematic review:

(Care or nursing or residential or skilled-nursing or assisted-living or Age)

AND (Facili* or Home or Long term or Old Age)

AND (reconciliation or Review or counselling or History)

AND (Admission or Admit or transfer or transition* or Discharge or entry or enter*)

AND (Drug* or Medicine* or Medication* or Pharmaceutical)

The search strategy was developed in PubMed during the scope and was adapted accordingly and used across the different databases, as shown in Table 4. The systematic review was undertaken by screening original articles from databases including PubMed, Ovid MEDLINE and Embase, PsycINFO, CINAHL complete (EBSCOhost) in December 2020.

Table 4. Search terms for search

Database	PubMed	Ovid Embase	Ovid MEDLINE	PsycINFO	CINAHL complete (EBSCOhost)
Search terms	(Care[Title] OR ((((Care[Title] OR nursing[Title] OR residential[Title] OR skilled-nursing[Title] OR assisted-living[Title] OR Age[Title]) AND (Facili*[Title] OR Home*[Title] OR Long term[Title] OR Old Age[Title])) AND (reconciliation OR Review OR counselling OR History)) AND (Admission OR Admit OR transfer OR transition* OR Discharge OR entry OR enter*)) AND (Drug* OR Medicine* OR Medication* OR Pharmaceutical)	((Care or nursing or residential or skilled-nursing or assisted-living or Age) and (Facili$ or Home$ or Long term or Old Age)).ti. and (reconciliation or Review or counselling or History).af. and (Admission or Admit or transfer or transition$ or Discharge or entry or enter$).af. and (Drug$ or Medicine$ or Medication$ or Pharmaceutical).af.	((Care or nursing or residential or skilled-nursing or assisted-living or Age) and (Facili$ or Home$ or Long term or Old Age)).ti. and (reconciliation or Review or counselling or History).af. and (Admission or Admit or transfer or transition$ or Discharge or entry or enter$).af. and (Drug$ or Medicine$ or Medication$ or Pharmaceutical).af.	TI (Care OR nursing OR residential OR skilled-nursing OR assisted-living OR Age) AND TI (Facili* OR Home* OR Long term OR Old Age) AND (reconciliation OR Review OR counselling OR History) AND (Admission OR Admit OR transfer OR transition* OR Discharge OR entry OR enter*) AND (Drug* OR Medicine* OR Medication* OR Pharmaceutical)	TI (Care OR nursing OR residential OR skilled-nursing OR assisted-living OR Age) AND TI (Facili* OR Home* OR Long term OR Old Age) AND (reconciliation OR Review OR counselling OR History) AND (Admission OR Admit OR transfer OR transition* OR Discharge OR entry OR enter*) AND (Drug* OR Medicine* OR Medication* OR Pharmaceutical)

3.2.4 Study selection

Results for each search were exported to EndNote X9. Duplicates and non-English studies were removed by the main reviewer, Janani Kandiah (JK). The titles were then exported into a Microsoft Excel spreadsheet and screened independently by two reviewers, the main reviewer and the second review author Jeanette Blacklock (JB). Both reviewers had to agree on included and excluded titles. At each stage, discrepancies between reviewers were resolved by discussion before continuing with abstract screening. Cohen's Kappa was calculated to provide a measurement of agreement between the two reviewers to identify any discrepancies at an early stage.

Reviewer 1 located the abstract for all included titles and exported these into a Microsoft word document. The selection process continued with both reviewers screening the included abstracts independently. Both reviewers had to agree on included and excluded abstracts against the inclusion criteria, and discrepancies were discussed. After an agreement, JK retrieved full texts for abstracts agreed by both reviewers. The full texts were sequentially and independently screened for relevance to the research question, and discrepancies resolved by

discussion. Reasons for rejection of each paper were documented, and Cohen's Kappa was also calculated at this stage.

The bibliographies of all final papers were manually searched by reviewer 1 to identify any additional papers suitable for inclusion. JK located abstracts for titles found in the manual search of the bibliographies, and these were independently assessed by the two reviewers against the inclusion criteria. Full texts for included abstracts were examined independently by both reviewers against the inclusion criteria, and a final list of papers was determined.

3.2.5 Data extraction

JK, JB and David Wright (DW) independently undertook the data extraction for one study, using a data extraction sheet developed at the scoping stage (Appendix 4). No concerns were identified, and JK and JB independently completed the data extraction for all the included studies.

Extracted data form for each study included:

- *Study details*
    - Year
    - Aim
    - Research question
    - Study setting
- *Study design*
    - Recruitment and sampling procedures used
    - Enrolment start and end date
    - Selection bias
    - Study quality
- *Participant details*
    - Characteristics
- *Intervention details*
    - Reasons for the intervention
    - Description of how the interventions was performed, the involved, including measurement tools, time (intervention duration and when), and who were involved in the service
    - Components and factors that affect the intervention, including barriers and facilitators for the intervention
- *Outcomes*

- Evidence that the outcome domain was assessed
- The economic, clinical and humanistic parameters reported in the studies.
- Qualitative and quantitative data

Reasons for the service were found in the introduction or methods, and information relating to barriers, enabler and outcomes were found in the results and discussion in each study. Completed extracted forms for each study was then combined into one, and any discrepancies between the reviewers' extraction forms were discussed. When there was disagreement between the reviewers, DW was consulted.

3.2.6 Synthesis of the results

Narrative synthesis was decided by the author, with consultation with the academic supervisors, as the best approach to synthesise the finding of eligible studies.

Synthesized data was exported into an Excel Spreadsheet by JK, where the data was collated and combined. The Excel spreadsheet consisted of information regarding; the reasons; enablers and barriers; outcomes for the intervention. JK reviewed the data to explore the relationship between the data from each study and clustered it together when similarity was found. Identified data was discussed with an academic supervisor, Hamde Nazar (HN), before JK coded the enablers, barriers and outcomes into different themes. Coded themes were discussed separately with HN and DW, and any disagreement were discussed before a final decision were taken.

3.2.7 Quality assessment

A quality assessment of all included studies was made by using the Mixed Methods Appraisal Tool (MMAT) in assessing the trustworthiness, relevance and results of the published papers[95]. The assessment was based on answering 'yes', 'no' or 'cannot tell' to seven questions, where two of them were the same for every paper. The remaining five questions were based on the methodology for the study. To be categorised as a high quality paper, all the questions should be answered as 'yes'. A paper would be categorised as medium quality if 3/5 of the common questions and ½ of the research related questions were answered as yes. A paper would be low quality for anything less than 3/5 for the common question and ½ for the research question.

The lead review author (JK) and DW independently undertook a critical appraisal of one of the studies to verify the quality assessment process. No concerns were identified, and JK and DW independently completed the quality assessment for all the included studies. After the

appraisal, discrepancies between JK and DW were discussed. Any disagreement was discussed with HN before a final decision was made.

3.3 Method pilot study

3.3.1 Description of the pilot study

To obtain a description of the intervention, a request was made to the service manager. A semi-structured interview was undertaken to obtain a description of the service and that was informed by the Template for Intervention Description and Replication (TIDier) checklist and guide (Appendix 5)[96].

Set up of the pilot study

To set up the pilot study, the service manager from AHSNs worked with the providers of PharmOutcomes, Pinnacle Health Partnership LLP. They were able to set up an interface which refers to the pharmaceutical team in cares homes to perform the service. To record the service, they used a Web-based version of PharmOutcomes. The Pinnacle Health Partnership LLP suggested a template for the service. After consultant with the CCG-pharmacist, who were going to perform the service, the service manager adapted the template to fit the purpose of the pilot service and what they wanted to record. The purpose of having an appropriate template was to have the same guide for everyone within the pilot service. The template was a guideline on how to undertake the medicine-related intervention, what information should be retrieved, and what details should be recorded. When the service went live, the service manager contacted the recipient rapidly and had a meeting every couple of weeks, to make sure the service went well. If it was needed, changes regarding service performance were made. The AHSNs used pharmacist employed within PCN who included this as their role with no additional funding.

Referrals and performance of the service

Resident who was going to be transferred into care homes were logged into PharmOutcomes with details such as: clients name, date of birth, postcode, address, NHS number, GP details, contact details. At the time of the discharge, a referral with discharge summary was transferred to PCN based pharmacist, who performed the review within 10 days of discharge. The PCN-pharmacists were not trained for the role as it was believed that this was within their competence. Furthermore, consent was not obtained from residents to receive the service because of the nature of the residents and as the PCN-pharmacists were already responsible for their care. To perform the service the pharmacist contacted the residents' carer or nurse, because of the residents' nature, and asked questions regarding the medication and performed

the pharmaceutical service. Details on how and who performed the intervention, analysis and outcomes of the intervention and further actions were recorded in PharmOutcomes,

3.3.2 Data Collection

Service activity data

To obtain access to the service data, a second request was made to the service manager. From PharmOutcomes, the data were then uploaded into an excel spreadsheet. All identifiable information was removed, but residents age, gender, postcode and which GP practice and care home they belonged to was included. We evaluated the data from June 2021 to March 2021 for Shropshire Community Health NHS Trust and Shrewsbury & Telford hospitals. From the Excel spreadsheet, the data was cleaned, columns were quantified, and coded, and relevant information was extracted. Details about the referral setting, referrer name and contact, acceptance/rejection and completion rate were extracted. Information on the residents' long-term condition, medication regimen, reported actions related to the medication were analysed. The intervention results and method, followed-up consultation time, medication information obtained and given, advice given for the residents as a consequence of Adverse Drug Reaction (ADRs), pharmaceutical or support services that was provided were collated and analysed from the Excel spreadsheet by JK.

Data analysis

Quantitative data was analysed and converted into percentages where it was appropriate. Free text entered into the columns were collated and analysed by JK. Collected data was discussed with DW for further analysis. Data collected from the pilot study and information from the systematic review was combined to give an overview of the clinical outcomes and evidence of medicine-related intervention related to transition into care homes.

4 Results

4.1 Results Scoping review

Identified articles from the search terms process is shown in Table 5, and were used to search through different databases. It was decided to include PubMed, Ovid MEDLINE and Embase, PsycINFO, CINAHL complete (EBSCOhost).

Table 5. Summary of databases used within systematic reviews of similar nature

Included review	PubMed	MEDLINE	Embase	PsycINFO	CINAHL	Web of Science	AMED	Scopus	The Cochrane databases
Pharmacist services in nursing homes: A systematic review and meta-analysis[97]	√	√	√	X	X	√	X	√	X
Patients safety culture in care homes for older people: a scoping review[98]	√	√	√	X	√	√	X	√	X
Quality improvement in long-term care settings: a scoping review of effective strategies used in care homes[99]	√	√	√	X	X	√	X	√	X
Death Following Recent Admission Into Nursing Home From Community Living: A Systematic Review Into the Transition Process[100]	√	√	√	√	√	√	X	√	X
Medication Reconciliation in Long-Term Care and Assisted Living Facilities: Opportunity for Pharmacists to Minimize Risks Associated with Transitions of Care[101]	√	√	√	X	√	√	X	√	X
Medication history reconciliation by clinical pharmacists in elderly inpatients admitted from home or a nursing home[102]	√	√	√	X	√	X	X	√	X
Medication reconciliation in nursing homes: thematic differences between RN and LPN staff[103]	√	√	√	X	√	√	X	√	X
Improving patient safety through a pharmacist-led medication reconciliation programme in nursing homes for the elderly in Spain[104]	√	√	√	X	√	√	X	√	X
A nurse practitioner-led medication reconciliation process to reduce hospital readmissions from a skilled nursing facility[105]	√	√	√	X	√	√	X	√	X
Pharmacist-led program to improve transitions from acute care to skilled nursing facility care[106]	√	√	√	X	√	√	X	√	X

4.1.1 Study search results

The scoping search was carried out in November 2020, and finalised search terms are summarised in Table 6. Figure 1 provides a summary of the scoping review screening process. The calculated Cohen's Kappa after title screening was k=*0.683*, after the abstract screening k=*0.835* and after the full paper stage (prior to bibliography review) k= *0.934*. A summary of the final *6 papers* selected for inclusion is provided in Table 7.

Table 6. Search terms for scoping search

Database	PubMed	Ovid Embase	Ovid MEDLINE	PsycINFO	CINAHL complete (EBSCOhost)
Search terms	(Care[Title] OR nursing[Title] OR residential[Title] OR skilled-nursing[Title] OR assisted-living[Title] OR Age[Title]) AND (Facili*[Title] OR Home*[Title] OR Long term[Title] OR Old Age[Title]) AND ((reconciliation OR Review OR counselling OR History)) AND (Admission OR Admit OR transfer OR transition* OR Discharge OR entry OR enter*)) AND (Drug* OR Medicine* OR Medication* OR Pharmaceutical))	((Care or nursing or residential or skilled-nursing or assisted-living or Age) and (Facili$ or Home$ or Long term or Old Age)).ti. and (reconciliation or Review or counselling or History).af. and (Admission or Admit or transfer or transition$ or Discharge or entry or enter$).af. and (Drug$ or Medicine$ or Medication$ or Pharmaceutical).af.	((Care or nursing or residential or skilled-nursing or assisted-living or Age) and (Facili$ or Home$ or Long term or Old Age)).ti. and (reconciliation or Review or counselling or History).af. and (Admission or Admit or transfer or transition$ or Discharge or entry or enter$).af. and (Drug$ or Medicine$ or Medication$ or Pharmaceutical).af.	TI ((Care OR nursing OR residential OR skilled-nursing OR assisted-living OR Age) AND TI (Facili* OR Home*OR Long term OR Old Age)) AND ((reconciliation OR Review OR counselling OR History) AND (Admission OR Admit OR transfer OR transition* OR Discharge OR entry OR enter*) AND (Drug* OR Medicine* OR Medication* OR Pharmaceutical)))	(TI (Care OR nursing OR residential OR skilled-nursing OR assisted-living OR Age) AND (Facili* OR Home*OR Long term OR Old Age)) AND ((reconciliation OR Review OR counselling OR History) AND (Admission OR Admit OR transfer OR transition* OR Discharge OR entry OR enter*) AND (Drug* OR Medicine* OR Medication* OR Pharmaceutical))
Hits	287	1597	788	51	570

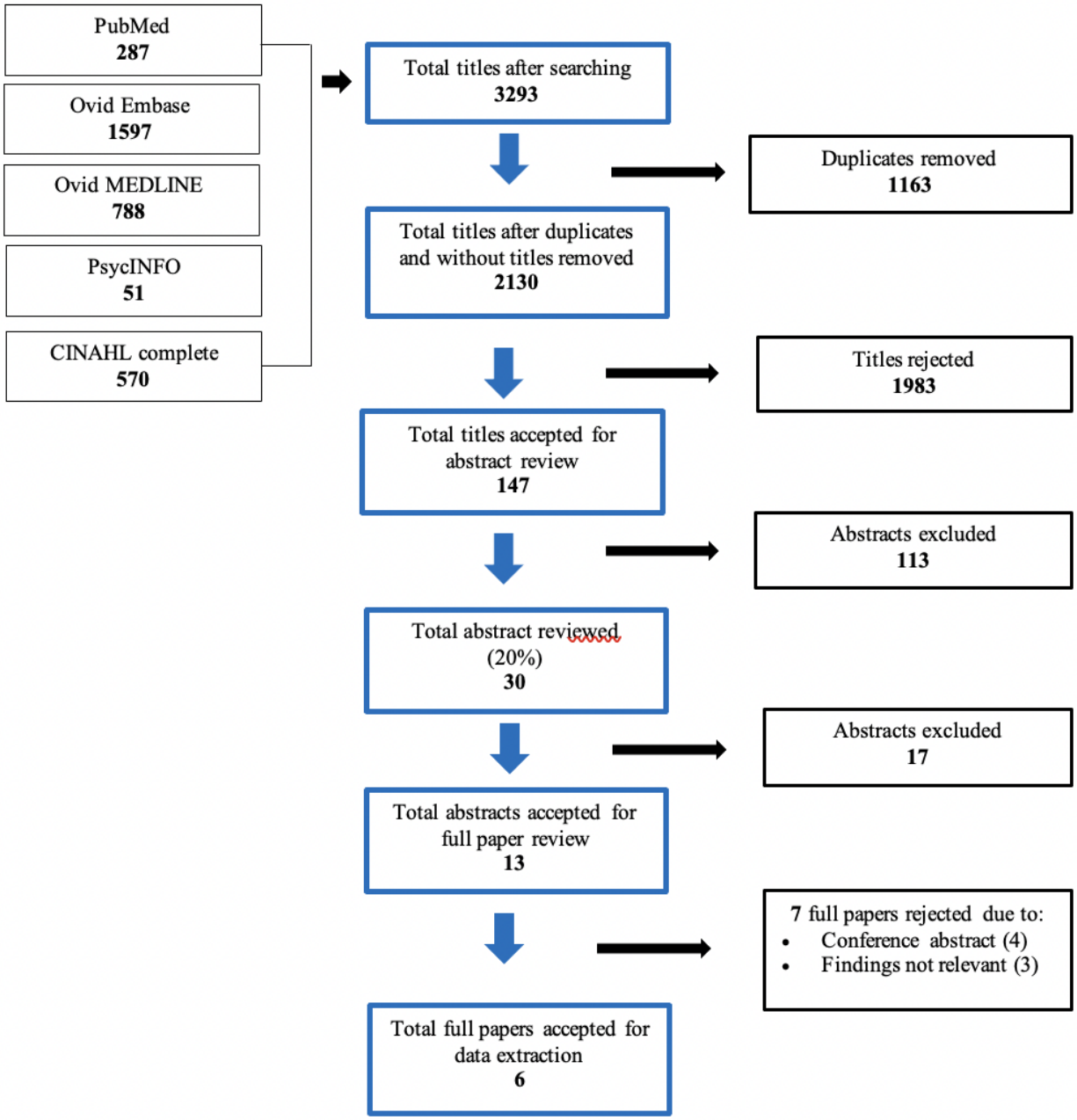

Figure 1. PRISMA flow diagram of included studies in the scoping scope

Table 7. Identified full text in the scoping review

First author	Year of study	Country of study	Methodology / theoretical approach	Aim (s) of study/Research question	Data generation method(s)	Study design
Anderson[107]	2019	USA	Quantitative enquiry	By implementing an NP-led medication reconciliation intervention, will it lead to a reduction in all-cause hospital readmissions from a SNF within 30 days	Paper charts for pre-implementation data Electronic health record for implementation period	Pre-post implementation design/Quality improvement project
Cook[108]	2019	USA	Qualitative enquiry	To determine which medication information source provided the least number of discrepancies and describe the different types of discrepancies among sources.	Focus group	Retrospective chart review/ secondary analysis
Koprivnik[109]	2020	Spain	Quantitative descriptive	To quantify and classify medicines reconciliations errors detected by a pharmacist during transitions of care of nursing home patients; assess if error frequency is associated with polypharmacy or type of transition; analyse types of medicines involved	Document / electronic record review Summary written by pharmacists	Service evaluation
Krol[110]	2018	USA	Quantitative descriptive	Evaluate the implementation of HOPE (Health Optimization Program for Elders) to improve patient transitions from acute hospital to SNFs	Process and outcome measures extracted from charts	Service evaluation and cohort study
Patterson[41]	2018	USA	Qualitative enquiry	Characterise challenges facing nursing home staff in receiving and resolving medication discrepancies during resident intake	Focus group	Qualitative study
Vogelsmeier[111]	2011	Midwest	Qualitative enquiry	To describe how medication reconciliation is performed by nursing home nursing staff to identify medication order discrepancies when residents transition to the nursing home	Observations Interviews	Content analysis

4.1.2 Quality assessment

Quality assessment tools identified as used within systematic reviews of a similar nature are summarised in Table 8, and these were assessment tools to be used for both quantitative and/or qualitative studies. The methodology for the identified studies is shown in Table 8. After discussing with HN and DW, MMAT [112] was selected as it enabled all types of study to be assessed within one tool.

Table 8. Identified appraisal tools and methodology

Appraisal Tool	Methodology
AMSTAR 2[113]	Randomised or non-randomised controlled trials
CASP[114]	Qualitative research
CEBM [115]	- Qualitative research - Randomised controlled trials - Systematic reviews - Diagnosis accuracy studies - Prognostic studies - Individual participant data
JBI[116]	- Cross sectional studies - Case control studies - Case reports - Case series - Cohort studies - Diagnostic test accuracy studies - Economic evaluations - Prevalence studies - Qualitative research - Quasi-experimental studies - Randomised controlled trials - Systematic reviews - Test and opinion
Mays and Pope [117]	Qualitative research
MMAT [112]	Systematic mixed methods studies including qualitative, quantitative and mixed method
NOS [118]	Non-randomised studies, including case-control and cohort studies
ROBIS [119]	Systematic review
RoB 2 [91]	Randomised trials
QUADAS-2 [120]	Systematic reviews of diagnostic accuracy studies

SURE [121]	- Qualitative studies - Randomised controlled trials - Non/randomised controlled trials - Cross sectional studies - Case control studies - Case series - Cohort studies - Systematic reviews - Diagnosis accuracy studies

4.2 Results systematic review

4.2.1 Study search results

A total of 3884 results were obtained after combining results for each search. After removal of duplicates and non-English publications, there were 2337 results. Figure 2 summarises the results from each stage of the study screening and selection process. Inter-rater agreement at title screening was k=*0.639* after the abstract screening k= *0.789* and after the full paper stage (prior to bibliography review) k= *0.796*.

4.2.2 Study characteristics

A summary of the study characteristics of the nine studies included in the narrative synthesis is shown in Table 9. Of the nine studies, two were qualitative studies [41, 111] and seven were quantitative studies [107, 109, 122-126]. Three of the included quantitative studies were descriptive studies [109, 123, 124]. The majority of the studies(six) were conducted in the USA[41, 107, 111, 122-124], and three were non-American; one from Australia [125], one from Spain [109] and one from Taiwan [126]. Table 10 shows a summary of the target population and setting. The participants in the included papers were aged 70 or more and included both care homes, nursing homes and SNF including transition from hospital. Seven of the included studies were published between 2011 and 2020, one in 2004 and one in 2006.

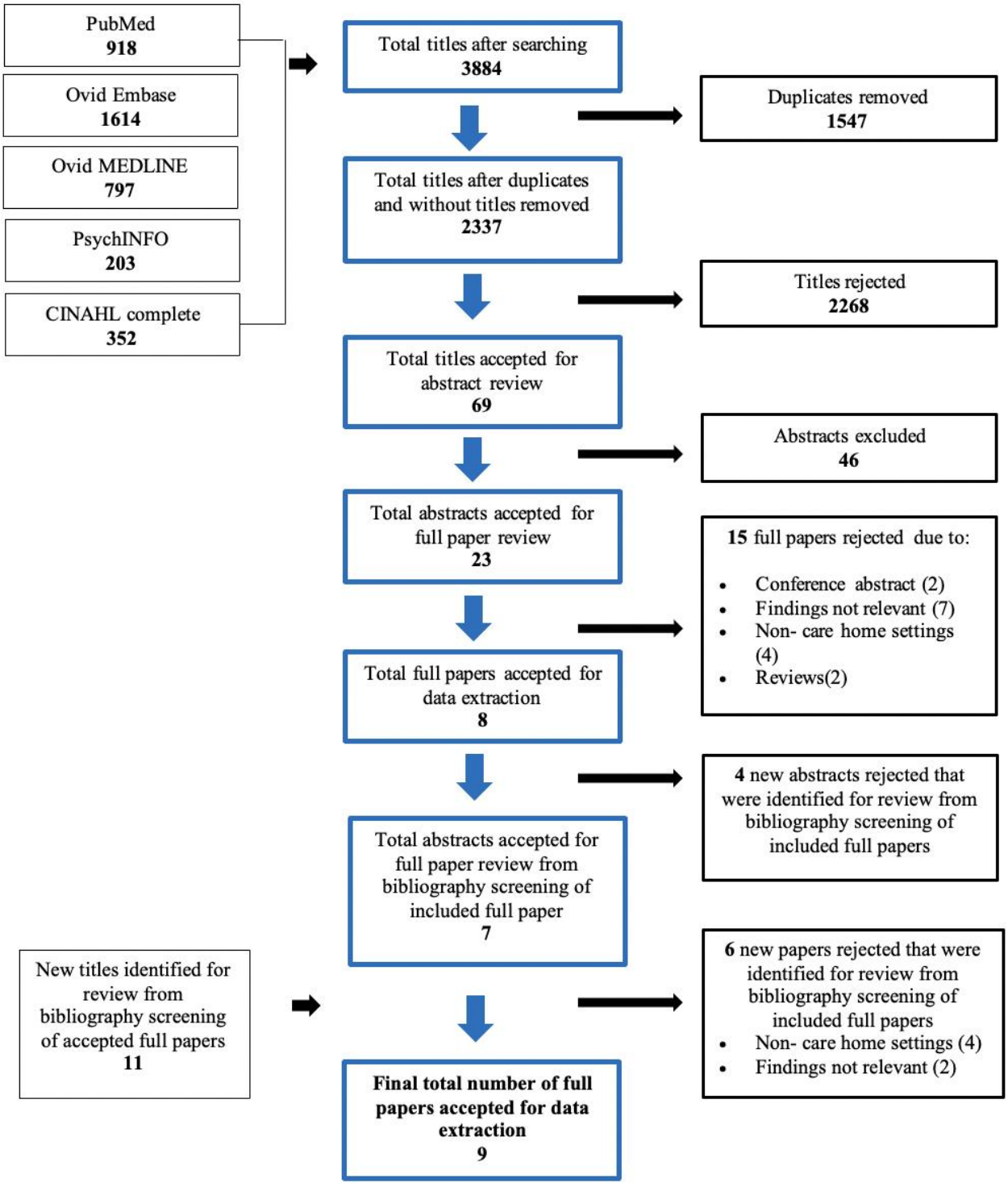

Figure 2. PRISMA flow diagram of included studies in the systematic review

Table 9. Summary of study characteristics

First author	Year	Country	Approach	Aim (s) of study/Research question	Data generation method(s)	Study design
Achilleos [122]	2020	USA	Quantitative enquiry	To reduce the time to medication administration and the time to order entry. To improve care transition and address the delays in medication administration	Observations Document / electronic record review	Quality improvement project
Anderson [107]	2020	USA	Quantitative enquiry	By implementing an NP-led medication reconciliation intervention, will it lead to a reduction in all-cause hospital readmissions from a SNF within 30 days	Paper charts pre-implementation. Electronic health record post-implementation	Pre-post implementation design Quality improvement
Boockvar [123]	2006	USA	Quantitative descriptive	Examine the effect of pharmacist medication reconciliation on the occurrence of drug-discrepancy ADEs among residents returning from the hospital to the nursing home	Document review	Pre-post intervention study
Crotty [125]	2004	Australia	Quantitative enquiry	If the quality of first-time transfer of older patients from a hospital to a long-term residential care facility improved with a pharmacist co-ordinating the transition	Document review	Randomised controlled trial
Koprivnik [109]	2020	Spain	Quantitative descriptive	To quantify and classify medicines reconciliations errors detected by a pharmacist during transitions of care of nursing home patients; assess if error frequency is associated with polypharmacy or type of transition.	Document / electronic record review Summary written by pharmacist	Service evaluation
Krol [124]	2018	USA	Quantitative descriptive	Evaluate the implementation of HOPE (Health Optimization Program for Elders) to improve patient transitions from acute hospital to SNFs	Process and outcome measures extracted from charts	Service evaluation and cohort study
Kuo [126]	2013	Taiwan	Quantitative enquiry	Evaluate a pharmacist-directed medication reconciliation program in a nursing home setting.	Document review	Pre-post intervention study
Patterson [41]	2019	USA	Qualitative enquiry	Characterise challenges facing nursing home staff in receiving and resolving medication discrepancies during resident intake	Focus group	Qualitative study
Vogelsmeier [111]	2011	USA	Qualitative enquiry	To describe how medication reconciliation is performed by nursing home nursing staff to identify medication order discrepancies when residents transition to the nursing home	Observations Interviews	Content analysis

Table 10. Characteristics of patients in studies reviewed

First author	No. of participant		Mean(sd) Age		Gender - female	
			Pre or Control vs Post or Intervention			
Achilleos [122]	75	43	71	74	27	37
Anderson [107]	52	37	79.5	77	37	29
Boockvar [123]	81	87	83.9	84.4	67	68
Crotty [125]	54	56	82	83.4	34	33
Koprivnik [109]	981		84.3		648	
Krol [124]	1016	245	77	81	59	65
Kuo [126]	20	18	80.6	80.2	11	7
Patterson [41]	No details		No details		No details	
Vogelsmeier [111]	RN staff = 18 LPN staff = 15		No details		No details	

4.2.3 Interventions

The key characteristics of the interventions for individual studies are shown in Table 11. This includes the involved healthcare professional (e.g. pharmacist, nurse), usual care (e.g. care homes, SNF), the reason for intervention, classification of the intervention (e.g. information, coordination, communication, patient communication). Three of the non-American studies reported that during the intervention, there was communication with the patients [109, 125, 126]. Six studies ensured a pharmacist was included in the intervention [41, 109, 122, 123, 125, 126] and three studies included other health care professionals (e.g. nurse or physician) [107, 111, 124]. Three studies used an electronic health care record as a tool during the intervention. This would include medication information and form of communication with other healthcare professionals about the patient medication and prescription application [109, 122, 124]. Two used fax as a communication method [41, 125], one study used a communication form with the nursing homes' physician when discrepancies were found [123]. In the Taiwanese study, the pharmacist contacted the prescriber if medication changes were not documented in the patient's medical chart [126]. The pharmacist involved in this study undertook medicines reconciliation for residents admitted or discharged from hospital during their weekly visit to

the home [126]. Two studies reported that the intervention was undertaken prior to admission or before transition from the hospital to the facility [107, 124] and five studies reported interventions during admission or within one day after admission into the care facility [109, 111, 122, 123, 125]. Another study used transfer documents to identify medication order discrepancies [111]. Studies included in this review showed increasement of information sharing between the facilities, improved coordination of care and improved communication.

Table 11. Intervention characteristics

(I=Information, C=Communication, CC=Co-ordination of care, IP= intervention performance, Resident-communication=RC)

First author	Reasons for intervention			Key roles	Classification of intervention				Usual care	Additional notes
	I	C	CC		I	C	IP	RC	CC	
Achilleos [122]	√		√	Pharmacist	Reviewed the resident's chart and Inpatient discharge order to perform medication reconciliation	Clarifies discrepancies with inpatient provider. Used electronic records and healthcare staff were consulted	Prior to resident transfer from hospital		SNF admission	Intervention's reason: Inappropriate doses, omissions, duplicate medications, unnecessary medications, and a need for additional medications
Anderson [107]			√	Nurse practitioner	Review medication pre-hospital to create original list for comparison and checked information with discharge letter for reconciliation		On admission to SNF		SNF	Medication review guided by a workflow process for a systematic medication reconciliation process
Boockvar [123]			√	Pharmacist Physician	Discrepancies identified, recorded and categorised and documented	Discrepancies communicated to Nursing home physician via communication form; Physician reviewed form, decided whether to take action and signed it. The form became a part of the nursing home pharmacy record	Residents identified within 1 day of return from hospital. Reconciliation was conducted when resident returned to the nursing home.		Nursing home admission	Used a medication reconciliation protocol.
Crotty [125]			√	Community pharmacist (CP), family physician, and transition	Additional information about changes to medication made in hospital and needs for monitoring	Information faxed to nursing staff, family physician and CP	When transferred to the long-term facility, TP co-ordinated medication review to be performed by	Case conference with the resident about medication use and appropriateness including family,	Standard hospital discharge.	

				pharmacist (TP)			CP within 10-14 days of transfer.	physician, TP, CP, nurse from facility		
Koprivnik [109]		√	√	Pharmacist	Reviewing different information sources in order to have the best medication list	Used an electronic health record (EHR), electronic prescription application (EPA)	First during admission and then after every transition to nursing home	Input from resident/if resident brought any medicines from home.	Nursing home	
Krol [124]	√	√	√	Nurse practitioner	Medication review and recommendations to primary team on deprescribing prior to discharge and identifying medicines errors in the transition process	Information collected from the health system's electronic health record. SNF evaluation and staff communication by phone or in-person	Happened prior to hospital discharge to the SNF		Standard hospital discharge and standard SNF inpatient consultation	
Kuo [126]		√	√	Pharmacist	Any frequency and types of medicines discrepancies were recorded	Contacted prescriber if medication changes were not documented in the resident's medical chart.	The pharmacist did a weekly visit	Educating residents on medication	Nursing home	
Patterson [41]	√	√	√	Nurse, clinician pharmacist, admissions administrator	Transcribe hospital discharge instructions and clarified discrepancies	The pharmacist communicates with hospitals and nursing home. Request new medication orders via fax with clinicians.			Care facility and SNF	Admissions administrator oversees nursing home intake processes while the general administrator oversees daily operations to ensure policy compliance.
Vogelsmeier [111]			√	Registered nurse or licensed practical nurse		Nurse used transfer documents to identify medication order discrepancies	During transition, on both day and evening shifts, when resident transfers most likely to occur			The nurses were observed when they conducted the medical reconciliation

4.2.4 Outcomes

Table 12 summarised the patient's outcome for the performed intervention. Mainly identified were discrepancies, followed up with a small reduction in hospital readmission/admission in the before and after studies. Found discrepancies were related to dosage, wrong medication, new medication, omission, substations, route and administration errors.

Table 12. Measured outcomes for the intervention

First author	Performed intervention	Outcome	Measure	Group or arm	Results	p-value
Achilleos [122]	Medication review	Identified medication errors in patients discharge summary	Overall No. in %	-	51%	N/A
		Decrease in readmissions	Overall change in %	-	10.4%	
Anderson [107]	Medicine reconciliation	Lower readmission to the hospital	No. of resident (%)	Before	10(19.2)	Not stated
				After	5(13.5)	
Boockvar [123]	Medicine reconciliation	Identification of discrepancies related to ADE	%	Before	2.3	Non-Significant
				After	14.5	
		Reduced hospital admission	Risk ratio	-	0.38	0.035
Crotty [125]	Transition service program	Lower Medication appropriateness index	Mean	Intervention	3.2	0.626
				Control	3.6	
Koprivnik [109]	Medicine reconciliation	Identified medication discrepancies	Overall, No. of medications rereviewed (%)	-	583(5)	N/A
		Discovered medicine reconciliation errors during transition of care	Overall No. of found errors during residents' transition (%)	-	273(28)	N/A
Krol [124]	Medication review and deprescribing recommendation	Lower 30-day readmission rate	No of residents	Study	11	Not stated
				Comparison	16	Not stated
Kuo [126]	Medicine reconciliation	Identified prescriptions	No. (%)	Study	266(45.5)	<0.01

		with discrepancies		Control	209(37.8)	

Summarised in Table ***13.*** The types of outcomes reported for the intervention in the included studies different themes were identified as outcomes of the intervention; improved service quality/improved resident outcome, reduced hospital readmission, identified ADE or side effects, identified medication errors, increased medication review/reconciliation performance and improved quality of prescribing and improved and managed transfer process.

An increase in performance of medicine-related interventions is also believed to be associated to improved service quality.

> *"That errors were most frequently related to inaccurate dosing (54%), adding new medication (commission errors) (21%) and omission errors (19%) with a substantial degree of high-risk medication involvement. We believe these findings highlight the importance of medication reconciliation at this transition point, making it an interesting initiative for reconciliation service quality improvement in other facilities."* [109].

Integrating the intervention as part of the admission process associated with a non-significant reduction in hospital readmission and decrease in medication administration delays.

> *"Decreased the average medication administration delays by 68%, 10,5% overall decrease in readmission.* [122] *."*

The types of medication errors believed to be prevented by the service were a reduction in missed doses and better timing of doses.

> *"From the results of this study, it is clear that pharmacist-implemented medication reconciliation can reduce the occurrence of harmful errors resulting from medication omissions."* [126].
>
> *"Other impacts that were emphasized in the pilot project included timing of antibiotic and high risk medications prior to discharge to ensure patients would not miss a dose on transfer to the SNF."* [122].

Implementing the intervention service, identified discrepancies which were related to prescribing,

> *"Prescribing changes plausibly related to 73(10.5%) of 696 total discrepancies were identified in the medication order."* [123].

By providing the intervention service, there was made modifications after identifying errors in the prescriptions.

> "*Prescriptions were modified at a rate of 57.6% for unintentional discrepancies and 41.3% for undocumented discrepancies with pharmacist intervention* ". [126].

Table 13. The types of outcomes reported for the intervention in the included studies

First author	Improved service quality/ resident outcomes	Reduced hospital readmission	Identified ADE/side effects	Identified medication errors	Increased Medication review/ reconciliation performance	Improved quality of prescribing	Improved/ managed transfer process
Achilleos [122]	√	√			√	√	√
Anderson [107]	√	√					
Boockvar [123]	√		√			√	
Crotty [125]	√		√			√	√
Koprivnik [109]				√	√	√	
Krol [124]	√	√		√			
Kuo [126]	√			√			√
Patterson [41]	√						√
Vogelsmeier [111]	√				√	√	

4.2.4 Enablers

All nine of the studies described at least two enablers for the intervention, as shown in Table 14. From analysing the extracted enablers, five themes were identified: Workforce, communication, systems and incentives.

Table 14. Enablers for the intervention

First author	Communication	Workforce	Systems	Incentives
Achilleos [122]	√	√	√	
Anderson [107]		√	√	√
Boockvar [123]	√			
Crotty [125]	√	√		
Koprivnik [109]	√	√	√	
Krol [124]	√	√		
Kuo [126]	√	√		
Patterson [41]	√	√	√	
Vogelsmeier [111]	√			

Communication

There were three different types which were believed to enhance service effectiveness. These were good communication between healthcare professionals and settings, good communication with the patient and good access to patient records.

Communication was an important factor to improve service quality and improving the transfer processes for the patient. When pharmacist communicated discharge discrepancies to inpatient providers, discharge paperwork processes were improved.

> *"The pharmacist played a key role in communication between providers and care teams throughout the process. By communicating discharge discrepancies to inpatient providers, discharge paperwork processes were improved. The pharmacist also led the team in ensuring that controlled substance hardcopy prescriptions were printed prior to patient transfer."* [122] .

Where the healthcare professional responsible for medicines reconciliation (HMR) were able to interact with personnel from the hospital directly, this was believed to improve the reconciliation process as a better understanding of the medications used was obtained. Using fax and phone calls as a communication method improved the information exchange between facilities, which improved the overall service quality.

> *"The ability to access both inpatient and SNF medication records allowed the pharmacist to collaborate with both inpatient and SNF physicians to determine appropriate medication regimes."* [122] .

The intervention process was facilitated when transfer sheets were filled out completely, and electronic health care records/medical records were used.

> *"Nursing homes rely upon hospitals to send accurate hospital transfer sheets reflecting the most recent prescription orders."* [41].

Similarly, being able to speak to the patient post discharge and giving the HMR access to the hospital record improved the process.

> *"…the inclusion of facilities within the same healthcare system. This allowed the pharmacist to access both EMRs for detailed information on inpatient and SNF phases of care…"* [122].

Workforce

Two different sub-themes were identified to improve the service quality. These were: involvement of healthcare personnel and workflow.

Where there was administrative support and appropriate logistics of working hours for the healthcare professionals, the intervention process was facilitated. [41] At the same time, it was improved when healthcare personnel such as a nurse practitioner was appointed fulltime at each setting and by using an experienced and dedicated nurse practitioner who was familiar with the environment.

> *"Using a full-time NP in each SNF setting can facilitate government mandates."* [107].
>
> *" To implement this program across all facilities within the health system, a dedicated pharmacist would be needed."* [122].

When the pharmacist was responsible for the medicines reconciliation process, it freed up nurse time and enabled nurses to redirect their focus to direct patient care. Therefore, to have an

effective collaboration, it relies on the cooperation between each health care professional involved in the setting.

> *"By having pharmacy personnel take ownership of medication order entry prior to patient arrival, nurses were able to redirect their focus to direct patient care."* [122].

Pharmacists also play an important role in nursing homes as they can correct unintentional discrepancies by performing medication reconciliation, especially when they had a specialised understanding of medication use in older adults.

> *"... the use of a pharmacist with a specialised understand of medication use in older adults appears to hold greats promise..."* [125].

When a hospital pharmacist was integrated into the nursing homes, they acted as a liaison between sites of care.

> *"The integration of our hospital pharmacists in the NH teams, having full access to both the general health system's and NH`s electronic medical charts, enables the former to act as a liaison between different sites of care."* [109].

In different care facilities, one will meet professionals with different qualifications, and to improve service quality and give the best patient outcomes, they have to work collaboratively. Therefore, to perform the intervention, it has shown it needs to be a collaboration between the health care professional in the facility.

> *"Reconciliation process is a shared responsibility of healthcare providers in collaboration with patients and families and it requires a team approach including nurses, pharmacists, physicians and other healthcare professionals."* [109].

By involving healthcare professionals, such as nurse practitioners, multiple factors were improved, which improved overall service quality.

> "*Additionally, use of NPs in the SNF setting has the ability to improve multiple short and long-term quality measures, reduce health care costs, improve survey results, and improve the quality of life for the vulnerable geriatric population."* [107].

Systems

Protocols and medication regimes facilitated the service. It was improved when flowcharts were used as a guide for the process, and the medicines reconciliation process was structured. By having policies and communication protocols, practical challenges were avoided.

"Our study showed that the risk to our patients of possible harm related to medication discrepancies can be minimised by conducting structured medication reconciliation." [109].

Incentives

When the facility was supported financially for the preparation and service mandated, it was enhancing the service. Additionally, the intervention was reported to reduce the health care cost and increase revenue by continuing the treatment for the residents within the care home instead of readmission to the hospital.

"… use of NPs in the SNF setting has the ability to improve multiple short and long-term quality measures, reduce health care costs…" [107].

"The positive benefits achieve included …. increased revenue by keeping the patients within the SNF setting for treatment." [107].

4.2.5 Barriers

Eight of the included studies described at least two barriers to the intervention. The barriers found in the included studies are shown in Table 15. From analysing the extracted barriers, four themes were identified: Knowledge, workforce capacity, organisation and communication.

Table 15. Barriers for the intervention

First author	Communication	Workforce capacity	Organisation	Knowledge
Achilleos [122]	√	√		
Anderson [107]		√		
Boockvar [123]		√	√	
Crotty [125]	√	√	√	√
Koprivnik [109]	√	√		
Krol [124]	√	√	√	
Kuo [126]				
Patterson [41]	√	√	√	
Vogelsmeier [111]				√

Communication

Under the theme communication, several sub-themes were identified as a barrier to the service. These includes communication between healthcare professionals and care settings, information sharing and documentation.

Lack of communication between healthcare professionals and inefficient communication between and among hospital and care homes were barriers for the service. It also caused challenges when they were unable to contact the other care sites.

> *"An important cause of medication errors during transitions of care is the lack of communication between different care sites."* [109].

Missed data between transition, last minutes changes and lack of a standardised hospital transfer sheets caused difficulties to perform the intervention.

> *"…Participants described discrepancies related to last minute changes that hospitals do not include on the transfer sheet."* [41].

When there was inconsistent sharing of information, miscommunication about medications, incomplete discharge summaries with no appropriate indication for medication, and discrepancies between medicines summaries and medicines provided, it was challenging for the healthcare professional who was performing the intervention.

> *"Outdated information from a hospital or inconsistent medication histories challenge nursing home staff."* [41].

Workforce capacity

There were three subthemes identified, resources and capacity, workload, absence of healthcare professional.

Lack of health care professionals to provide the service, as the organization had limited resources and not the capacity to employ a healthcare profession, and lack of processes to assure adequate service was a barrier.

> *"Organisations have limited resources for pharmacy counselling…."* [123].
>
> *"Pharmacists in Australia are currently reimbursed for medication review in residential care facilities on bed-per year basis rather than on the basis of per-patients service, which may have limited community pharmacists' provision of medication services and attendance at case conference."* [125].

Where the healthcare professional was not present all weekdays, there was a lack of follow up and delays in performing the intervention. Conducting the intervention is dependent on the time availability. When the workload is excessively high for healthcare professionals, delays occur when it comes to intervention and admission processes.

> *"Reasons for lack of SNF follow-up included clinical absence of NP…"* [124].
>
> *"… where the NP was off for personal time and no medication reconciliation or NP stabilization visit was preformed, six patients were admitted to the SNF and three of those were returned to the hospital within a 30-day period."* [107].

Organisation

Identified organisational barriers for the intervention can be divided into four subthemes. These were: Discharge process, Workflow, Medical health care records and coordination of care.

Discharging a patient from the hospital includes the involvement of various healthcare professional. To provide the intervention service, it was necessary to know when the patient would be discharged. Therefore, it required health care professionals to constantly follow up when the patient was going to be discharged as it could occur with last minutes changes. This could delay the discharge process and therefore postpone the intervention.

> *"The initial HOPE inpatient evaluation to occur just prior to discharge proved difficult to coordinate, as it required the NP to constantly monitor changing discharge plans."* [124].

When the healthcare professionals had inefficient workflows at hospitals and different working hours from other settings, challenges occurred for the intervention.

> *"Participants described some practical challenges such as staff working different shift schedules between settings and timing of a new admission (e.g., late in the day or weekend) that make timely communication more difficult because others may not be immediately available."* [41] .

When the healthcare professional did not follow the required nursing homes' procedures for the medical services, it affected the workflow as it was challenging for the other healthcare professionals.

> *"[The order of communication] needs to come from [nursing facility] to the doctor or from [pharmacy] to the doctor; and then the doctor to [the nursing facility] that's another challenge…. if the doctor does it the wrong way and he signed it and he thinks he's good and [we say] 'you can't do it that way, you've got to follow the rules."* [41].

The digital divide between hospitals and care homes, as the care homes did not have electronic health records, the absence of universal access to the records and confusion with prescriptions and formulary, was a barrier for the service.

> *"Need to focus on decreasing the digital divide between nursing homes and hospitals in order to improve the accuracy of exchanged information."* [41].

Similarly, when the patients were allocated to a new family physician during the transition, there was a lack of clinical information in the discharge summary, which was a barrier when they were admitted to the care homes.

> *"Furthermore, there were discrepancies between the medication summaries and the medication provided. Importantly, 69.1% of study patients were allocated to new family physician on transfer to the long care facility."* [125].

Knowledge

It was highlighted that there was the necessity to have the cognitive skills, to follow the procedures and have the information to provide the clinical information.

Lack of clinical and cognitive skills to perform the intervention was a barrier to the service.

> *"Safety practices such as medication reconciliation require nursing staff who possess the necessary cognitive skills to ensure medication order discrepancies are appropriately identified and managed."* [111].

4.2.6 Quality assessment

Table 16 shows the quality assessment of included studies based on MMAT. Most of the studies (n=6) were rated as medium quality, two rated as high [111, 124] and one as low quality [122]. The main criteria poorly addressed were the intervention and data analysis/sampling method, if the cofounders were accounted for in the design and analysis and if the risk of nonresponse bias low.

Table 16. Quality assessment of included studies based on MMAT

First author	Are there clear research questions?	Do the collected data allow to address the research questions?	Quality assessment from	Overall quality assessment
Achilleos [122]	No	No	3/5	Low
Anderson [107]	Yes	Yes	3/5	Medium
Boockvar [123]	Yes	Yes	4/5	Medium

Crotty [125]	Yes	Yes	3/5	Medium
Koprivnik [109]	Yes	Yes	4/5	Medium
Krol[124]	Yes	Yes	5/5	High
Kuo [126]	Yes	No	4/5	Medium
Patterson [41]	Yes	Yes	3/5	Medium
Vogelsmeier [111]	Yes	Yes	5/5	High

4.3 Results pilot services

The pilot service was set up by West Midlands AHSNs, which were mainly asked to support the work into acute trust. The community trust wanted to support residents and make a referral to help them with their medicines. Therefore, it was decided that the service will go live into both acute and community trust. It was also decided that the appropriate team to send a referral to, was the team that was supporting the clinical pharmacist services to the care homes. After the pilot service went live, there was changes in already planned service, as virtual consultation and a follow-up consultation was added to the service.

A total of 188 hospital patients, from two hospitals, participated in the pharmacist intervention post hospital discharge/after receiving the referral during the evaluative period. Of these, 100 patients were from Shropshire Community Health NHS Trust and 88 patients were from Shrewsbury and Telford Hospitals. The evaluative period lasted for nine months. The age range, gender and the long-term condition of patients were recorded (Table 17). The majority of the consulted patients were older people and did not have long-term condition. There was no pattern in the reported long-term condition.

Table 17. Patient demography: The age, gender and long-term condition

Characteristics of referrals		Shrewsbury	Shrewsbury and Telford	Total
		Number (%) (n=100)	Number (%) (n=88)	Number (%) (n=198)
Age	<59 years	1 (1)	5(5.7)	6(3.2)
	60-69 years	1 (1)	10(11.4)	11(5.9)
	70-79 years	15 (15)	18(20.5)	23(12.2)
	80-89 years	49(49)	42(47.7)	91(48.4)
	90-99 years	34(34)	13(14.8)	47(25.0)

Gender	Female	66(66)	54(61.4)	120(63.8)
	Male	34(34)	34(38.6)	68(36.2)
Long-term condition	Epilepsy	2(2)	1(1.1)	3(1.6)
	Parkinson	1(1)	1(1.1)	2(1.1)
	Dementia	3(2)	3(3.4)	6(3.2)
	Traumatic brain injury	-	1(1.1)	1(0.5)
	Postural hypotension	1(1)	-	1(0.5)
	Atrial fibrillation	7(7)	1(1.1)	8(4.3)
	High blood pressure	2(7)	-	2(1.1)
	Heart failure	1(1)	1(1.1)	2(1.1)
	Ischemic heart disease	-	1(1.1)	1(0.5)
	Congestive cardiac failure	1(1)	-	1(0.5)
	Diabetes type 2	2(2)	-	2(1.1)
	COPD, IHD	-	1(1.1)	1(0.5)
	Hypothyroidism	-	1(1.1)	1(0.5)
	Anaemia	-	1(1.1)	1(0.5)
	Fall	2(2)	-	2(1.1)
	Recurrent falls	1(1)	-	1(0.5)
	Chronic kidney disease	1(1)	-	1(0.5)
	Chronic liver disease	-	1(1.1)	1(0.5)
	Gastrointestinal	1(1)	-	1(0.5)
	Cancer	1(1)	-	1(0.5)
	Osteoarthritis	1(1)	-	1(0.5)
	Constipation	-	1(1.1)	1(0.5)
	Total	27(27)	14(15.9)	41(21.8)

After referrals were sent out, the decision to accept and complete the referrals was largely carried out within 7-14 days (Table 18). Most of the referrals was accepted within 72 hours, as the patients was discharge during working hours and therefore most likely resolved within

that time. If the intervention time was more then 10 days, it was related to contacting and involvement of other healthcare professional who were facilitating the service.

For Shropshire, 95% of the patients completed the first time-consultation. For Shrewsbury and Telford, only 42% of the patients received the intervention. Main reasons reported for this were non-completion due to the ongoing pandemic. The evaluated numbers were recorded during the pandemic. At that time the patient turnover in community hospital was lower than usually, therefore numbers over referred patients were lower than expected. Furthermore, the reason for not completing the intervention was that the resident got discharge from the trust, moved out of the area or passed away. One care setting refused to engage with the service provider.

Table 18. Time taken to complete the pharmacist intervention post hospital discharge

	Shropshire	Shrewsbury and Telford
Referral days	Number (%) (n=100)	Number (n=88)
0-1	17(17)	1(1.4)
2-3	14(14)	1(1.4)
4-5	18(19)	6(6.8)
6-7	23(23)	6(6.8)
8-10	8(8)	7(8.0)
11-15	11(11)	6(6.8)
16-20	3(3)	4(4.6)
21-28	1(1)	6(6.8)
No. completed	95(95)	37 (42%)
Not completed	5(5)	51(68)

The initial idea for the services, was to perform it once. After the service went live, it was decided to have a follow up consultation to see if the residents were followed up to see if the treatment decisions made had benefited the patient and/or whether any intervention was required. regarding the medication reconciliation when they came to the care homes.

A number of residents were referred to have a second consultation (Table 19). This was either performed by a technician or pharmacist. If the technician was performing the intervention, there would be a need for referring them to the pharmacist. Reason for further referral was such as of missing doses, missing medication, medication interaction, general oversight and review, recent exacerbation of long-term condition, repeated admission or for additional information.

Table 19. Overview of follow-up consultation after completed first-time consultation

Followed-up	Shropshire		Shrewsbury and Telford	
	Number (%) (n=95)	Referred to pharmacist	Number (%) (n=37)	Referred to Pharmacist
Yes	40(42.1)	5	17(45.9)	5
No	55(57.9)		20(54.1)	

The intervention was performed by the pharmacist in both hospital (Table 20). Mainly, they performed medication review and medication reconciliation through telephone consultation with the carer or nurse and the patient were not involved. For Shrewsbury and Telford, they mainly performed medicines reconciliation. For Shropshire, almost everyone received medicines reconciliation, and more than half of the residents also received medication review.

Table 20. Intervention provided by the pharmacist post hospital discharge

		Shropshire	Shrewsbury and Telford
		Number (%) (n=95)	Number (%) (n=37)
Medicine-related intervention	Structured medication review without resident	60(63.2)	1(2.7
	Medicines related queries	30(31.6)	21(56.8)
	Medicines reconciliation	90(94.7)	35(94.6)
	Drug monitoring	3(3.2)	1(2.7)
	Forward to other	-	1(2.7)
	Declined by carer	-	1(2.7)
	Contacted GP	3(3.2)	1(2.7)
	Contacted others	3(3.2)	2(5.4)
Consultation type	Telephone consultation with carer/nurse	83(87.4)	35(94.6)
	Telephone consultation with patient	2(2.1)	1(2.7)
	Virtual review (no patient present)	11(11.6)	1(2.7)

The intervention outcome is shown in Table 21 and details the medication/related information the pharmacist provided during the consultation, any advice on ADRs and any pharmaceutical

or support services that was delivered. The reason for giving the advice was because carer/nurse had lack of knowledge regarding the medication and treatment.

Table 21. Details about intervention outcome

	Intervention outcome	Shropshire	Shrewsbury and Telford
		Number (%) (n=95)	Number (%) (n=37)
Information	More information on medication(s)	57(60)	13(35.1)
	Dose check	22(23.2)	12(32.4)
	Information on condition	33(34.7)	10(27.0)
	Drug interaction	1(1.1)	1(2.7)
	Symptom response check	33(34.7)	10(27.0)
	Patient monitoring	56(59.0)	18(48.7)
	Prescribing errors	6(6.3)	1(2.7)
Advice provided on reported ADRs	Refer to other health professionals	15(15.8)	12(32.4)
	Stop taking the medication	17(17.9)	2(5.4)
	Change of dose	12(12.6)	2(5.4)
	Change of formulation	4(4.2)	-
Pharmaceutical/ support service provided	New medicines	4(4.2)	3(8.1)
	Adherence Advice	19(20.0)	12(32.4)
	Side effect advice	19(20.0)	8(21.6)
	Administration advice	14(14.7)	5(13.5)
	Formulation advice	3(3.2)	-
	Lifestyle advice	26(27.4)	11(29.7)
	Synchronisation of quantities	5(5.3)	3(8.1)
	Fall prevention	32(33.7)	7(18.9)

After the intervention were performed, the pharmacist was told to decide how likely their intervention would reduce any future readmission. Table 22, for Shropshire, and Table 23 for Shrewsbury and Telford, shows the details on how the intervention performed will reduce future admission of the patient.

Table 22. Overview of how likely the intervention reduced future readmission(rate) and how for Shropshire hospital

	Intervention (%) (n=95)	Examples
No likelihood	49(51.6)	- Correct medication - Lifestyle advice - No risk factors - No issues identified - Only taking OTC
Possible likelihood	39(41.1)	- Formulation change - Dosage change - Monitoring - Symptom analysis - Side effect analysis - Lifestyle advice - Fall risk analysis and advice - Administration advice - Identification of illness and advice
Likely	7(7.4)	- Safety issue - Dosage change - Stopped medication - Referral to other health personal - Fall risk analysis and advice - Side effect analysis

Table 23. Overview of how likely the intervention reduced future readmission(rate) and how for Shrewsbury and Telford

	Intervention (%) (n=37)	Examples
No likelihood	26 (70.3)	
Possible likelihood	11(29.7)	- Interaction analysis - Referral to other care personnel - Monitoring - Analysis of blood test results - Symptom analyses - Side effect analysis

For Shrewsbury and Telford, no medication was stopped, but for Shropshire, 14 patients it was agreed to using stop the medication with the carer (Table 24). This were both high risk and low

risk medication. The main reasons were that it was not required anymore, not using is anymore or it was replaced by a different medication

Table 24. Overview of long-term medication stopped for patients form Shropshire hospital

High risk	Low risk
- Tamsulosin	- Fenbid gel
- Innohep	- Folic acid
- Ranexa	- Allopurinol
- Bisoprolol	- Epaderm cream
- Exelon	- Vitamin B-compound
- Atorvastatin	- Omeprazole
- Isosorbide dinitrate	- Montelukast
- Metformin	- Lactulose
- Risedronate sodium	- Senna tablets
- Alendronic acid	- Hydroxacobalamin injection
- Warfarin	- Carbomer eye gek
- Risperidone	- Fostair inhalere
- Trajenta	- Ibuprofen gel
- Eliquis	- Spiriva inhalerer
	- Eurax
	- Colecalciferol capusles
	- Codeine
	- Systane eyedorps
	- Adcal chewable tablets

5 Discussion

Whilst our scoping review suggested that we may find a reasonable number of papers for eventual synthesis, the systematic review only provided a small number of additional papers. Furthermore, of the nine papers we found most were from the USA therefore providing little to no insight into how services could be delivered in predominantly government funded health and social care systems. To date, none have been reported from the UK and therefore, publication of the data from the UK pilot studies is warranted. We found only one randomised controlled trial designed to test the effectiveness of a service, with the remainder being service evaluations which either compared the effect of the service before and after implementation, considered changes in process resulting from the new service or explored participant views. The numbers of residents included in most studies was small, with limited follow up time and largely measures of process used as outcomes. The quality of evidence is therefore low to medium with respect to the evidence for providing medicines-related services to support resident discharge from hospital for care home residents.

The majority of services located a pharmacist at the centre, but others used nurses and/or physicians as the primary healthcare professional responsible for improving transition. A small number of recent publications have reported on the use of electronic healthcare records, which may have a significant impact on this process moving forward. We had anticipated that such services would be located in care homes, however this was frequently not the case with some reporting interventions prior to discharge. In the intervention, improving co-coordination of care was the most frequently reported. Perhaps unsurprisingly given the nature of the residents in care homes only a few studies involved direct communication. The heterogeneity in service location, design, delivery, purpose and evidence means that we do not have a clear message as to how such a service should be delivered to optimise effectiveness.

The review has provided good insight into the range of outcomes which could be considered for capturing if a trial to evaluate a discharge support service was to be designed and delivered. This would include reduction in medication errors, identification of ADEs, reduction in hospital readmission, improved prescribing quality and improved quality of service overall.

The main enablers from the included studies were that the facility needs to have the appropriate workforce in place, effective communication strategies, well designed systems and financial incentives. The main barriers were lack of communication between both health professionals and the facilities, inappropriate workload and insufficient staff, not having an appropriate

organisational structure and insufficient knowledge regarding medication and medication safety.

Evaluation of the pilot service gave similar outcomes as those found in the systematic review, as the pharmacist service involved analysis and giving advice regarding medication administration and safety, identifying and preventing medication and prescribing related errors.

When considering the strengths of the research, the scoping review enabled us to optimise our search strategy and ensure that there would be a sufficient number of papers to review. The identification of a number of NOT statements made the process more efficient, limiting the number of papers which required screening. There was good inter-relater correlation within the screening process thereby demonstrating that the inclusion and exclusion criteria provided good clarity with respect what papers were required.

A quality assessment tool which covered all study designs was selected as the nature of the final review is narrative and therefore an indication of quality is all that is required.

The scoping review was undertaken in a systematic and iterative manner, fully utilizing the available literature. Therefore, we are reasonably confident that the final systematic review is likely to identify the majority of papers within the area.

In the systematic review, two reviewers independently screened and selected the included studies, and disagreements were discussed to reach consensus. Screening involved a non-pharmacist researcher (JB) and the extraction process required consensus from supervisors who have experience in this form of review. This systematic review was also conducted and conformed to the PRISMA checklist as per guidelines.

Conversely, whilst we found 6 papers for inclusion from screening 20% of all titles, only 9 papers were found for the final analysis, which is much less than anticipated. Reasons for this included that the selection of the abstracts was done as every fifth paper in the scoping review and therefore we might have found most of the studies just by chance. Whilst the majority of these requirements for the systematic review protocol were identified within the scoping review process we did not develop and test the proposed data extraction or quality assessment tools.

The search strategy of this study was limited to English publications. It is difficult to predict the consequences this has had on the outcomes of the review. Another limitation was that most of the included studies were located in the USA and findings may not translate into all international settings.

The limitations of the pilot services were that the service was not performed as planned. A large number of services were not completed and therefore valuable results are missed out. Unfortunately, most of the interventions were performed over the phone because of the ongoing pandemic, and therefore the pharmacist was not able to visit the care homes when needed. The method of assessing likelihood of preventing future readmission within the pilot services is significantly flawed as it is pharmacists rating their own interventions who have limited insight, as practitioners, as to what causes and influences hospital admissions.

There was no pattern in referral, when it comes to health condition or use of medications and there is no characteristic of those who were not referred to the service rather than not being discharged to care homes. The number of residents involved in the service was varying between the hospitals and the overall number was low because of the pandemic. Therefore, it is hard to predict how likely the overall service is generalisable when it comes to improving medication safety. Furthermore, the pilot service did not capture the clinical impact of the service as this was not the purpose of a pilot. A study to determine the actual clinical effectiveness is warranted to determine whether the service provides value to the NHS. Further investigations should therefore be undertaken before implementing the service, as qualitative work is warranted to better understand what worked and what did not.

From the systematic review we found that there were a wide range of service configurations, and the evidence was such that it is not possible to determine which would be most appropriate. The questions which require answering were who should provide it, where should it be provided, how should it be supported e.g. using electronic tools or not and what should it consist of. We have some insight into the barriers and enablers for such services and how to capture its impact but no real insight into its true effectiveness.

When considering who should provide the service, the data is unclear as a variety of models exist. Both nurses, technician and pharmacists performed the services identified in the systematic review, and in both the pilot service and the systematic review provided good insight into the outcomes achievable from such a service. The individual professional included in the service, will facilitate the intervention with their competence [127]. For instance, by including a pharmacist, who are drugs expert, will facilitate the service with their knowledge about the medication [82, 128, 129]. However, to perform the service, it requires that the involved staff have the knowledge and skills to perform the intervention [129]. To perform a medicines reconciliation, they need to recognise the medicine names and strengths

and be able to reconcile them with the records. In medication review, it requires that the person who performs the service has a detailed knowledge of medicines, which includes knowledge regarding which medication and dose to use and when to use it. One could assume that a pharmacist is better trained for medicine-related intervention, however, it does not require a pharmacist to perform the service as long as the service provider has the required skills and knowledge. Therefore, before implementing a similar system, further research should be undertaken on how the involved staff should be trained before being a part of the service process. If there is lacking of knowledge, values or skills, the necessary training, such as problem-based learning, training or e-learning, seminars, workshops [127, 130], should be provided to improve the patient outcomes [77, 131-134].
In both pilot study and the review, most of the performed interventions were delivered by a pharmacist who also collaborated with other health care professionals such as nurses and physician. As they were able to contact other health personnel in other facilities and had good access to the resident's record it demonstrated a potentially valuable outcome.

Location of the service performance varied in this study and all seemed to work reasonably well as they were able to detect any medication errors or needs. However, according to the Joint Commission [69] and WHO [71], medicines reconciliation should be performed at every transition of care. If the medicines reconciliation is performed at the hospital, prior to discharge, a relevant care home staff member should also be performing the intervention at admission. Additionally, when medicines related intervention is performed before resident arrival, the carer will not be able to make any patient consultation and detect any errors from the residents' side. This is because the review at the hospital level will be dependent on the quality of information obtained on admission and therefore the final result needs checking in the care home against their records. As mentioned patient involvement is important [77, 128, 135, 136]. Therefore, when the intervention is conducted before resident arrival, relevant information could be missed out. However, this could be solved if the care home has a procedure where they will have a consultation with the resident after arrival. At the same time, this could be difficult because of the current health condition of the residents as a good proportion of them will not be able to contribute meaningfully to any discussion. Therefore, when considering the location of the service performance, further research related to the outcomes of preforming the service on different location is needed. as the results are not clear which service location will give the best resident outcomes.

Interventions identified as being provided on transition into care homes were medicines reconciliation, medication review and resident counselling. However, in the UK pilot service, the numbers were not the same for both sites, as in the first group, majority of the residents received medication review in combination with medicines reconciliation. With one pilot site providing medication review and medicine reconciliation and the other not, we could see that more patient monitoring was recommended, more medicines were stopped, and more dose formulation changes. It is unclear whether the benefits of including medication review are warranted by the additional cost of the pharmacist time to undertake it and medical practice time as a result of responding to increased monitoring and changes to repeat requests. Again, research to determine the value of each element is required.

Patient involvement is believed to be an important factor within any medicines reconciliation process, with discussion, education and patient' needs would be acknowledge and further assistance could be offered [66, 137]. Additionally, if the residents has been in charge of their medication before transition in care, other medication that is it not been recorded in the transfer document would be identified [66]. At the same time, residents in care homes, would most likely not be in charge of their own medications. Therefore, giving the carer or nurse the necessary advice regarding medication seemed to be more reasonable. However, one could not tell the overall outcomes for involving the carer from evaluating the results from this study as few studies reported it, therefore further consideration should be taken before concluding how likely this involvement will give clinical outcomes for the resident.

When considering how to interface the facilities, both the pilot service and the included studies gave good insight. Digital divide between the hospital and the involved care facility has shown to cause difficulties to transfer accurate information. PharmOutcomes, were used by the hospitals, pharmacist and care homes in the UK pilot services which may represent and effective solution. By using an electronic healthcare record and having the same system for both hospital and the care facility, would let the providers access the necessary information in a timely manner and facilitate effective performance of the intervention [129] and improve coordination of care for the residents in the care homes and facilitate the service. At the same time, in the recent years, various forms of electronic tools such as e-mails, electronic medication reconciliation tools, electronic medical and health records have been used to ensure residents medication safety during transition [77, 78, 138-140], transfer of information more effectively and safer, and to link facilities by using electronic health technology tool [129]. The

effectiveness and appropriateness of PharmOutcomes for this process is however unknown and any more detail evaluation of the pilot should include detailed consideration of this element. Poor communication and transfer of medical information during transition between facilities has been reported to be a reason for medication errors [127-129].When the information was accurate, up to date and transferred in a timely manner it improved the service, which was shown in the pilot service. Therefore, not having an electronic system to support the intervention, lack of electronic prescription databases, and reliance on handwritten records has shown to be a limitation for the service as the process was prolonged [135]. Saying that, electronic records are becoming the norm and therefore the question in the future will be what must be included in the record and how can errors in creating electronic records be minimised.

Studies have shown that to give residents the right treatment and to ensure medication and patient safety, effective communication between the care facilities is essential [127, 130]. Additionally, by contacting other health care professionals, if needed, showed the importance of collaboration and communication with other healthcare professionals, since everyone has different roles and responsibilities in patient care and performance of the service [66]. Therefore, there should be further investigation on how this would work in care homes, as this pilot service did not focus on collaboration and potential resident outcome.

The PCN pharmacists in the pilot service did not contact the residents in most cases, and therefore shows the difference from the findings from few studies outside of the UK. In the pilot study, this could be due to the nature of residents where most will have some form of dementia and may not be able to accurately describe their current medicines. At the same time, the results from the systematic review regarding resident involvement were limited and did not give us the greatest insight and evidence for involvement of the resident when performing the intervention.

The pilot study was planned by the service manager and the AHSNs team before implementing the service and the service manager supported the team within the whole service period. In the systematic review, it was found that administration support and organisation was important factors, and therefore, this shows how structural organisation and administrative support enables the service. Additionally, the template used in the pilot study was used as a guideline to perform the service. This was a factor that enabled the service in the systematic review and shows how this could be used in practise. However, one can say it important it is to have the

protocol and guidelines in place before implementing a similar process. The accessibility of the PCN based pharmacists in the pilot service therefore also requires review to determine whether this was a barrier to timely intervention.

Incentivisation were a factor that was important for improvement of the service and were found in the American studies. In USA, to improve health care quality, Pay-for-performance is commonly used [141, 142]. As most of the included studies were from USA, this could be an important factor that is worth having in mind when implementing the service. [143]. However, the pilot service did not receive any extra funding rather than the ordinary salary for the involved staff, who were appointed for the service. Therefore, the evidence is mixed, and it has found to give different outcomes. A study by Werner [141] also stated that there should be experimenting when implementing this into nursing homes in the future.

In the systematic review, having different working hours for the facilities was found as a barrier for the service. The intervention in the pilot study was accepted by the pharmacist and further action was taken after a short amount of time because the residents was discharged to care homes during their working hours. Adequate working hours and administrative support to perform the service has shown to facilitate the service. Sufficient working hours, organisational ability to implement the service and resources are important factors found for the service improvement, but it also shown it is necessary to have guidelines such as protocols and regimes to perform and facilitate the intervention [129].

Adequate funding and support were identified to be important for the preparation and performance of the service [77, 130, 135]. To perform the service, the facility needs resources, which includes availability of relevant staff. Therefore, there would be a need for more financial support because of the cost of staff time to prepare and appoint the relevant staff [144]. When they were supported financially, they were able to perform the intervention, at the same time it will reduce the overall cost as readmission to the hospital was avoided and the residents were hold within the care homes. Saying that, performance of the service will most likely be less than the cost for admitting the residents to the hospital.

The included studies were mostly before and after studies which reported the findings by using process outcomes, but the results were not represented by a large number. Additionally, half of the included studies did not present their p-value for their results, and therefore it cannot be taken any conclusion on how effective the services really were.

A few of the included studies reported reduction in readmission rate, but they were not randomised controlled trials and therefore not reliable evidence on the effectiveness for the intervention. The one randomised controlled trial used discrepancies as the primary outcome measure, which is of limited value for commissioners seeking patient orientated outcomes.

In this study, most of the included studies performed medicine reconciliation which showed an effect for the resident. Discrepancies was identified and few studies showed a small reduction in hospital readmission/admission. However, the results provide limited evidence for effectiveness with the one randomised controlled trial not reporting readmission/admission rate. The evaluation by the pharmacist regarding readmission in the pilot services were not further investigated by service provider and they were not responsible for readmission for resident, and therefore hard to compare these outcomes. Furthermore, the results from the pilot service study was based on the outcomes reported by the service provider, and therefore are likely to be affect by social desirability bias. Additionally, most of the studies were before and after, which frequently experience regression to the mean effect whereby a high level of something reduces over time. Therefore, further studies should investigate the readmission rate after an intervention is performed for a larger number of residents. We can also say that whatever healthcare professional provided the services, discrepancies were identified and there was reduction in the readmission/admission rate which is believed to improve the overall quality for the residents.

5.1 Future needs

Findings in the pilot service relates to the enablers and barriers found in the systematic review, as communication, workforce, knowledge, organisational structure and systems were facilitating the pilot service. Comparison with results from this study and outcomes in other studies involving transition between care levels shows the same outcomes [17, 65, 66, 74, 76-82, 127-152]. Therefore, some of the recognised factors will facilitate the services if it is implemented in the UK.

Findings in this study has shown how several countries have implemented the medicine-related intervention, and the finding will be relevant when implementing the similar services. However, those countries can have a different health system and therefore we do not know how these would translate into the UK care setting.

Before implementing a similar service in the UK, our study shows that there should be protocols and guidelines on how the service should be provided. It is important to make sure

that residents in care homes, regardless on which care homes, gets the same service. However, literature does not allow us to definitively decide what the service should or should not include and the evidence are limited.

Furthermore, to conclude certainly in this, there is a need for more generalisable studies within the UK, as all the included literature studies were outside of the UK. Additionally, the results from the small pilot study that was delivered across the UK, gave small numbers, and therefore there should be further researcher before making any conclusions on how to implement the service.

The current evidence base is weak and there is a need for more and better studies regarding which setting, when, and how the medicine-related intervention should be performed. Further studies should be focusing more on the intervention outcomes. There is also a need for evaluating the value regarding cost and outcomes. More studies that collect outcome data will contribute to the evidence base for these interventions. Studies employing more experimental designs will be more ideal to recognise the actual impact of the intervention, such as services performed by nurse or pharmacist and at hospital or care homes. Interventions that tackle issues with communication and the workforce are those which appear to be more successful, but the current evidence is still quite limited.

6 Conclusion

There is limited evidence regarding effectiveness to support the routine implementation of such a service. There is no evidence demonstrating the potential value of such a service, e.g. outlining the relationship between cost and outcomes. The pilot services demonstrated that the transition stage provided a large number of opportunities to optimise therapy, with the inclusion of medication review increasing this further.

A number of questions remain regarding exactly how the service should be configured but some insight is provided into the barriers and enablers to service implementation and what outcomes could be expected as a result.

Information found in study could be used to develop a randomised controlled trial testing medicines reconciliation, medicines reconciliation with review and usual care, it should be sufficiently powered to identify a clinically important reduction in rehospitalisation rate.

References

1. Singh, S. and B. Bajorek, *Defining 'elderly' in clinical practice guidelines for pharmacotherapy.* Pharm Pract (Granada), 2014. **12**(4): p. 489.
2. Orimo, H., et al., *Reviewing the definition of "elderly".* Geriatrics & Gerontology International, 2006. **6**(3): p. 149-158.
3. Age UK. *Later Life in the United Kingdom 2019*. 2019; Available from: https://www.ageuk.org.uk/globalassets/age-uk/documents/reports-and-publications/later_life_uk_factsheet.pdf.
4. Alldred, D.P., et al., *Interventions to optimise prescribing for older people in care homes.* Cochrane Database Syst Rev, 2016. **2**(2): p. Cd009095.
5. National Health Service. *Care homes*. 2019, january [cited 2019; Available from: https://www.nhs.uk/conditions/social-care-and-support-guide/care-services-equipment-and-care-homes/care-homes/.
6. Andreassen, L.M., et al., *The potential for deprescribing in care home residents with Type 2 diabetes.* International Journal of Clinical Pharmacy, 2016. **38**(4): p. 977-984.
7. Gordon, A.L., et al., *Health status of UK care home residents: a cohort study.* Age and Ageing, 2013. **43**(1): p. 97-103.
8. Age UK. *How to get care and support*. 2019, November; Available from: https://www.ageuk.org.uk/globalassets/age-uk/documents/factsheets/fs41_how_to_get_care_and_support_fcs.pdf.
9. Age UK. *Finding, choosing and funding a care home*. 2020, july; Available from: https://www.ageuk.org.uk/globalassets/age-uk/documents/factsheets/fs29_finding_choosing_and_funding_a_care_home_fcs.pdf.
10. Boscart, V., et al., *Chronic disease management models in nursing homes: a scoping review.* BMJ Open, 2020. **10**(2): p. e032316.
11. Koller, D., et al., *Multimorbidity and long-term care dependency--a five-year follow-up.* BMC Geriatr, 2014. **14**: p. 70.
12. Wallace, E., et al., *Managing patients with multimorbidity in primary care.* BMJ : British Medical Journal, 2015. **350**: p. h176.
13. Cassell, A., et al., *The epidemiology of multimorbidity in primary care: a retrospective cohort study.* British Journal of General Practice, 2018. **68**(669): p. e245-e251.
14. Bao, J., et al., *Multimorbidity and care dependence in older adults: a longitudinal analysis of findings from the 10/66 study.* BMC Public Health, 2019. **19**(1): p. 585.
15. National institute for Health and Care Excellence. *Multimorbidity and polypharmacy*. 2019; Available from: https://www.nice.org.uk/advice/ktt18/chapter/evidence-context.
16. Walckiers, D., J. Van der Heyden, and J. Tafforeau, *Factors associated with excessive polypharmacy in older people.* Arch Public Health, 2015. **73**: p. 50.
17. World Health Organization. *Medication safety in polypharmacy: technical report*. 2019; Available from: https://apps.who.int/iris/handle/10665/325454.
18. Anderson, L.J., et al., *A systematic overview of systematic reviews evaluating interventions addressing polypharmacy.* American Journal of Health-System Pharmacy, 2019. **76**(21): p. 1777-1787.
19. Dagli, R.J. and A. Sharma, *Polypharmacy: a global risk factor for elderly people.* J Int Oral Health, 2014. **6**(6): p. i-ii.

20. Morin, L., et al., *The epidemiology of polypharmacy in older adults: register-based prospective cohort study.* Clin Epidemiol, 2018. **10**: p. 289-298.
21. Barber, N.D., et al., *Care homes' use of medicines study: prevalence, causes and potential harm of medication errors in care homes for older people.* Qual Saf Health Care, 2009. **18**(5): p. 341-6.
22. Fialová, D., et al., *Potentially inappropriate medication use among elderly home care patients in Europe.* Jama, 2005. **293**(11): p. 1348-58.
23. Maher, R.L., J. Hanlon, and E.R. Hajjar, *Clinical consequences of polypharmacy in elderly.* Expert Opin Drug Saf, 2014. **13**(1): p. 57-65.
24. Bibi, Z., *Role of cytochrome P450 in drug interactions.* Nutrition & metabolism, 2008. **5**: p. 27-27.
25. Gurwitz, J.H. and P. Rochon, *Improving the quality of medication use in elderly patients: a not-so-simple prescription.* Arch Intern Med, 2002. **162**(15): p. 1670-2.
26. Mangoni, A.A. and S.H. Jackson, *Age-related changes in pharmacokinetics and pharmacodynamics: basic principles and practical applications.* Br J Clin Pharmacol, 2004. **57**(1): p. 6-14.
27. J. Mark Ruscin and Sunny A. Linnebur. *Drug-Related Problems in Older Adults*. 2018; Available from: https://www.msdmanuals.com/en-gb/professional/geriatrics/drug-therapy-in-older-adults/pharmacokinetics-in-older-adults?query=Aging%20and%20Drugs.
28. Ivanova, I., et al., *Medication use in a cohort of newly admitted nursing home residents (Ageing@NH) in relation to evolving physical and mental health.* Arch Gerontol Geriatr, 2018. **75**: p. 202-208.
29. Besdine, R.W. *Physical Changes With Aging*. 2019; Available from: https://www.msdmanuals.com/professional/geriatrics/approach-to-the-geriatric-patient/physical-changes-with-aging.
30. James M. Ritter, et al., *Rang & Dale's pharmacology*. Eighth ed. 2016, England: Elsevier Churchill Livingstone.
31. J. Mark Ruscin and S.A. Linnebur. *Pharmacodynamics in Older Adults*. 2018; Available from: https://www.msdmanuals.com/en-gb/professional/geriatrics/drug-therapy-in-older-adults/pharmacodynamics-in-older-adults?query=Aging%20and%20Drugs.
32. British Medical Jornal. *237+ million medication errors made every year in England*. 2020 june; Available from: https://medicalxpress.com/news/2020-06-million-medication-errors-year-england.html
33. Wolfe, D., et al., *Incidence, causes, and consequences of preventable adverse drug reactions occurring in inpatients: A systematic review of systematic reviews.* PLoS One, 2018. **13**(10): p. e0205426.
34. National Coordinating Council for Medication Error Reporting and Prevention. *About Medication Errors*. What is a Medication Error? 2020; Available from: https://www.nccmerp.org/about-medication-errors.
35. Elliott., R.A., et al. *Prevalence and economic burden of medication errors in the NHS in England*. 2018.
36. Lehnbom, E.C., et al., *Impact of Medication Reconciliation and Review on Clinical Outcomes.* Annals of Pharmacotherapy, 2014. **48**(10): p. 1298-1312.
37. Nebeker, J.R., P. Barach, and M.H. Samore, *Clarifying adverse drug events: a clinician's guide to terminology, documentation, and reporting.* Ann Intern Med, 2004. **140**(10): p. 795-801.

38. World Health Organization. *Safety of Medicines; A guide to detecting and reporting adverse drug reactions*. 2002; Available from: http://archives.who.int/tbs/safety/esd_safety.pdf.
39. Assiri, G.A., et al., *What is the epidemiology of medication errors, error-related adverse events and risk factors for errors in adults managed in community care contexts? A systematic review of the international literature.* BMJ Open, 2018. **8**(5): p. e019101.
40. Kim, J. and A.L. Parish, *Polypharmacy and Medication Management in Older Adults.* Nurs Clin North Am, 2017. **52**(3): p. 457-468.
41. Patterson, M.E., et al., *Inter-facility communication barriers delay resolving medication discrepancies during transitions of care.* Res Social Adm Pharm, 2019. **15**(4): p. 366-369.
42. Blenkinsopp, A., C. Bond, and D.K. Raynor, *Medication reviews.* Br J Clin Pharmacol, 2012. **74**(4): p. 573-80.
43. Shaw, J., R. Seal, and M. Pilling. *Room for review – a guide to medication review: the agenda for patients, practitioners and managers* 2002; Available from: https://www.webarchive.org.uk/wayback/archive/20140627111246/http%3A/www.npc.nhs.uk/review_medicines/intro/resources/room_for_review.pdf.
44. Goh, B.Q., et al., *Effectiveness of Medication Review in Improving Medication Knowledge and Adherence in Primary Care Patients.* Proceedings of Singapore Healthcare, 2014. **23**(2): p. 134-141.
45. Weiss, B.D., et al., *Improving the Effectiveness of Medication Review: Guidance from the Health Literacy Universal Precautions Toolkit.* J Am Board Fam Med, 2016. **29**(1): p. 18-23.
46. Huiskes, V.J., et al., *Effectiveness of medication review: a systematic review and meta-analysis of randomized controlled trials.* BMC Fam Pract, 2017. **18**(1): p. 5.
47. National Institute for Health and Care Excellence. *Medicines optimisation: the safe and effective use of medicines to enable the best possible outcomes*. 2015 [cited 2021 March]; Available from: https://www.nice.org.uk/guidance/ng5.
48. Pharmaceutical care network Europe. *Position Paper on the PCNE definition of Medication Review 2016*. 2016 [cited 2021 March]; Available from: https://www.pcne.org/upload/files/149_Position_Paper_on_PCNE_Medication_Review_final.pdf.
49. NICE Medicines and Prescribing Centre (UK). *Medicines Optimisation: The Safe and Effective Use of Medicines to Enable the Best Possible Outcomes*. 2015 March; NICE Guideline, No. 5:[Available from: https://www.ncbi.nlm.nih.gov/books/NBK355921/.
50. Zermansky, A.G., et al., *Clinical medication review by a pharmacist of elderly people living in care homes—randomised controlled trial.* Age and Ageing, 2006. **35**(6): p. 586-591.
51. Sorensen, L., et al., *Medication reviews in the community: results of a randomized, controlled effectiveness trial.* Br J Clin Pharmacol, 2004. **58**(6): p. 648-64.
52. Duncan, P., et al., *Efficiency versus thoroughness in medication review: a qualitative interview study in UK primary care.* Br J Gen Pract, 2019. **69**(680): p. e190-e198.
53. Zermansky, A.G., et al., *Clinical medication review by a pharmacist of patients on repeat prescriptions in general practice: a randomised controlled trial.* Health Technol Assess, 2002. **6**(20): p. 1-86.
54. PETTY, D.R., et al., *Clinical medication review by a pharmacist of elderly patients on repeat medications in general practice — pharmacist interventions and review outcomes.* International Journal of Pharmacy Practice, 2002. **10**(1): p. 39-45.

55. Petty, D.R., et al., *Patients' views of a pharmacist-run medication review clinic in general practice.* The British journal of general practice : the journal of the Royal College of General Practitioners, 2003. **53**(493): p. 607-613.
56. Mergenhagen, K.A., et al., *Pharmacist- versus physician-initiated admission medication reconciliation: impact on adverse drug events.* Am J Geriatr Pharmacother, 2012. **10**(4): p. 242-50.
57. Chick, N. and A. Meleis. *Transitions: A Nursing Concern*. 1986; Available from: https://repository.upenn.edu/nrs/9.
58. Mukamel, D.B., et al., *Personalizing Nursing Home Compare and the Discharge from Hospitals to Nursing Homes.* Health Serv Res, 2016. **51**(6): p. 2076-2094.
59. National institute for Health and Care Excellence. *Transition between inpatient hospital settings and community or care home settings for adults with social care needs*. 2015; Available from: https://www.nice.org.uk/guidance/ng27/documents/transition-between-inpatient-hospital-settings-and-community-or-care-home-settings-for-adults-with-social-care-needs-full-guideline2.
60. Wilson, S.A., *The transition to nursing home life: a comparison of planned and unplanned admissions.* Journal of Advanced Nursing, 1997. **26**(5): p. 864-871.
61. Care Quliaty Comission. *Medicines reconciliation (how to check you have the right medicines)*. 2020, july; Available from: https://www.cqc.org.uk/guidance-providers/adult-social-care/medicines-reconciliation-how-check-you-have-right-medicines.
62. World Health Organization, *Medication errors*. Technical Series on Safer Primary Care. 2016, Geneva: World Health Organization.
63. Kerstenetzky, L., et al., *Improving medication information transfer between hospitals, skilled-nursing facilities, and long-term-care pharmacies for hospital discharge transitions of care: A targeted needs assessment using the Intervention Mapping framework.* Res Social Adm Pharm, 2018. **14**(2): p. 138-145.
64. Richardson, A., et al., *UK nurses' views on their role in hospital to care home transitions for people living with dementia.* Innovation in Aging, 2018. **2**(suppl_1): p. 825-825.
65. Tong, M., et al., *Nursing Home Medication Reconciliation: A Quality Improvement Initiative.* J Gerontol Nurs, 2017. **43**(4): p. 9-14.
66. Barnsteiner, J.H. *Medication Reconciliation. In: Hughes RG, editor. Patient Safety and Quality: An Evidence-Based Handbook for Nurses*. 2008 Apr; Available from: https://www.ncbi.nlm.nih.gov/books/NBK2648/.
67. National institute for Health and Care Excellence, *Technical patient safety solutions for medicines reconciliation on admission of adults to hospital.* 2007.
68. Cadman, B., et al., *Pharmacist provided medicines reconciliation within 24 hours of admission and on discharge: a randomised controlled pilot study.* BMJ Open, 2017. **7**(3): p. e013647.
69. Mulloy, D.F. and R.G. Hughes. *Wrong-Site Surgery: A Preventable Medical Error. In: Hughes RG, editor. Patient Safety and Quality: An Evidence-Based Handbook for Nurses*. 2008 April; Available from: https://www.ncbi.nlm.nih.gov/books/NBK2678/.
70. National Prescribing Centre. *Medicines Reconciliation: A guide to implentation*. 2007; Available from: https://www.nicpld.org/courses/fp/learning/assets/NPCMedicinesRecGuideImplementation.pdf.

71. World Health Organization. *Standard Operating Protocol for Medication Reconciliation, Assuring Medication Accuracy at Transitions in Care:Medication Reconciliation*. 2014; Available from: https://www.who.int/patientsafety/implementation/solutions/high5s/h5s-sop.pdf.
72. Digiantonio, N., J. Lund, and S. Bastow, *Impact of a Pharmacy-Led Medication Reconciliation Program.* P t, 2018. **43**(2): p. 105-110.
73. Redmond, P., et al., *Impact of medication reconciliation for improving transitions of care.* Cochrane Database of Systematic Reviews, 2018(8).
74. Mueller, S.K., et al., *Hospital-based medication reconciliation practices: a systematic review.* Arch Intern Med, 2012. **172**(14): p. 1057-69.
75. Kwan, J.L., et al., *Medication Reconciliation During Transitions of Care as a Patient Safety Strategy.* Annals of Internal Medicine, 2013. **158**(5_Part_2): p. 397-403.
76. McCarthy, L., et al., *Medication reconciliation interventions in ambulatory care: A scoping review.* American Journal of Health-System Pharmacy, 2016. **73**(22): p. 1845-1857.
77. Fredrickson, B.-A. and E. Burkett, *Interventions to improve the continuity of medication management upon discharge of patients from hospital to residential aged care facilities.* Journal of Pharmacy Practice and Research, 2019. **49**(2): p. 162-170.
78. Chhabra, P.T., et al., *Medication reconciliation during the transition to and from long-term care settings: a systematic review.* Res Social Adm Pharm, 2012. **8**(1): p. 60-75.
79. Mekonnen, A.B., A.J. McLachlan, and J.A. Brien, *Effectiveness of pharmacist-led medication reconciliation programmes on clinical outcomes at hospital transitions: a systematic review and meta-analysis.* BMJ Open, 2016. **6**(2): p. e010003.
80. Kaboli, P.J., et al., *Clinical Pharmacists and Inpatient Medical Care: A Systematic Review.* Archives of Internal Medicine, 2006. **166**(9): p. 955-964.
81. Scarsi, K.K., M.A. Fotis, and G.A. Noskin, *Pharmacist participation in medical rounds reduces medication errors.* American Journal of Health-System Pharmacy, 2002. **59**(21): p. 2089-2092.
82. Steurbaut, S., et al., *Medication History Reconciliation by Clinical Pharmacists in Elderly Inpatients Admitted from Home or a Nursing Home.* Annals of Pharmacotherapy, 2010. **44**(10): p. 1596-1603.
83. Hammad, E.A., et al., *Pharmacy led medicine reconciliation at hospital: A systematic review of effects and costs.* Res Social Adm Pharm, 2017. **13**(2): p. 300-312.
84. Institute for Healthcare Improvement. 2011; Available from: Available at www.ihi.org.
85. Pharmaceutical Services Negotiating Committee. *Discharge Medicines Service*. 2021; Available from: https://psnc.org.uk/services-commissioning/essential-services/discharge-medicines-service/.
86. Pharmaceutical Services Negotiating Committee. *Primary Care Networks (PCNs)*. 2021; Available from: https://psnc.org.uk/the-healthcare-landscape/primary-care-networks-pcns/.
87. Fowler Davis, S., et al., *The Contribution of Pharmacists and Pharmacy Technicians to Person-Centred Care within a Medicine's Optimisation in Care Homes Service: A Qualitative Evaluation.* Pharmacy (Basel), 2021. **9**(1).
88. Arksey, H. and L. O'Malley, *Scoping studies: towards a methodological framework.* International Journal of Social Research Methodology, 2005. **8**(1): p. p. 19-32.
89. Richardson, W.S., et al., *The well-built clinical question: a key to evidence-based decisions.* ACP J Club, 1995. **123**(3): p. A12-3.

90. Snowden, M. and P. Roy-Byrne, *Mental illness and nursing home reform: OBRA-87 ten years later. Omnibus Budget Reconciliation Act.* Psychiatr Serv, 1998. **49**(2): p. 229-33.
91. Higgins JPT, et al., *Cochrane Handbook for Systematic Reviews of Interventions*. 2nd ed. 2019, Chichester (UK): John Wiley & Sons.
92. Liberati, A., et al., *The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions: explanation and elaboration.* BMJ, 2009. **339**: p. b2700.
93. Ryan Synnot, et al. *Cochrane Consumers and Communication Group Data extraction template for included studies*. 2016 November 29th]; Available from: https://cccrg.cochrane.org/author-resources.
94. Moher D, L.A., Tetzlaff J, Altman DG, The PRISMA Group. *Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement*. 2009 [cited PLoS Med 6(7): e1000097; Available from: http://www.prisma-statement.org/documents/PRISMA%202009%20checklist.pdf.
95. Hong QN, P.P., Fàbregues S, Bartlett G, Boardman F, Cargo M, Dagenais P, Gagnon M-P, Griffiths F, Nicolau B, O'Cathain A, Rousseau M-C, Vedel I, *Mixed Methods Appraisal Tool (MMAT)*. 2018: Canadian Intellectual Property Office, Industry Canada,.
96. Hoffmann, T.C., et al., *Better reporting of interventions: template for intervention description and replication (TIDieR) checklist and guide.* BMJ : British Medical Journal, 2014. **348**: p. g1687.
97. Lee, S.W.H., V.S.L. Mak, and Y.W. Tang, *Pharmacist services in nursing homes: A systematic review and meta-analysis.* British Journal of Clinical Pharmacology, 2019. **85**(12): p. 2668-2688.
98. Gartshore, E., J. Waring, and S. Timmons, *Patient safety culture in care homes for older people: a scoping review.* BMC Health Services Research, 2017. **17**(1): p. 752.
99. Chadborn, N.H., et al., *Quality improvement in long-term care settings: a scoping review of effective strategies used in care homes.* European Geriatric Medicine, 2020.
100. Ferrah, N., et al., *Death Following Recent Admission Into Nursing Home From Community Living: A Systematic Review Into the Transition Process.* J Aging Health, 2018. **30**(4): p. 584-604.
101. Gooen, L.G., *Medication Reconciliation in Long-Term Care and Assisted Living Facilities: Opportunity for Pharmacists to Minimize Risks Associated with Transitions of Care.* Clinics in Geriatric Medicine, 2017. **33**(2): p. 225-239.
102. Steurbaut, S., et al., *Medication history reconciliation by clinical pharmacists in elderly inpatients admitted from home or a nursing home.* Annals of Pharmacotherapy. **44**(10): p. 1596-603.
103. Vogelsmeier, A.A., J.R. Scott-Cawiezell, and G.A. Pepper, *Medication reconciliation in nursing homes: thematic differences between RN and LPN staff.* Journal of gerontological nursing, 2011. **37**(12): p. 56-63.
104. Koprivnik, S., et al., *Improving patient safety through a pharmacist-led medication reconciliation programme in nursing homes for the elderly in Spain.* International Journal of Clinical Pharmacy. **42**(2): p. 805-812.
105. Anderson, R. and R. Ferguson, *A nurse practitioner-led medication reconciliation process to reduce hospital readmissions from a skilled nursing facility.* Journal of the American Association of Nurse Practitioners, 2020. **32**(2): p. 160-167.

106. Achilleos, M., et al., *Pharmacist-led program to improve transitions from acute care to skilled nursing facility care.* American Journal of Health-System Pharmacy, 2020. **77**(12): p. 979-984.
107. Anderson, R. and R. Ferguson, *A nurse practitioner-led medication reconciliation process to reduce hospital readmissions from a skilled nursing facility.* J Am Assoc Nurse Pract, 2020. **32**(2): p. 160-167.
108. Cook, H., J. Parson, and N. Brandt, *Identifying Potential Medication Discrepancies During Medication Reconciliation in the Post-Acute Long-Term Care Setting.* J Gerontol Nurs, 2019. **45**(7): p. 5-10.
109. Koprivnik, S., et al., *Improving patient safety through a pharmacist-led medication reconciliation programme in nursing homes for the elderly in Spain.* Int J Clin Pharm, 2020. **42**(2): p. 805-812.
110. Krol, M.L., et al., *Health Optimization Program for Elders: Improving the Transition From Hospital to Skilled Nursing Facility.* J Nurs Care Qual, 2019. **34**(3): p. 217-222.
111. Vogelsmeier, A.A., J.R. Scott-Cawiezell, and G.A. Pepper, *Medication reconciliation in nursing homes: thematic differences between RN and LPN staff.* J Gerontol Nurs, 2011. **37**(12): p. 56-63.
112. Hong, Q., et al. *Mixed Methods Appraisal Tool (MMAT)*.
113. Shea, B.J., et al., *AMSTAR 2: a critical appraisal tool for systematic reviews that include randomised or non-randomised studies of healthcare interventions, or both.* BMJ, 2017. **358**: p. j4008.
114. Long, H.A., D.P. French, and J.M. Brooks, *Optimising the value of the critical appraisal skills programme (CASP) tool for quality appraisal in qualitative evidence synthesis.* Research Methods in Medicine & Health Sciences, 2020. **1**(1): p. 31-42.
115. Centre For Evidence-based Medicine. *Critical appraisal tool*. Available from: https://www.cebm.ox.ac.uk/resources/ebm-tools/critical-appraisal-tools.
116. Joanna Briggs Institute. *Critical appraisal tool*. Available from: https://jbi.global/critical-appraisal-tools.
117. Mays, N. and C. Pope, *Assessing quality in qualitative research.* BMJ, 2000. **320**(7226): p. 50-52.
118. Oremus, M., et al., *Inter-rater and test-retest reliability of quality assessments by novice student raters using the Jadad and Newcastle-Ottawa Scales.* BMJ Open, 2012. **2**(4).
119. Whiting, P., et al., *ROBIS: A new tool to assess risk of bias in systematic reviews was developed.* Journal of clinical epidemiology, 2016. **69**: p. 225-234.
120. Whiting, P.F., et al., *QUADAS-2: a revised tool for the quality assessment of diagnostic accuracy studies.* Ann Intern Med, 2011. **155**(8): p. 529-36.
121. Specialist Unit for Review Evidence (SURE). *Critical appraisal tools*. Available from: https://www.cardiff.ac.uk/specialist-unit-for-review-evidence/resources/critical-appraisal-checklists.
122. Achilleos, M., et al., *Pharmacist-led program to improve transitions from acute care to skilled nursing facility care.* Am J Health Syst Pharm, 2020. **77**(12): p. 979-984.
123. Boockvar, K.S., et al., *Medication reconciliation for reducing drug-discrepancy adverse events.* Am J Geriatr Pharmacother, 2006. **4**(3): p. 236-43.
124. Krol, M.L., et al., *Health optimization program for elders (HOPE)-improving transitions from hospital to skilled nursing facility.* Journal of the American Geriatrics Society, 2018. **66 (Supplement 2)**: p. S121.
125. Crotty, M., et al., *Does the Addition of a Pharmacist Transition Coordinator Improve Evidence-Based Medication Management and Health Outcomes in Older Adults*

Moving from the Hospital to a Long-Term Care Facility? Results of a Randomized, Controlled Trial. American Journal of Geriatric Pharmacotherapy (AJGP), 2004. **2**(4): p. 257-264.
126. Kuo, C.N., et al., *Pharmacist-directed reconciliation for reducing medication discrepancies: A pilot study in a nursing home setting in Taiwan.* Journal of Food and Drug Analysis, 2013. **21**(2): p. 160-164.
127. Hatton, K., et al., *Barriers and facilitators to pharmacists integrating into the ward-based multidisciplinary team: A systematic review and meta-synthesis.* Res Social Adm Pharm, 2021.
128. Bruce Bayley, K., et al., *Evaluation of patient care interventions and recommendations by a transitional care pharmacist.* Ther Clin Risk Manag, 2007. **3**(4): p. 695-703.
129. Meguerditchian, A.N., et al., *Medication reconciliation at admission and discharge: a time and motion study.* BMC Health Services Research, 2013. **13**(1): p. 485.
130. Ocloo, J., et al., *Exploring the theory, barriers and enablers for patient and public involvement across health, social care and patient safety: a systematic review of reviews.* Health Research Policy and Systems, 2021. **19**(1): p. 8.
131. Fitzpatrick, J.M. and V. Tzouvara, *Facilitators and inhibitors of transition for older people who have relocated to a long-term care facility: A systematic review.* Health & Social Care in the Community, 2019. **27**(3): p. e57-e81.
132. Ferguson, S., T. Howell, and P. Batalden, *Knowledge and skills needed for collaborative work.* Qual Manag Health Care, 1993. **1**(2): p. 1-11.
133. Lu, Y., et al., *Quality improvement through implementation of discharge order reconciliation.* Am J Health Syst Pharm, 2013. **70**(9): p. 815-20.
134. Hatfield, T.G., T.M. Withers, and C.J. Greaves, *Systematic review of the effect of training interventions on the skills of health professionals in promoting health behaviour, with meta-analysis of subsequent effects on patient health behaviours.* BMC Health Services Research, 2020. **20**(1): p. 593.
135. Redmond, P., et al., *Barriers and facilitators of medicines reconciliation at transitions of care in Ireland – a qualitative study.* BMC Family Practice, 2020. **21**(1): p. 116.
136. Rennke, S. and S.R. Ranji, *Transitional care strategies from hospital to home: a review for the neurohospitalist.* The Neurohospitalist, 2015. **5**(1): p. 35-42.
137. Rodehaver, C. and D. Fearing, *Medication Reconciliation in Acute Care: Ensuring an Accurate Drug Regimen on Admission and Discharge.* The Joint Commission Journal on Quality and Patient Safety, 2005. **31**(7): p. 406-413.
138. Bassi, J., F. Lau, and S. Bardal, *Use of Information Technology in Medication Reconciliation: A Scoping Review.* Annals of Pharmacotherapy, 2010. **44**(5): p. 885-897.
139. Bergkvist, A., et al., *Improved quality in the hospital discharge summary reduces medication errors—LIMM: Landskrona Integrated Medicines Management.* European Journal of Clinical Pharmacology, 2009. **65**(10): p. 1037-1046.
140. Schnipper, J.L., et al., *Effect of an electronic medication reconciliation application and process redesign on potential adverse drug events: a cluster-randomized trial.* Arch Intern Med, 2009. **169**(8): p. 771-80.
141. Werner, R.M., R.T. Konetzka, and D. Polsky, *The effect of pay-for-performance in nursing homes: evidence from state Medicaid programs.* Health Serv Res, 2013. **48**(4): p. 1393-414.

142. Werner, R.M., et al., *The effect of pay-for-performance in hospitals: lessons for quality improvement.* Health Aff (Millwood), 2011. **30**(4): p. 690-8.
143. Nuckols, T.K., et al., *Economic Evaluation of Quality Improvement Interventions Designed to Prevent Hospital Readmission: A Systematic Review and Meta-analysis.* JAMA internal medicine, 2017. **177**(7): p. 975-985.
144. Sebaaly, J., et al., *Clinical and Financial Impact of Pharmacist Involvement in Discharge Medication Reconciliation at an Academic Medical Center: A Prospective Pilot Study.* Hospital pharmacy, 2015. **50**(6): p. 505-513.
145. Midlöv, P., et al., *Medication report reduces number of medication errors when elderly patients are discharged from hospital.* Pharm World Sci, 2008. **30**(1): p. 92-8.
146. Varkey, P., et al., *An Experiential Interdisciplinary Quality Improvement Education Initiative.* American Journal of Medical Quality, 2006. **21**(5): p. 317-322.
147. Midlöv, P., et al., *Medication errors when transferring elderly patients between primary health care and hospital care.* Pharm World Sci, 2005. **27**(2): p. 116-20.
148. van Sluisveld, N., et al., *Medication reconciliation at hospital admission and discharge: insufficient knowledge, unclear task reallocation and lack of collaboration as major barriers to medication safety.* BMC Health Serv Res, 2012. **12**: p. 170.
149. Naylor, M.D., *Nursing intervention research and quality of care: influencing the future of healthcare.* Nurs Res, 2003. **52**(6): p. 380-5.
150. Geerligs, L., et al., *Hospital-based interventions: a systematic review of staff-reported barriers and facilitators to implementation processes.* Implementation science : IS, 2018. **13**(1): p. 36-36.
151. Makowsky, M.J., et al., *Collaboration between pharmacists, physicians and nurse practitioners: a qualitative investigation of working relationships in the inpatient medical setting.* J Interprof Care, 2009. **23**(2): p. 169-84.
152. Jeffers, H. and M. Baker, *Continuity of care: still important in modern-day general practice.* The British journal of general practice : the journal of the Royal College of General Practitioners, 2016. **66**(649): p. 396-397.

Appendix

Appendix 1. PubMed search to define the search terms

Databases	Searches	Results
PubMed, search 1	(Care home*[Title] OR nursing home*[Title] OR residential home*[Title] OR skilled-nursing facilit*[Title] OR assisted-living facilit*[Title] OR aged-care facilit*[Title]) AND (systematic review OR scoping review)	383
PubMed, search 2	(Care home*[Title] OR nursing home*[Title] OR residential home*[Title] OR skilled-nursing facilit*[Title] OR assisted-living facilit*[Title] OR aged-care facilit*[Title] OR Residential Facilit*[Title] OR Care Facili*[Title] OR home for the aged[Title] OR Old Age home[Title] OR Residential aged care[Title] OR Long term care[Title]) AND (systematic review OR Scoping review)	661
PubMed, search 3	((Care home*[Title] OR nursing home*[Title] OR residential home*[Title] OR skilled-nursing facilit*[Title] OR assisted-living facilit*[Title] OR aged-care facilit*[Title] OR Residential Facilit*[Title] OR Care Facili*[Title] OR home for the aged[Title] OR Old Age home[Title] OR Residential aged care[Title] OR Long term care[Title])) AND (reconciliation[Title])	18
PubMed, search 4	(((Care home*[Title] OR nursing home*[Title] OR residential home*[Title] OR skilled-nursing facilit*[Title] OR assisted-living facilit*[Title] OR aged-care facilit*[Title] OR Residential Facilit*[Title] OR Care Facili*[Title] OR home for the aged[Title] OR Old Age home[Title] OR Residential aged care[Title] OR Long term care[Title]) AND (reconciliation OR Review OR counselling OR History)) AND (Admission OR Admit OR transfer OR transition* OR Discharge OR entry)) AND (Drug* OR Medicine* OR Medication* OR Pharmaceutical)	166
PubMed, search 5	((((Care[Title] OR nursing[Title] OR residential[Title] OR skilled-nursing[Title] OR assisted-living[Title] OR Age[Title]) AND (Facili*[Title] OR Home*[Title] OR Long term[Title] OR Old Age[Title])) AND (reconciliation OR Review OR counselling OR History)) AND (Admission OR Admit OR transfer OR transition* OR Discharge OR entry OR enter*)) AND (Drug* OR Medicine* OR Medication* OR Pharmaceutical)	287

Appendix 2. Search strategy for PubMed

PICO tool			
	General term	**SEARCH 1**	**SEARCH 2**
P	Care home settings	Care home* OR nursing home* OR residential home* OR skilled-nursing facilit* OR assisted-living facilit* OR aged-care facilit* OR Residential Facilit* OR Care Facili* OR home for the aged OR Old Age home OR Residential aged care OR Long-term care [Title]	Care[Title] OR nursing[Title] OR residential[Title] OR skilled-nursing[Title] OR assisted-living[Title] OR Age[Title]) AND (Facili*[Title] OR Home*[Title] OR Long term[Title] OR Old Age[Title]
HITS		531,576	344,105
I		(reconciliation OR Review OR counselling OR History)) AND (Admission OR Admit OR transfer OR transition* OR Discharge OR entry)) AND (Drug* OR Medicine* OR Medication* OR Pharmaceutical)	(reconciliation OR Review OR counselling OR History)) AND (Admission OR Admit OR transfer OR transition* OR Discharge OR entry OR enter*)) AND (Drug* OR Medicine* OR Medication* OR Pharmaceutical)
HITS		37,853	44,084
C	n/a		
O	n/a		
FINAL HITS		166	287

Appendix 3. Databases searches

PICO tool	Search terms					
	General term	**PubMed**	**Ovid Embase**	**Ovid MEDLINE**	**PsycINFO**	**CINAHL complete**
P	Healthcare setting	(Care[Title] OR nursing[Title] OR residential[Title] OR skilled-nursing[Title] OR assisted-living[Title] OR Age[Title]) AND (Facili*[Title] OR Home*[Title] OR Long term[Title] OR Old Age[Title])	((Care or nursing or residential or skilled-nursing or assisted-living or Age) and (Facili$ or Home$ or Long term or Old Age)).ti.	((Care or nursing or residential or skilled-nursing or assisted-living or Age) and (Facili$ or Home$ or Long term or Old Age)).ti.	TI (Care OR nursing OR residential OR skilled-nursing OR assisted-living OR Age) AND TI (Facili* OR Home*OR Long term OR Old Age)	TI (Care OR nursing OR residential OR skilled-nursing OR assisted-living OR Age) AND (Facili* OR Home*OR Long term OR Old Age)
HITS		344,105	75,960	66,259	6886	73,365
I	Medicine-related intervention	(reconciliation OR Review OR counselling OR History)) AND (Admission OR Admit OR transfer OR transition* OR Discharge OR entry OR enter*)) AND (Drug* OR Medicine* OR Medication* OR Pharmaceutical)	((reconciliation or Review or counselling or History) and (Admission or Admit or transfer or transition$ or Discharge or entry or enter$) and (Drug$ or Medicine$ or Medication$ or Pharmaceutical)).af	((reconciliation or Review or counselling or History) and (Admission or Admit or transfer or transition$ or Discharge or entry or enter$) and (Drug$ or Medicine$ or Medication$ or Pharmaceutical)).af.	(reconciliation OR Review OR counselling OR History) AND (Admission OR Admit OR transfer OR transition* OR Discharge OR entry OR enter*) AND (Drug* OR Medicine* OR Medication* OR Pharmaceutical)	(reconciliation OR Review OR counselling OR History) AND (Admission OR Admit OR transfer OR transition* OR Discharge OR entry OR enter*) AND (Drug* OR Medicine* OR Medication* OR Pharmaceutical)
HITS		44,084	311,673	137,658	13,095	16,364
C	n/a					
O	n/a					
FINAL HITS		287	1597	788	51	570

Appendix 4. Extraction form

General review information

Review Title:

Study ID *(Surname of study authors)*:

Name of review author completing this form:

Date form completed:

Name of review author checking the data extracted to this form

Notes:

Characteristics

Year of study	
Country of study	
Quant / Qual / Mixed	
Methodology/ theoretical approach e.g. CRT, CT, B&A, Interviews, FGs	
Aim (s) of study and Research question(s)	
Method of data collection (if Applicable)	
Number of control groups	
Funding source (also any details about possible or explicit conflicts of interest)	
Other data or notes:	

Participants

Setting (Home, primary health centre, acute care hospital, care homes etc.)	
Number of settings	
City/state	

Age group		
Number of participants		
Methods of recruitment of participants (How were potential participants approached and invited to participate?)		
Withdrawn numbers and reason (e.g. Study participants)		
Other data or notes:		

Control group or baseline period: medicine-related documentation or management

Who delivered it (n)? (e.g. Nurse, Physician/GP, pharmacist, students)	
When did it happened (e.g. during transition, after arrival, after a few weeks)	
Service location (e.g. Administration room, residents' room etc). Was it done in a research setting or in the residents usual setting for receiving care?	
How did it happen/process (tools used, how was the information gathered, time duration)	
When outcomes measured? (If it is only during transition, before every doctor appointment etc.)	
Who collected data (Service provider or independent)	
Other data or notes:	

Intervention period: medicine-related documentation or management

Who delivered it (n)? (e.g. Nurse, Physician/GP, pharmacist, students)	
When did it happened (e.g. during transition, after arrival, after a few weeks)	
Service location (e.g. Administration room, residents' room etc). Was it done in a research setting or in the residents usual setting for receiving care?	
How did it happen/process (tools used, how was the information gathered, time duration)	

Who collected data (Service provider or independent)	
How was the intervention documented? Electronic / paperwork	
Other data or notes:	

Outcomes

Outcome	Result
Other data or notes:	

Reasons for intervention (usually in introduction) Problems trying to resolve

Why service needed	**Where found in paper**

Enablers for service (Maybe results if Qual, or in discussion)

What things were identified as making service effective?	**Where found in paper**

Barriers for service (Maybe results if Qual, or in discussion)

What things were identified as making service less effective?	**Where found in paper**

Other results or data:
For example:
• additional data collected only for some participants that may be important for understanding the effects of the interventions
• Other data that would be important to collect
• statements about the effects of interventions

Appendix 5. Topic guide based on the Template for Intervention Description and Replication

Rationale:
What was the aim/rationale of the intervention? Reasons for the intervention?

Resources:
Which resources was used, e.g pharmaaoutocmes, hospital papers? Who were contacted and how were they contacted? Was it given out any material to the resident/or where it could be assessed?

Provider:
Who were the provider and why were they chosen? How were they chosen and their background? Were they given any training in performing the intervention? Was it only one or more health professional involved during the intervention?

Procedures:
What was procedures? How was it documented (both during the intervention and documentation after completing the intervention)? (include any details about how the information was forwarded to other health facilities). How was the consultation content made?

Delivery:
How were the residents referred and approached? Methods of recruitment? Where there any reason for referral? Where they any inclusion or exclusion criteria for the resident

The follow-up consultation, what was the criteria? Why did they receive a follow-up consultation and how was it evaluated?

Locality:
Where did the intervention happen? What was the reason for choosing those hospitals? If it was not for the pandemic, where was it supposed to be undertaken, any type(s) of location(s) e./g consultation room?

When and How Much?
How many times were the intervention delivered, the time period? How long was session and did have time scheduled? When did the intervention happened? How many timed were it planned to happen or how often? How was the follow-up consultation happen, was it the same time period? E.g time period after discharge

Tailored or personalised:
Was the template tailored to the resident and the answer/residents need?

Modifications:
Was there any modification of the referral form? Was the intervention modified during the study time? What were the changes

How Planned:
How was this project presented for the hospital staff? How was the plan tested?
Did it happen according to the planned methodology?

How well

Planned: If intervention adherence or fidelity was assessed? How and whom? Where the involved provider encourages to perform the intervention? How and by whom? Where there any strategies used to maintain or improve fidelity(description) e. g monitoring?

Actual: If intervention adherence or fidelity was assessed, describe the extent to which the intervention was delivered as planned?
Who is the key stakeholder?

Other:
Reason for not completing the intervention. Withdrawn number?