

**Assessing the Effectiveness of Pharmacist-Initiated
Strategies on Prescription Errors and Drug-
Associated Problems among Geriatric Patients
within a Hospital Setting: A Systematic Review**

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ADE	“Adverse Drug Event”
ADR	“Adverse Drug Reaction”
BPMH	“Best Possible Medical History”
CMR	“Comprehensive Medicines Reconciliation”
COPD	“Chronic Obstructive Airway Disease”
CPOE	“Computerised Provider Order Entry”
CNS	“Central Nervous System”
CVS	“Cardiovascular System”
DEPICT	“Descriptive Elements of Pharmacist Interventions Characterisation Tool”
FINERMAPS	“Feasibility, Interesting, Novel, Ethical, Relevant, Manageable, Appropriate, Potential Value, Systematic”
GRADE	“Grading of Recommendations, Assessment, Development and Evaluations”
HF	“Heart Failure”
IPET	“Improved Prescribing in the Elderly”
IV	“Intravenous”
MAI	“Medication Appropriateness Index”
NSAID	“Non-Steroidal Anti-inflammatory Analgesic”
PICOT	“Population, Intervention, Comparison, Outcome, Time Frame”
PPI	“Proton Pump Inhibitor”
PRISMA	“Preferred Reporting Items for Systematic Reviews and Meta-Analyses”
QoL	“Quality of Life”
RCT	“Randomised Control Trial”
SHiM	“Structured History Taking of Medicines”
SOPs	“Standard Operating Procedures”
START	“Screening Tool Alert to Right Treatment”
STOPP	“Screening Tool for Older People’s Prescriptions”
TDM	“Therapeutic Drug Monitoring”

Abstract

Background

Geriatrics are a special subgroup of patients, usually subjected to multiple medications and inappropriate prescribing, complicated by comorbidities. This research sought to assess the influence of pharmacist-initiated strategies on prescribing errors and other drug-related issues among the elderly in hospitals either as outpatients or hospitalised patients.

Methods

Prospective interventional studies, that were randomised or otherwise, involving 9016 patients, were included. Only interventional study articles in English published between 2017 and 2022, free text searched from “google scholar” and “PubMed” were part of the study. The risk of bias was examined with the aid of a tool designed from an idea from the CLARITY Group at McMaster University, which was modified and adapted.

Results

A sum of 97 articles was identified, 50 on google scholar and 47 on PubMed. After screening, removal of duplicates, disqualification for various reasons and a hand search, 11 articles were eligible. A total of 9016 patients aged at least 60 years, both male and female were involved. Most studies reported a decrease in DRPs and ADRs and improved QoL following pharmacist interventions. However, drug-associated hospitalisation was not affected by the interventions. The acceptance rate was high (median = 80%).

Conclusion

Pharmacist interventions impact the quality of prescribing and reduce DRPs and ADR but have no impact on hospital admissions.

Keywords: Prescribing error, geriatric, drug-related problems, older patients, pharmacist interventions, pharmacist-initiated strategies, high-risk medicines, geriatric care, geriatric medicine, randomised controlled trial, interventional study, pharmaceutical care and hospital setting.

1. Introduction

1.1. Background and Rationale

Given the vulnerability of older patients to errors and drug-related issues, coupled with polypharmacy and multimorbidity, what is the evidence that pharmacists' interventions can significantly reduce prescribing errors and enhance clinical endpoints? Through development in the clinical scope of pharmacists in recent times, the functions of pharmacists have grown and their initiatives have become central to the patient treatment plan by simplifying drug treatment and curbing patient harm (Cortejoso, Dietz, Hofmann, Gosch & Sattler, 2016). Gallagher, Lavan, & O'Mahony (2016) concur with this assertion, adding that pharmacists position themselves to recognise and detect prescription errors by reconciling patients' medicines. Furthermore, according to Gallagher, Lavan, & O'Mahony (2016), pharmacists offer advice on error rectification by way of feedback to prescribers, which is particularly important if the error is knowledge-based. Cortejoso, Dietz, Hofmann, Gosch, & Sattler (2016) suggest that having a pharmacist as part of a collaborative approach to patient management could enhance outcomes and lower mortality, particularly in discharging the patient and in critical care environments (Gallagher, Lavan, & O'Mahony, 2016). Although Cortejoso, Dietz, Hofmann, Gosch & Sattler (2016) bemoan the poor development of the patient-oriented practice by clinical pharmacists in Europe, Alshehri, Kutbi, Lee & Martin (2015), indicate that pharmacists now gradually participate in primary care designs that pay special attention to high standards and safety. This shifting of pharmacists' responsibilities from the traditional issuance of medicines is the trend worldwide, including in developing countries (Alshehri, Kutbi, Lee & Martin, 2015). According to Al Ansari, Aljasmi & Almalood (2017), inappropriate antibiotic prescriptions can negatively impact older patients and unwarranted hospitalisations, consequently leading to errors.

Pharmacists positively influence a variety of clinical outcomes in a broad array of disease states, including in elderly individuals (Alshehri, Kutbi, Lee & Martin, 2015). Pharmacists are frequently involved in drug therapy for lifelong conditions such as providing care to diabetics, hypertensive patients and those with heart disease. When reviewing chronic conditions provisions by pharmacists, researchers often aim to measure the effects on patient compliance, condition containment as seen through clinical markers, care services usage (e.g., hospitalisation) and medical expenses (Alshehri, Kutbi, Lee & Martin, 2015). Research has demonstrated that pharmacists can enhance the precision of information regarding patients' medication upon reconciling insufficient medication records, which cause at least a

quarter of hospitals' prescription errors (Cortejoso, Dietz, Hofmann, Gosch, M. & Sattler, 2016). Since geriatric patients suffer from co-morbidities and receive multiple medicines, they are the primary beneficiaries of pharmacist-initiated error management strategies (Alshehri, Kutbi, Lee & Martin, 2015; Berhe, Gidey, Gudina, Hailu, & Getachew, 2020). Several countries have reported multiple drug use, coupled with prescriptions of inappropriate medicines (Alshehri, Kutbi, Lee & Martin, 2015). Geriatric patients are a unique patient population requiring specialised care, including pharmaceutical care (Berhe, Gidey, Gudina, Hailu, & Getachew, 2020) It is imperative that, as professionals, clinical pharmacists should undergo advancement in geriatric care and drug management (Gallagher, Lavan, & O'Mahony, 2016). It is crucial to enhance ways of caring for the elderly, including pharmaceutical care, to realise better ageing in society. By improving pharmaceutical care for geriatrics, the aim is to build a healthy, geriatric population that can live productive and comfortable lives by participating in and contributing to the community. The findings will be shared with the relevant pharmaceutical body and recommendations may be adopted to reduce prescribing errors among geriatric patients, leading to improved quality of life.

1.2 Aim

To assess the impact of pharmacist-initiated strategies in recognising, detecting and mitigating prescription errors and drug-related issues as well as improving geriatric patient outcomes in a hospital environment.

1.3 Objectives

1. To quantify the prevalence of prescription errors and drug-related issues among older patients;
2. To explore the acceptance of pharmacist-initiated strategies and tools to reduce prescribing errors and manage drug-related issues in older patients;

1.4 Research Questions

The research questions derived from the topic are as follows:

1. Can pharmacists' interventions significantly reduce prescribing errors and improve outcomes among geriatrics?
2. What is the frequency of drug-associated challenges in the older patient population?

1.5 Conditions

The research questions followed the "Population, Intervention, Comparison, Outcome, Time frame (PICOT)" method:

- Population – Geriatric Patients

- Interventions – Pharmacist-initiated strategies
- Comparison – Without geriatric pharmaceutical care
- Outcome – Effect on prescription errors and drug-related issues
- Time frame – Duration of data collection is guided by the length of the project

The research questions were further tested for conformity with “Feasibility, Interesting, Novel, Ethical, Relevant, Manageable, Appropriate, Potential value and publishability, Systematic (FINERMAPS)” The research is exploratory as well as hypothesis-generating. The research followed a clearly defined strategy of PRISMA.

2. Literature Review

Drug therapy is a complex issue in geriatric care since the elderly are susceptible to drug interactions, underdose, overdose, poor outcomes and adverse reactions. In a study by Berhe, Gidey, Gudina, Hailu & Getachew (2020), drug-related issues were identified in more than 80% of geriatric patients. Many studies have found that pharmacist-led interventions improve drug safety throughout the care process, implying that pharmacists play a crucial part in treating older patients (Ajaz et al (2022)). This literature review will examine the definition and inappropriate prescribing in geriatrics. The paper will delve into high-risk medicines and an overview of inappropriate prescribing tools as well as pharmacist-initiated interventions and their outcomes.

2.1 Defining Prescribing error

The “Delphi technique” became instrumental in establishing a valid definition, championed by health professionals, determining if particular types should be accepted as prescribing errors (Barber, Dean & Schachter, 2000). Their adopted final definition is “*A clinically meaningful prescribing error occurs when, as a result of a prescribing decision or prescription writing process, there is an unintentional significant (1) reduction in the probability of treatment being timely and effective or (2) increase in the risk of harm when compared with generally accepted practice*” (Dean & Schachter, 2000). Barber et al. (2012) highlight crucial facts regarding a definition, adding that there should be appropriateness to context and it is not the same as classifying, a point also underscored by Aronson & Ferner (2006). They further point out the confusion in the literature regarding the use of words, with different or same meanings depending on the author(s). However, Aronson & Ferner (2006); Aronson (2009) and Ferner (2009) criticise the “Delphi technique”, stressing that establishing a definition using general agreement procedures such as the Delphi process is incorrect since

it is portrayed as a panel definition. Aronson & Ferner (2006) argue that it is crucial to detect all errors even if they are of no clinical significance since any form of error points to a weak system, which Aronson (2009) corroborates. Aronson & Ferner (2006) associate an error with incompetence in the process whether or not it actually leads to patient harm or merely creates an opportunity for harm to occur.

2.2 Inappropriate Prescribing in Geriatrics

A simple approach to defining appropriateness or otherwise includes whether or not a medicine is safe considering its physicochemical characteristics, and whether or not cost-effectiveness is derived from its prescription (Gallagher O'Connor & O'Mahony, 2012).

However, a more comprehensive technique for appropriate prescribing in geriatrics takes into account:

- Life expectancy of the individual;
- Limiting preventive therapy to those with a good prognosis;
- Promotion of the use of medicines that are beneficial compared to risks;
- Co-morbidities and patient's cognitive status (Gallagher & O'Mahony, 2008).

Furthermore, according to Gallagher O'Connor & O'Mahony (2012), ensuring appropriate prescribing in the elderly should adequately cover the following areas:

- *Overprescribing* – inclusion of unnecessary medicines with no clear indication;
- *Underprescribing* – Omitting medicines that are considered to have a potential clinical value to the patient;
- *Misprescribing* – Prescribing a drug with a considerable chance of triggering an adverse reaction.

Due to the direct effect on morbidity and mortality and healthcare resources, inappropriate prescribing is considered a public health issue (Gallagher & O'Mahony, 2008). The prescriber must be acquainted with the pharmacokinetic and pharmacodynamic changes in older patients for appropriate prescribing, limiting adverse effects (Ocampo-Candiani, Pena-Lazo, Tamez-Pena, Tamez-Perez & Torres-Perez, 2014).

A study by Faustino, Jacob-Filho & Martins (2011) highlights that the frequency of potentially inappropriate medicines in the age range 60-69 years, was 49.9 per cent, followed by the 70-79 years age range with nearly 35%. According to Rochon (2021), elderly people above 65 years, taking anticholinergic medicines, have a greater chance of suffering from dementia and cognitive problems, while females were more likely to get prescription errors than males (Jacob-Filho & Martins, 2011). Nearly a third of all hospitalisations of the elderly

are due to the toxicity of medicines (Ocampo-Candiani, Pena-Lazo, Tamez-Pena, Tamez-Perez & Torres-Perez, 2014), and 67 per cent of those hospitalisations are linked to insulin, warfarin, oral antidiabetics and antiplatelets (Rochon, 2021). In the elderly, vulnerability to drug interactions is high, often due to comorbidities and polypharmacy (Rochon, 2021). Just under a third (30%) of geriatric hospitalisations are related to drug toxicity producing avoidable issues like falls, injuries, constipation, confusion and depression (Ocampo-Candiani, Pena-Lazo, Tamez-Pena, Tamez-Perez & Torres-Perez, 2014). Between 3 and 10 per cent of hospitalisations in geriatrics are due to ADRs and are considered preventable, in most cases (Rochon, 2021). Geriatrics, in particular, are susceptible to adverse events attributable to anticholinergic drugs which can precipitate glaucoma and urinary retention in those at risk (Rochon, 2021).

2.3 High-Risk Medicines

Table 1 represents “high-risk” medicines that must be kept away from geriatrics, according to Gallagher & O’Mahony (2008):

1	Loop diuretic in peripheral oedema only, without heart failure signs.
2	Thiazide diuretics in gout (Attacks can be worsened).
3	Aspirin for treatment of dizziness not related to cerebrovascular disease
4	Tricyclic anti-depressants in glaucoma.
5	More than a month on neuroleptics as hypnotics (potential to cause disorientation, low blood pressure, “extrapyramidal side-effects”, falls).
6	Anticholinergic drugs for the treatment of “extrapyramidal side-effects” of antipsychotics (possibility of anticholinergic harm).
7	Prochlorperazine in Parkinsonian disease (likely to exacerbate Parkinsonism).
8	PPI in peptic ulcers at maximum dose for >2 months (reducing the dose or early discontinuation indicated).
9	Theophylline, as a single drug in COPD (limited safety range).
10	“Non-steroidal anti-inflammatory drugs (NSAIDs)” with high blood pressure (possibility of worsening high blood pressure).
11	NSAID in HF (possibility of worsening).
12	NSAID in poor kidney failure (kidney function may deteriorate).
13	Alpha-blockers in male patients with poor urinary control (worsening of condition likely).

14	“Beta-blockers” in diabetics with recurring hypoglycaemia (potential masking of hypoglycaemia).
15	Oestrogens, with a record of “venous thromboembolism” (likely to recur).
16	Neuroleptics and repetitive falls (likely to induce gait dyspraxia and Parkinson’s disease, causing more falls).
17	Vasodilators unrelenting postural hypotension (possibility of syncope and falls).
18	Long-term (≥ 12 weeks) on opioids in chronic constipation with no simultaneous use of laxatives (likelihood of severe constipation).
19	Any duplication of drugs in the same group (a single drug trial is worthwhile before considering another option).

2.4 Inappropriate Prescribing Tools

Expert committees have crafted several tools for evaluating the appropriateness of prescribing tendencies and the utilisation of pharmaceuticals in elderly individuals (Rochon, 2021). The primary aim of developing the criteria, by consensus, was to reduce challenges that result from inappropriate prescriptions in older adults (Ocampo-Candiani, Pena-Lazo, Tamez-Pena, Tamez-Perez & Torres-Perez, 2014).

2.4.1 Beers Criteria

The Beers assessment tool (Ocampo-Candiani, Pena-Lazo, Tamez-Pena, Tamez-Perez & Torres-Perez, 2014; Rochon, 2021), which was first pioneered in 1991, reviewed in 1997 and updated in 2019, is the most broadly utilised criteria to assess prescription quality in geriatrics. Drugs are categorised into five classes:

- Potentially inappropriate to the majority of geriatrics
- Those that need to be avoided in certain disease states
- Dose alteration in line with renal function
- Medicines that require a cautious approach
- Drugs involved in known interactions (Rochon, 2021).

Despite its usefulness, Ocampo-Candiani, Pena-Lazo, Tamez-Pena, Tamez-Perez & Torres-Perez (2014) point out that it is limited by the fact that some drugs identified as inappropriate may be beneficial, while included drugs may be risky to administer. Although Rochon (2021) asserts that Beers criteria are limited by its inclination towards the US clinical environment, Gallagher O’Connor & O’Mahony (2012), note that it has been applied across Europe by quantifying the frequency of inappropriate prescriptions in the elderly. This tool, however,

does not deal with *underprescription* of important medicines, duplication and drug interactions, which are crucial in geriatric prescribing (Gallagher O'Connor & O'Mahony, 2012). Drugs normally associated with adverse events are anticoagulants, diuretics, NSAIDs, cardiovascular, steroids, antidiabetics, benzodiazepines and anticholinergics (Ocampo-Candiani, Pena-Lazo, Tamez-Pena, Tamez-Perez & Torres-Perez, 2014).

2.4.2 START/STOPP Tool

Two implements, "Screening Tool for Older Persons' Prescriptions (STOPP)" and "Screening Tool to Alert to Right Treatment (START)" (Tamez-Perez & Torres-Perez, 2014; Gallagher, O'Connor & O'Mahony, 2012; Ocampo-Candiani, Pena-Lazo, Tamez-Pena; Rochon, 2021) were designed in 2008. While STOPP and Beers methods overlap in some areas, the former takes into account medicine duplicates within a pharmacologic group and drug interactions (Rochon, 2021). START/STOPP has been deployed in various geographical and clinical settings across the globe and has shown reliability among physicians and pharmacists (Gallagher O'Connor & O'Mahony, 2012). However, the START/STOPP tool is difficult to apply to older psychiatric patients as it considers psychotropic drugs inappropriate (Aguilar, da Costa & Marques, 2021). Furthermore, the appropriateness of prescriptions revolves around consensus, which has a very low ranking on the hierarchy of evidence (Aguilar, da Costa & Marques, 2021).

2.4.3 Fit FOR The Aged

This is a patient-focused approach to listing medicines, developed in 2008 to enhance drug therapy in the elderly (Pazan & Wehling, 2020). The list of medicines is categorised as follows:

- beneficial to the patient;
- Proven but safety and efficacy issues arise;
- Questionable benefit and safety;
- Avoid and replace with a substitute (Rochon, 2021).

2.4.4 Tool Comparison

Comparison of tools, according to Gallagher, O'Connor & O'Mahony (2012) are listed in table 2 below:

Tool	Origin	Validation Approach	Target Population	Advantages	Disadvantages
Beers	US	Expert consensus	≥ 65 years	Brief deals with common medicines.	Some medicines are not available outside the US and do not address drug interactions and duplicates.
McLeod's	Canada	Expert consensus	≥ 65 years	Brief and suggests better substitutes.	Some indicators are obsolete, and some medicines are unavailable in other countries.
"Improved Prescribing in the Elderly (IPET)"	Canada	Based on McLeod's	≥ 70 years	Brief	Mostly CVS and CNS drugs, lack comprehensiveness and do not address under prescription.
Zhan's method	US	Expert consensus	Ambulatory, ≥ 70 years	Less restrictive	Does not address under-prescription and drug interactions
START/STOPP	UK, Ireland	Expert consensus	≥ 65 years	Includes under prescriptions, duplicates and drug interactions	Does not include substitutes, formulation, indication and cost.
Priscus List	Germany	Expert consensus	≥ 65 years	Includes alternatives, dose	Limited to German settings.

				adjustments and TDM.	
“Australian Prescribing Indicators Tool”	Australia	No validation	≥65 years	Duplication and under-prescription are considered.	Lacks validation, is limited to Australia, time-consuming.
Rancourt	Canada	4-member expert panel	≥65 years	Duplication and under prescription included.	Criteria are too broad; data becomes available only on chronic care.
“Norwegian General Practice (NORGEPI)”	Norway	Expert panel consensus	≥70 years	No clinical information is necessary to apply to the medication list.	Underprescribing and drug interactions are not addressed, limited outside Norway.

2.5 Risk Factors

The nature of the medications and the accompanying group actions are the biggest and most important contributing factors, yet there is no way to estimate the risk involved with a single medicine or its class based on academic records (Marriott & Suggett, 2016). Multiple drug therapy (Arun, Ay, Ertuna, Gokdemir, Kocak, & Ispirli, 2019; Divasish, Gayathri, Hup, Prasath & Soni, 2018; Marriott & Suggett, 2016), administration of intravenous drugs at home and ageing are associated with errors and problems (Divasish, Gayathri, Hup, Prasath & Soni, 2018). Compromised renal or hepatic function, common in the elderly, are other risk factors although they are associated specifically with renally or hepatically excreted drugs (Marriott & Suggett, 2016). However, the effect of specific medical conditions, poor knowledge of pharmacology, gender and age, is controversial, according to Fonts et al. (2021).

2.6 Causes

Prescribing problems can be categorised as knowledge-associated or rule-associated mistakes, lapses and slip-ups (Alanazi, Lewis & Tully, 2016). Poor medicine or dose selection as well as lack of communication between healthcare workers or between the healthcare worker and the patient (Divasish, Gayathri, Hup, Prasath & Soni, 2018) have been

cited as causes of errors and problems. High workload, coupled with rotation among junior doctors, who do most of the prescribing, increases the risk of errors (Gallagher, Lavan, & O'Mahony, 2016). Logistical problems in the pharmacy, including unavailability of medicines, may be a source of prescribing errors (Divasish, Gayathri, Hup, Prasath & Soni, 2018). Gallagher, Lavan, & O'Mahony (2016) divide causes of errors into the individual, team, work and task-related categories as in Table 3 below:

Team and individual	<ul style="list-style-type: none"> • Lack of prescriber's awareness of medicines • Lack of prescriber's awareness of patient's multiple disease states • Relegating prescribing to junior members without close supervision
Patient Issues	<ul style="list-style-type: none"> • Lack of patient awareness of medicines • Patient not volunteering certain information regarding medicine use • Patient unable to relay medicine use information • Patient's multiple disease states
Work/Environment Issues	<ul style="list-style-type: none"> • Poor staffing • Improper time allocation to prescribing • Uncomfortable workload • Lack of access to pharmacist or physician after hours
Task Associated Issues	<ul style="list-style-type: none"> • Prescription type • Poor handwriting • Lack of clarity of the information to pharmacist and patient

2.7 Pharmacist-initiated Interventions

Courtemanche et al. (2022) describe eight important pharmacist-initiated interventions summarised in table 4 below:

Point of Care	Intervention	description
Admission and Hospitalisation	Medication Reconciliation	A comprehensive history of medicine use including home remedies and comparing list with prescriber's order.
	Pharmaceutical care	Patient assessment, identifying drug problems, care plan establishment and follow up.
	Patient Education	Interactive provision of disease or drug-related information directly to patient or caregiver.
	Interdisciplinary Care	Pharmacist presence and interactions through interventions, enhancement of drug therapy management and patient outcomes.
Discharge	Pharmaceutical Care	Patient assessment, enhancement of adherence, optimisation of drug therapy, and the transmission of the care plan to the next caregiver.
	Medication Reconciliation	Best possible medicine use compilation in comparison with discharge prescription.
	Patient Education	Complete information to patient or caregiver ensures

		safe medication use and reiterates the importance of adhering to the care plan.
After discharge	Follow up	Assessing patient knowledge and compliance, adherence counselling and updating medication list.

These interventions are underpinned by pharmaceutical care, the backbone of clinical pharmacy, involving pharmacists' activities that contribute to individual patient care to optimise the use of medicines and enhance outcomes (Arun et al., 2019). According to Brien, McLachlan & Mekonnen (2016), unwarranted medicine list discrepancies account for more than 50% of errors at transition care points affirming medicines reconciliation as a crucial intervention. Alhahwassi, Alhwaibi, Alzahrani, Asiri & Kamal (2021) have 12 separate types of interventions:

1. Prevention of ADEs;
2. Withdrawal of contraindicated drugs;
3. Dose modifications;
4. Drug interaction prevention;
5. Changing IV to oral formulation;
6. Withdrawal of medicines not indicated;
7. Treatment monitoring optimisation;
8. Adjusting according to renal function;
9. Controlled medicines approval;
10. Duplication prevention;
11. Suggesting treatment for untreated conditions;
12. Other interventions not fitting the above criteria.

In a study by Arun et al (2019), the acceptance rate of pharmacist strategies and suggestions to resolve DRPs was 86.36%, which is quite high. This is in line with a study in Ethiopia by Berhe, Gidey, Gudina, Hailu & Getachew, (2020), who report a rate of 91.7% although, in a study by Alabdan et al (2019), the rate stands at 40.1%.

However, Courtemanche et al (2022) bemoan the lack of clarity on the challenges in applying these interventions in geriatrics and poor knowledge of their incorporation into clinical

practice. In contrast, studies by Anzuoni et al (2021) and Bertilsson et al. (2021) failed to demonstrate the impact of CMRs that incorporated follow up after discharge, on hospital visits. The Bertilsson et al. (2021) trial was on a much larger scale with two interventional groupings involving 2637 elderly patients compared to only 361 in the Anzuoni et al (2021) study. This identifies a gap as to which intervention or set of interventions influences which clinical outcomes taking into account the conditions under which they are delivered.

2.8 Outcomes

In recent years, research has emerged to evaluate the effectiveness of pharmacist-driven approaches in geriatric patient outcomes. A study by Ali, Azhar, Babar, Curley, Kousar, & Murtaza (2017) concluded that pharmaceutical care is effective in lowering hospital admissions and additional outcomes relating to a specific disease. This view is shared by Buck et al. (2018) and Bermejo et al. (2022), who further state that cost savings relating to hospitalisation, are realised, more so in those at moderate or high risk of preventable hospitalisation. Other study reports (Adam et al., 2021; Elwyn, Huws, Huntley, Mann & Thomas, 2014) suggest that pharmacist-initiated strategies do not influence the rehospitalisation of geriatrics with cardiac failure. Research by Aguiar, Colombo & Lima (2017) reports a marked symptomatic relief of cancer-associated symptoms following pharmacist interventions. The quality of life as assessed through the appropriate questionnaire improved following interventions (Adam et al., 2021; Ali, Azhar, Babar, Curley, Kousar, & Murtaza (2017). A study by Chisholm-Burns, Ehrman, Lee & Martin (2013) concluded that pharmacist-initiated strategies have a desirable influence on safety, treatment, adherence and hospitalisation outcomes in the elderly. An updated review by Bradley et al. (2018), involving 32 studies, reported neither improvement in prescription appropriateness nor a reduction in hospitalisation. However, the studies were marred by poor methodological rigour and as such certainty of the evidence was either weak or very weak.

2.9 Summary

The definition of prescribing errors was given using the “Delphi technique” and should include both clinically significant and minor errors. Through error analysis, prescription errors can be classified according to the occurrence or the likely consequence. Certain medicines, old age, poor kidney and liver function, as well as polypharmacy, are some of the prominent risk factors. Poor communication and high workload, particularly among junior doctors, are cited as some of the causes of errors and drug-related issues. To minimise errors, medicine reconciliation, use of prescription assessment tools, computerisation and education

for both practitioners and patients, can be utilised. A plethora of studies suggest that pharmacist-led interventions improve drug safety throughout the care process, implying that pharmacists perform an important role in the treatment of the elderly. Inappropriate prescribing is regarded as a public health problem as it affects morbidity and mortality and the consumption of healthcare resources. Potentially inappropriate medicines are prescribed most in the 60–69-year age group. Expert committees have created several tools for evaluating the appropriateness of prescribing tendencies and pharmaceutical use in elderly individuals. These include the Beers criteria, Fit for the Aged, START/STOPP tool and the IPET tool. Although the tools are quite useful in reducing prescribing errors, they have limitations, particularly transferability between settings. Pharmacist-initiated interventions, which underlie pharmaceutical care, are the foundation of clinical pharmacy and contribute to patient care by optimising drug therapy and enhancing clinical outcomes. Medicines reconciliation, involving a comprehensive listing of patients' medicines at discharge, during the hospital stay, at discharge and post-discharge, is the single most important intervention by pharmacists.

3 Materials and Methods

PRISMA guidelines were utilised to document findings in this research. The PICOT method was deployed in formulating the research questions and search terminology.

Population – Geriatric patients aged 60 years or older as either inpatients or outpatients in a hospital setting. Care homes were excluded as a study by Alldred, Chen, Hughes, Kennedy, & Miller (2016) comprehensively addresses this issue.

Intervention – Pharmacist-initiated strategies were described as any strategy in which the pharmacist plays a pivotal function to reduce and address errors and drug-related issues (Byrne, Galvin, Kearney, Riordan, Sinnott & Waklsh, 2016).

Comparison – The comparison will be patients without the pharmacist-initiated interventions or receiving standard care.

Outcome – The primary outcomes of interest was a change to safe prescribing and a reduction in drug-related issues and errors detected. Secondary outcomes entailed a change in the clinical course of the disease and subjective or objective information volunteered by the patient that included improved quality of life.

3.1 Search Strategy and Sources

Databases searched were:

1. “PubMed <https://pubmed.ncbi.nlm.nih.gov/>”, Filters (“Full text”, “Randomised Control Trial”, “5 years”)
2. “Google Scholar <https://scholar.google.com/>”, Filters (“Custom, 2017-2022”)

Suitable keywords that were used to conduct the electronic search are but are not limited to: Prescribing error, geriatric, drug-related problems, older patients, pharmacist interventions, pharmacist-initiated strategies, high-risk medicines, geriatric care, geriatric medicine, randomised controlled trial, interventional study, pharmaceutical care and hospital setting. Sorting according to relevance, together with filters was applied to avoid large volumes of irrelevant articles. A hand search of some of the references in selected papers of interest was also conducted.

3.2 Inclusion Criteria

Studies from 2017 to 2022 were included. The population of interest was 60 years and above, both male and female. Articles in the English language were included as there were no translation services available to the researcher. All interventions that are pharmacist-initiated form part of the study. Included were studies relating to prescriptions by doctors, notwithstanding their qualifications or experience. Study papers available for free as a full text were included. The browser extension “unpaywall” was deployed to quickly check the availability of free full-text articles in the databases. Randomised Control Trials and prospective interventional trials were included.

3.3 Exclusion Criteria

Prescriptions by nurses and pharmacists were not included. Articles earlier than 2017 were excluded to examine fairly recent articles. Paediatric prescriptions and those of adults less than 60 years were excluded from this study. Case reports and systematic review papers did not form part of this research.

The exclusion and inclusion criteria deployed are summarised in table 5 below:

Criteria	Included	Excluded
Language	English	Other languages

Population	≥ 60 years	<ul style="list-style-type: none"> • Paediatrics • Adults < 60years
Setting	Hospital outpatients Hospital inpatients	Care homes
Period	2017-2022	Before 2017
Study Design	RCTs, Prospective Interventional studies	Unpublished, Blogs, Ongoing trials, Systematic reviews, Ongoing Studies and Retrospective Interventional Studies.
Intervention	Pharmacist-led	Non-Pharmacist initiated
Prescribers	Junior doctors, Senior doctors, Physicians and Specialists.	Pharmacists and Nurses.
Article Status	Free, Open access and full text.	Abstract only, full article available for a fee.

3.4 Data Extraction

The entire paper of each report was read and relevant data were extracted. Data extraction was anchored on research design, inclusion and exclusion methods, demographic considerations, strategies and their comparisons and outcome metrics employed. A standard data extraction tool derived from “Cochrane checklist for Systematic Reviews of Interventions” (Chandler, Cumpston, Higgins, Thomas, Page & Welch, 2021) was the basis upon which a variation (Annexure 1) was constructed and adopted. Important information captured included:

- Author/Year or citation
- Country
- Setting
- Demographics (e.g., age, gender)
- Study type (Randomised Control Trials, Prospective Interventional Studies)
- Aims and Objectives of the study
- Number of participants enrolled including withdrawals/Lost to follow up/Deaths
- Disease characteristics

- Comorbidities
- Interventions and their characteristics
- Comparators
- Outcomes, including non-clinical outcomes, and their characteristics.

The form links what has been reported in the research papers and what is being reviewed (Deeks, Huggins & Li (2022) in this study. The data collection form promotes consistency, is straight forward and is available in an electronic excel format. The tool is closely related to the research questions, the methods of assessing which papers are eligible and acts as a starting point in data analysis. The “quality” of the presented reports was examined through the form “Risk of Bias”. The “Risk of Bias form” was designed using ideas from “The Cochrane Risk of Bias tool” (Chandler, Cumpston, Higgins, Thomas, Page & Welch, 2021) which is an important implement designed to evaluate potential bias. While the “Cochrane review risk of bias form” may be considered the “gold standard”, it is cumbersome and requires rigorous training to familiarise with its various fields. It was, therefore, not feasible to deploy it here, given the limited time within which data had to be collected. However, the general idea in its provisions, together with information from “CLARITY Group at McMaster University: <https://www.evidencepartners.com/resources/methodological-resources/tool-to-assess-risk-of-bias-in-randomized-controlled-trials-distillersr>” were considered in designing the form for assessing potential bias. The risk of bias tool (Annexure 2) contains 10 questions, each with four possible responses. The responses were then allocated points from 1 to 4, with 1 depicting the lowest and 4 the highest risk. The total number of points for each study paper was then calculated. Points 10-20 were considered “low risk”, 21-30 “moderate risk” and 31-40, “high risk”. All the data extraction tools were piloted by collecting data from a few studies.

3.5 Data Analysis

The literature review revealed that the studies are quite heterogeneous and therefore meta-analysis was not feasible. Data analysis followed a narrative synthesis also referred to as “Synthesis Without Meta-analysis (SWiM)” (Brennan et al. (2020). How strong presented evidence is, exploration of consistency of results across studies as well as investigations into reasons for any deviations, were considered. The reporting methods combined both PRISMA (Bossuyt et al., 2021) and SWiM guidelines (Bossuyt et al., 2021). Heterogeneity was investigated by way of tabulating study characteristics (for instance design) and subpopulations that included gender and age groups (Brennan et al., 2020). To ease the

comparability of results from every integrated investigation, study results given in charts and tables were organised in the same way that the syntheses were presented in the descriptive text. Main Synthesis and conclusions were drawn from RCTs with a low bias risk, a large sample size, providing relevant evidence in respect of the interventions, outcome and the research question. Characteristics and risk of bias among the papers were tabled, with excel utilised to generate charts and plots summarising the presentation.

3.6 Ethical Issues

This study will not disclose any patient information. Issues relating to informed consent and ethical approval do not apply.

4 Results

The guided search produced a total of 97 articles which were then processed as shown in the the flow diagram below, which details the search process.

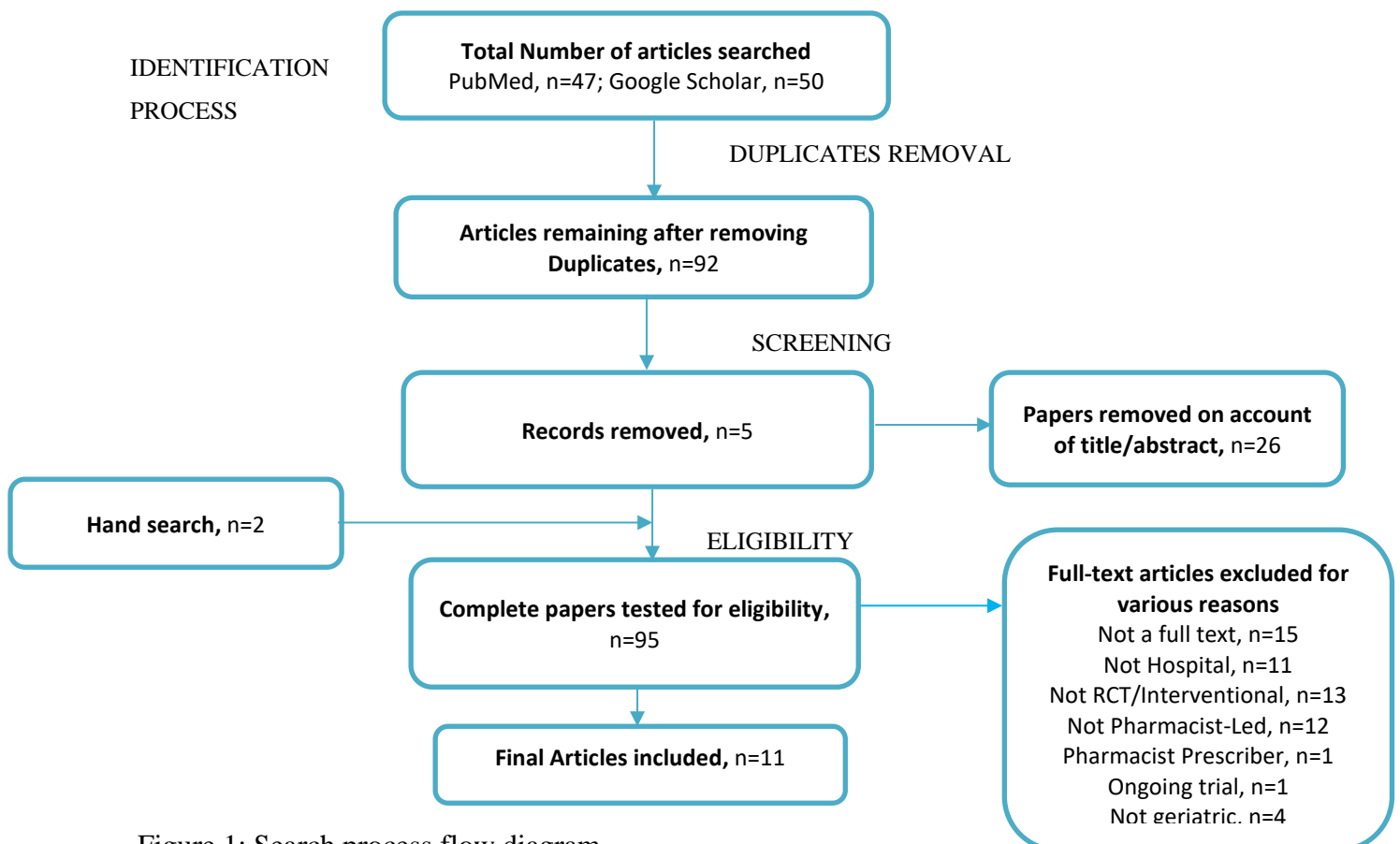


Figure 1: Search process flow diagram.

4.1 Study Characteristics

After screening and applying the criteria described in the methodology section, there were 11 papers published between 2017 and 2022 across the globe as shown in table 7 below.

Prospective interventional studies constituted the majority (5, 45.5%), followed by RCT (3, 27.3%), cluster RCT (2, 18.2%) and prospective quasi-randomised (1, 9.1%). Ten of the studies (90.9%) involved hospital inpatients with only one (9.1%) dealing with outpatients. Table 6 (pages 27 & 28) shows study characteristics.

4.2 Patient Characteristics

There was a total of 9016 patients across studies with the highest number (n=2637, 29%) in the study by Bertilsson et al. (2021), followed by Adam et al. (2021) (n=2008, 22%) and Bruni et al. (2021) (n=1702, 19%). A study by Bertilsson et al. (2021) had one control and two different interventional groups. There were 4399 and 4617 males and females respectively.

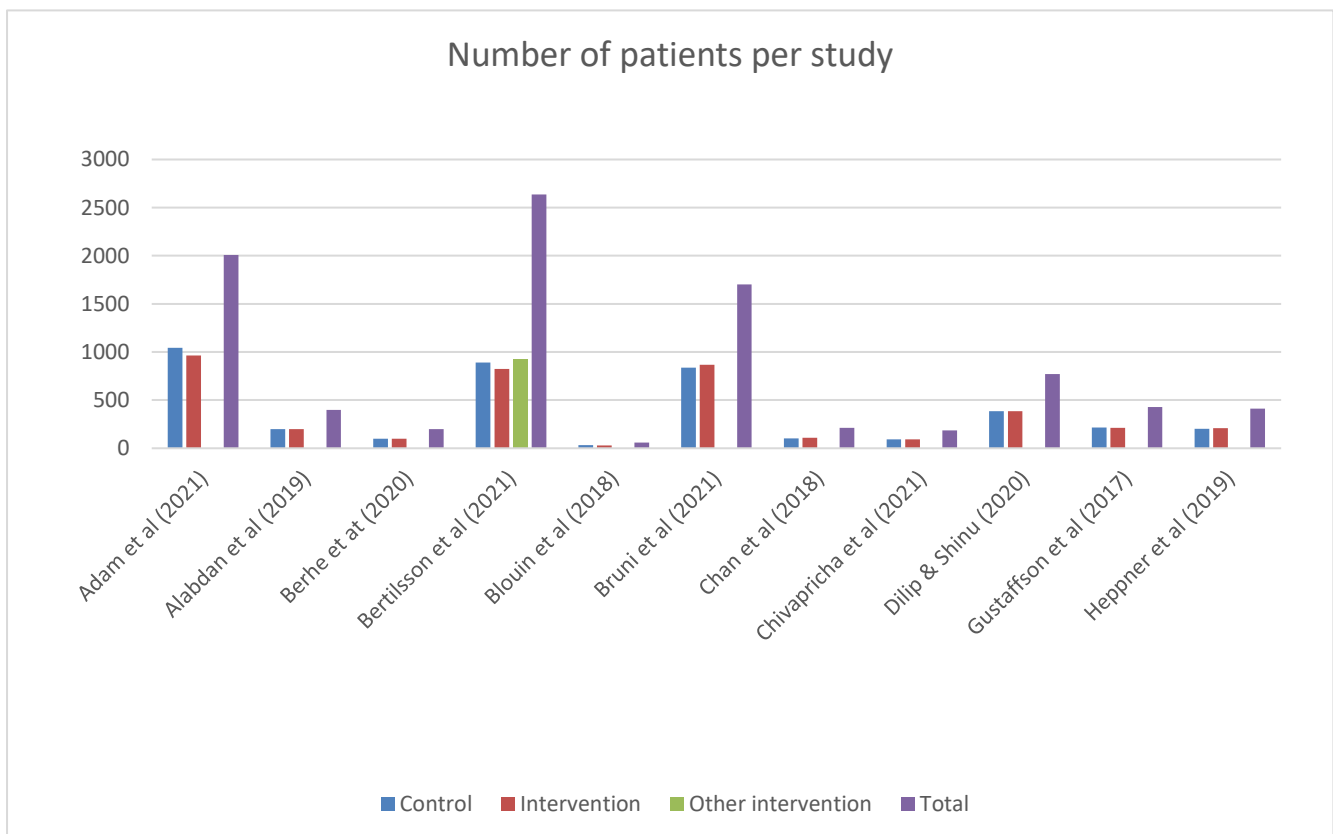


Figure 2: Number of patients per study

Author/Year	Country	Study Type	Setting	Sample size	Control	Intervention	Age	Median Age	Male	Female
Adam et al. (2021)	Switzerland, Belgium, Ireland, Netherlands	Cluster RCT	In patient University Hospitals	2008	1045	963	≥70	79	1110	898
Alabdan et al. (2019)	Saudi Arabia	Prospective Interventional	Hospital Inpatients	400	200	200	≥65	NS	183	217
Berhe et al. (2020)	Ethiopia	Prospective Interventional	University Hospital Inpatients	200	100	100	≥60	67.3	135	65
Bertilsson et al. (2021)	Sweden	Cluster RCT	4 Hospital wards	2637	892	823	≥65	81	1280	1357
Blouin et al. (2018)	USA	RCT	Hospital Outpatients - Oncology	60	31	29	≥65	71.74	28	32

Bruni et al. (2021)	Switzerland	RCT	Teaching Hospital Inpatients	1702	836	866	≥85	86	720	982
Chan et al. (2018)	Hong Kong	Prospective Interventional	Hospital Inpatients	212	104	108	≥65	83.3	102	110
Chivapracha et al. (2021)	Thailand	prospective, quasi-experimental study	Hospital Inpatients	187	93	94	≥60	NS	91	96
Dilip & Shinu (2020)	India	Prospective Interventional	Hospital Inpatients	770	385	385	≥60	NS	444	326
Gustaffson et al. (2017)	Sweden	RCT	Hospital Inpatients	429	217	212	≥65	83.1	158	271
Heppner et al. (2019)	German	Prospective, quasi-randomized, controlled	Hospital Inpatients	411	202	209	≥70	82	148	263

Table 6: Study Characteristics.

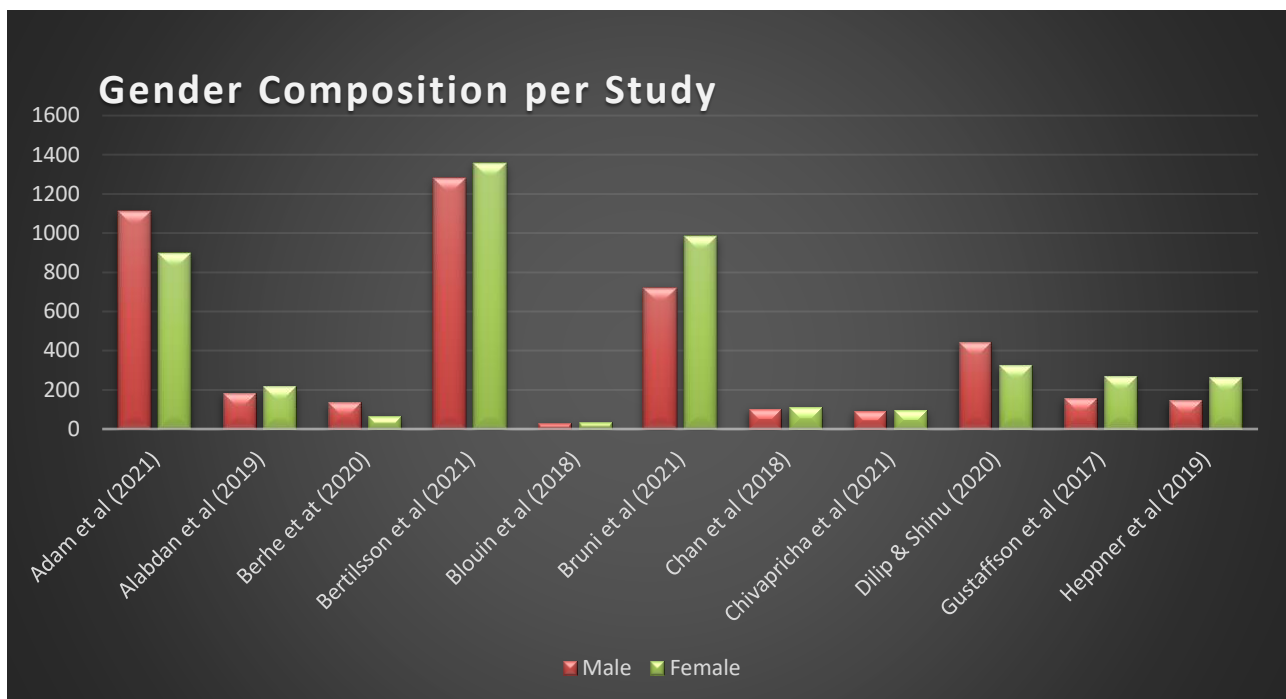


Figure 3: Gender Composition per Study.

The age range, in years, was between ≥ 60 and ≥ 85 . The median age ranged from 67.3 to 86 years, with three studies not stating. All the patients had comorbidities and were on multiple medicines. The median number of medicines ranged from 3.9 to 13, with that measurement not reported in one study by Gustaffson et al. (2017).

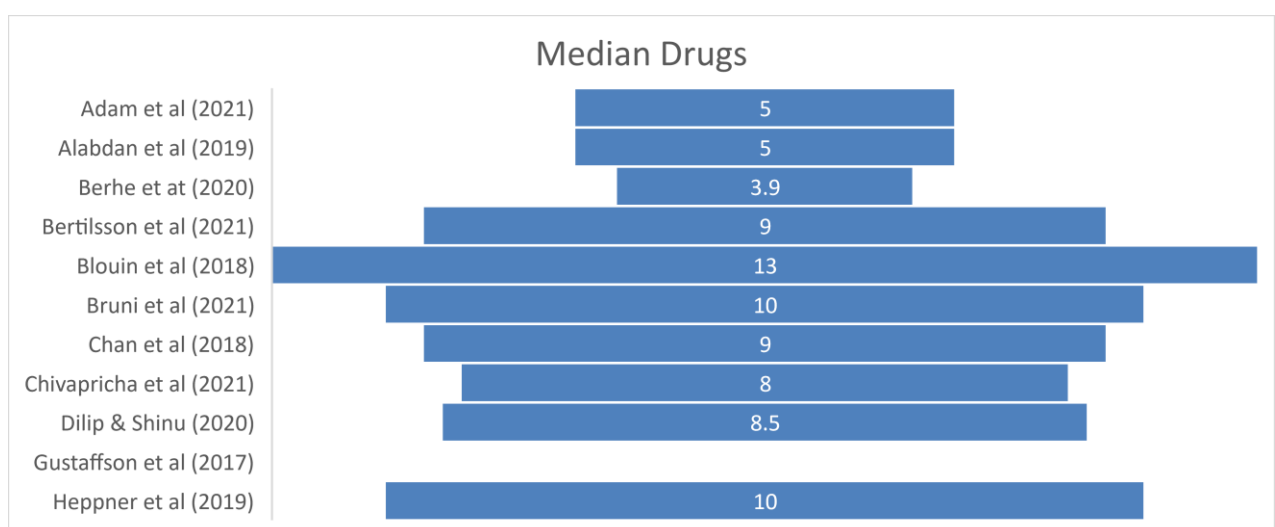


Figure 4: Median number of drugs per study.

All studies save for three, reported ADRs as absolute numbers as opposed to percentages.

The number of patients involved in those ADRs was not reported making it difficult to compute their prevalence for comparability. Studies that reported percentage ADRs are Adam et al. (2021), 22.4%; Alabdan et al. (2019), 45%; Dilip & Shinu (2020), 22.07%.

4.3 Use of Inappropriate Prescribing Tools

Six out of 11 (54.5%) used at least one inappropriate prescribing tool, while 5 studies (45.5%) did not use any tool. Beers criteria had a wider use across studies (3) followed by START/STOPP (2). MAI, BPHM, Micromedex, DEPICT, SHiM and PRISCUS were each used in a single study. Adam et al. (2021) and Heppner et al. (2019) employed the greatest number of tools (3).

Use of Inappropriate Prescribing Tools									
Author/Year	MAI	STRIP	START/STOPP	BEERS	MICROMEDEX	BPMH	SHiM	DEPICT	PRISCUS
Adam et al (2021)		✓	✓				✓		
Alabdan et al (2019)			✓	✓					
Berhe et al (2020)					✓				
Bertilsson et al (2021)									
Blouin et al (2018)				✓					
Bruni et al (2021)						✓			
Chan et al (2018)									
Chivapricha et al (2021)				✓					
Dilip & Shinu (2020)									
Gustaffson et al (2017)									
Heppner et al (2019)	✓							✓	✓

Table 7: Inappropriate Prescribing Tools

4.4 Interventions

All interventions encountered were classified into six themes as shown in table 8 below. All the studies deployed multiple strategies simultaneously. The majority of the studies (90.1%) utilised at least three interventions while only one study (Heppner et al., 2021) used two interventions. In all studies, pharmacists provided feedback and recommendations to prescribers and also carried out medication reviews, representing the two most popular intervention themes. Table 8 below shows intervention themes.

Author/Year	Intervention Themes					
	Structured Pharmacotherapy Optimisation	Educational & Patient Counseling	Feedback & Recommendations	Post Discharge F/U	Medication Reconciliation	Medication Review
Adam et al (2021)	✓		✓			✓
Alabdan et al (2019)		✓	✓			✓
Berhe et al (2020)		✓	✓			✓
Bertilsson et al (2021)	✓		✓	✓	✓	✓
Blouin et al (2018)			✓		✓	✓
Bruni et al (2021)			✓		✓	✓
Chan et al (2018)		✓	✓		✓	✓
Chivapricha et al (2021)		✓	✓		✓	✓
Dilip & Shinu (2020)		✓	✓			✓
Gustaffson et al (2017)			✓		✓	✓
Heppner et al (2019)			✓			✓

4.5 Risk of Bias

This was assessed with a tool designed by the author, as shown in annexure 2

The risk of bias tool contains 10 questions, each with four possible responses. Assessment for bias revealed that 6 papers had low risk, while 5 had a moderate risk of bias. No article was considered high risk. Figure 5 displays a potential bias graph:

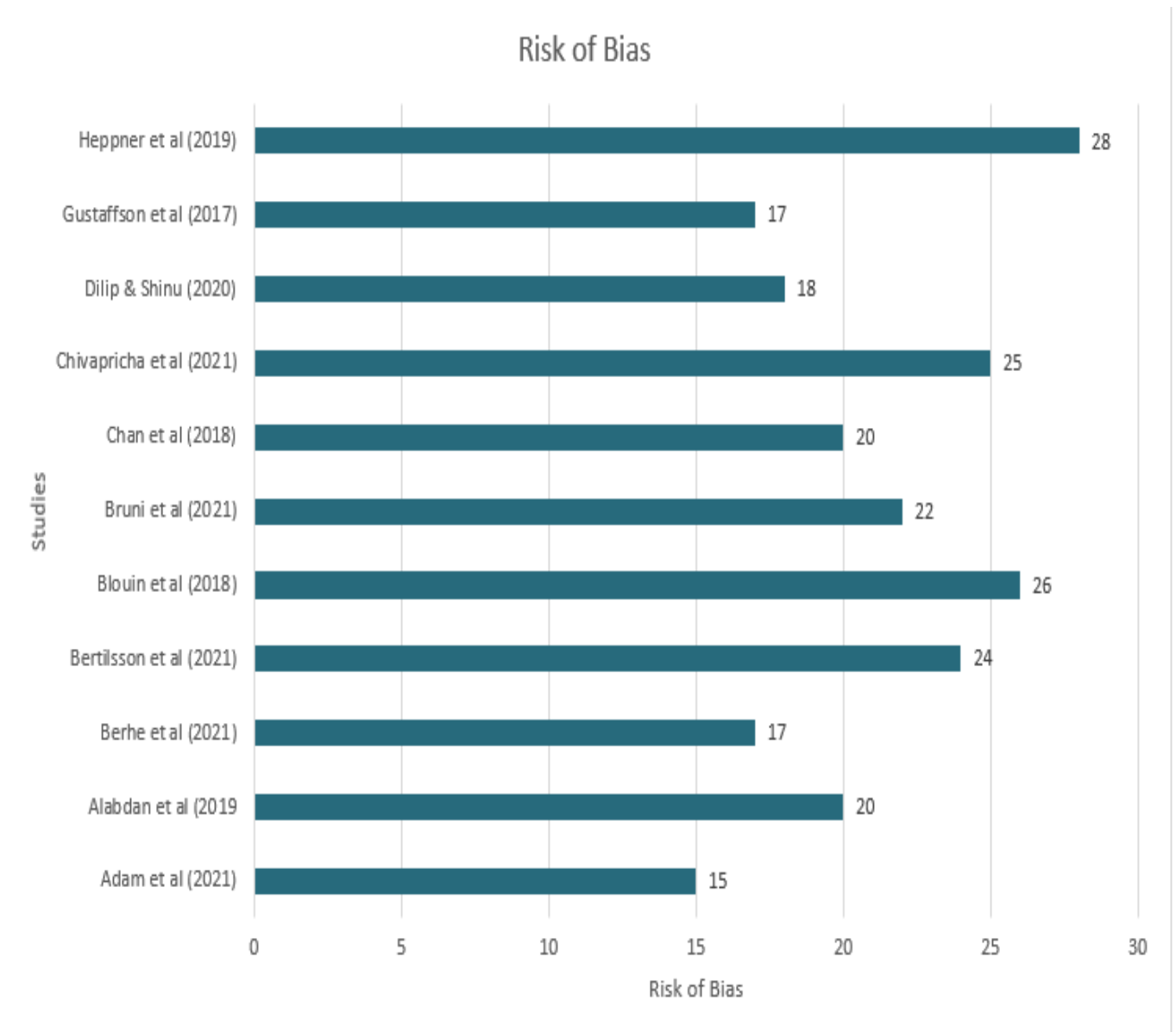


Figure 5: “Risk of bias”.

4.6 Outcomes

Outcomes were categorised into 9 themes which were either primary or secondary to the study as indicated in table 9 below:

			Outcomes							
Author/Year	Unplanned Hospital Visits	first drug related hospital admission within 30, 180 days or 12 months	Incidence of DRPs	Incidence of ADRs	Discrepant medications between patient and EHR	Appropriateness of prescription	All cause mortality	QoL	costs of hospital-based care	Acceptance Rate
Adam et al (2021)	✓	✓	✓					✓		
Alabdan et al (2019)			✓	✓						
Berhe et at (2020)			✓							✓
Bertilsson et al (2021)	✓	✓					✓		✓	
Blouin et al (2018)					✓	✓				
Bruni et al (2021)	✓	✓		✓			✓		✓	
Chan et al (2018)	✓	✓			✓	✓				✓
Chivapricha et al (2021)			✓					✓		✓
Dilip & Shinu (2020)			✓	✓				✓		
Gustaffson et al (2017)		✓						✓	✓	
Heppner et al (2019)			✓			✓				

4.6.1 Unplanned Hospital Visits

Five of the 12 studies assessed the impact of pharmacist-initiated strategies on unplanned hospital visits, including emergency. Three reports (Adam et al., 2021; Bertilsson et al., 2021; Bruni et al., 2021) were of the view that unscheduled hospital visits were not impacted in any way by pharmacists. However, Chan et al. (2018) and Gustafsson et al. (2017) found that unplanned visits reduced significantly although ED visits were not affected.

4.6.2 Drug-linked Hospitalisation

Closely linked to unscheduled visits, 5 of the studies analysed drug-associated hospitalisation either within 30 or 180 days. Four papers indicated there was no impact on this outcome and

only one (Chan et al., 2018) claimed a significant reduction in readmission one month after discharge.

4.6.3 Prevalence of DRPs and ADRs

Six studies scrutinised DRPs prevalence and all of them indicated pharmacists were able to markedly reduce DRPs. Dilip & Shinu (2020) even claimed that 80.26% of drug-related issues were completely rectified after pharmacist interventions. The prevalence of prescribing errors ranged from 9.04% to 86.6% across studies with one study by Blouin et al. (2018) not reporting the data. The median was calculated to be 63.5%. The prevalence is highest (86.6%) in the Heppner et al. (2019) study in which the participants were at least 70 years old and taking at least five drugs (median number of drugs = 10). The lowest prevalence (9.04%) was in the study by Bertilsson et al. (2021) in which the median number of drugs was 9.

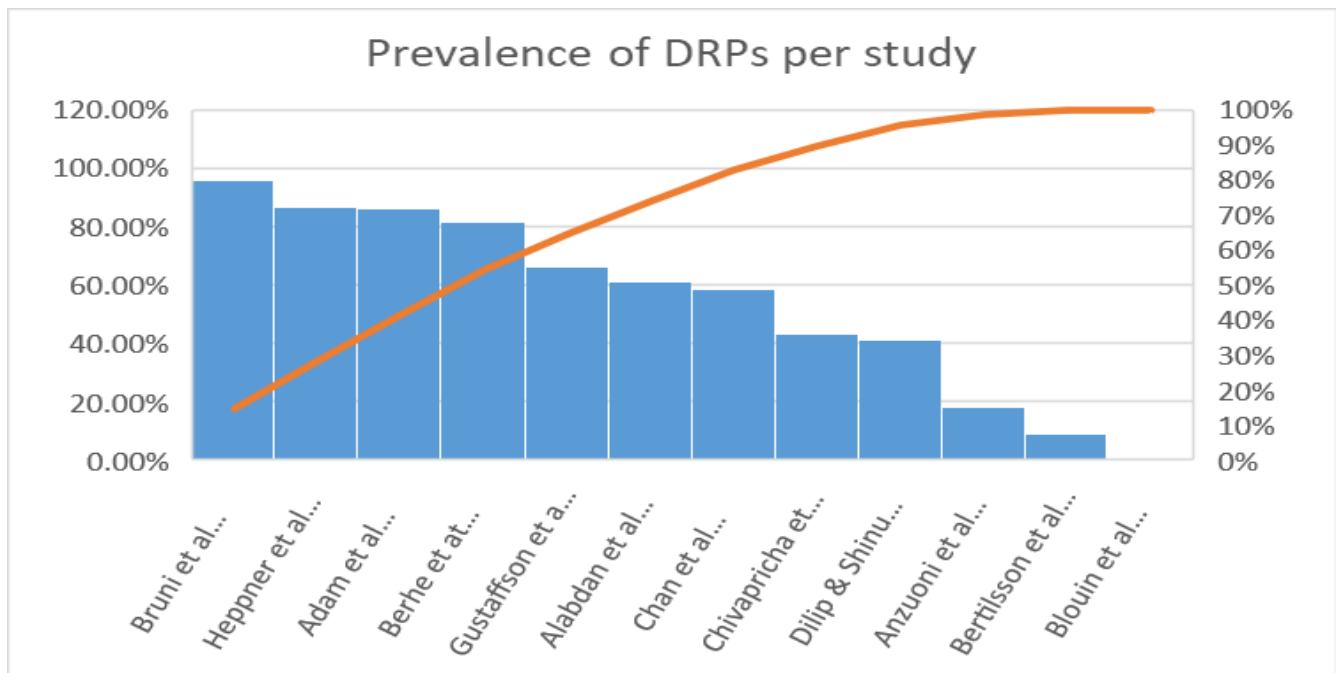


Figure 6: Prevalence of DRPs by study.

4.6.4 Discrepant Medications

Only two papers (Blouin et al., 2018; Chan et al., 2018) addressed this issue and both agreed that pharmacists lead to fewer discrepant medicines, with the former adding that the rate of vaccination for influenza and pneumonia increased.

4.6.5 Prescription Appropriateness

Three papers tackled this issue and all reported positively regarding pharmacist strategies.

4.6.6 All-Cause Mortality

This was not affected by pharmacists, according to Bertilsson et al. (2021) and Bruni et al. (2021), the only two studies which examined this issue.

4.6.7 Quality of Life

Only Adam et al. (2021), Chivapricha et al. (2021), Dilip & Shinu (2020) and Gustaffson et al. (2017) dealt with this issue and concluded that the quality of life, as confirmed by the patients, improved after interventions.

4.6.8 Acceptance rate

After pharmacists discovered drug-related issues, they discussed with prescribers and recommended therapy which would either be accepted as presented, accepted after being modified or outrightly set aside. A total of five studies did not report an acceptance rate. The acceptance percentage was calculable from the interventions accepted without modification. Accordingly, if a total of y interventions is recommended to the prescriber and x are accepted as they are,

$$\text{Acceptance rate} = \frac{x}{y} \times 100\%$$

Accepted interventions ranged from 40.1% in the Indian study to 91.7% in Ethiopia. The median acceptance rate was 80%.

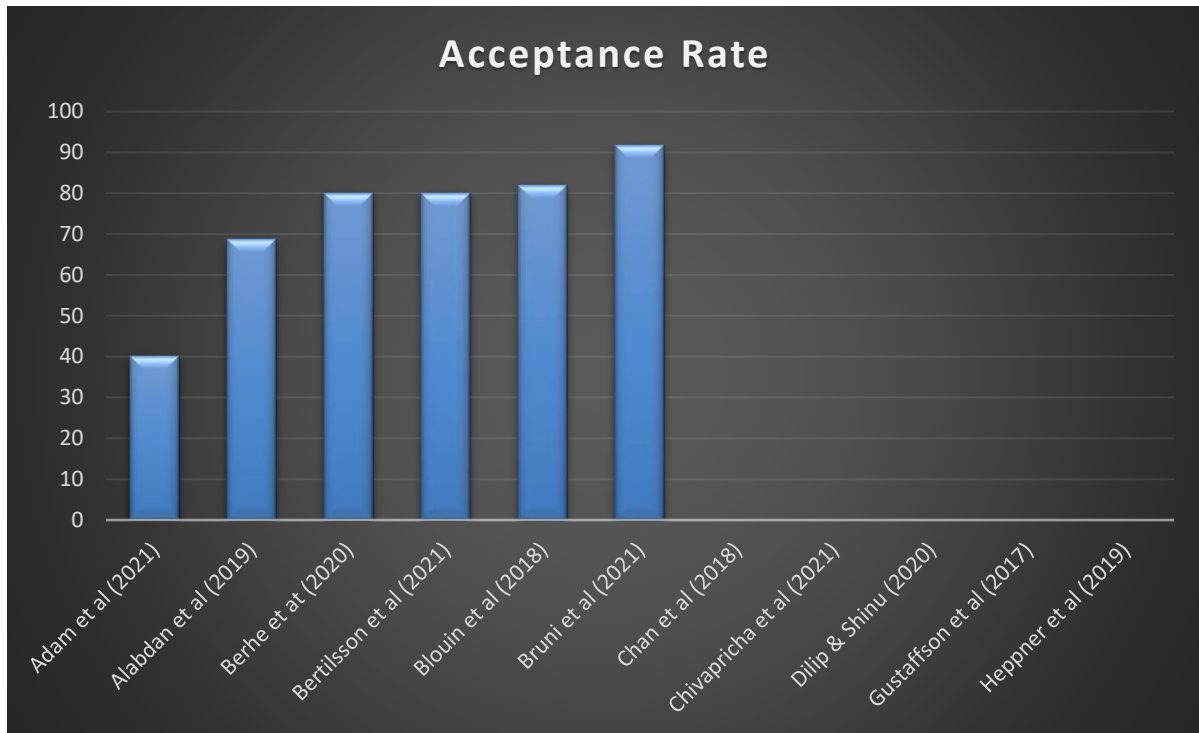


Figure 7: Acceptance rates of studies.

5 Discussion

This paper seeks to demonstrate the impact of pharmacist-initiated measures on prescribing errors, including drug-related issues, as well as clinical outcomes, in older patients. Study characteristics show variations in settings, comparators, intervention groups, sample sizes, gender composition, median age, study types, and primary as well as secondary outcomes sought thus indicating heterogeneity. This review calls for studies to be consistent in terms of methodology and the outcomes measured. Literature is replete with evidence of pharmacist interventions decreasing drug-related issues in older patients.

All but one study deployed at least three interventions. This demonstrates a multifaceted approach (Courtemanche et al., 2022) by pharmacists to alter the behaviour of both the patient and the prescriber (Ang et al., 2020). The most popular interventions used in all studies were “medication review” and “feedback and recommendations”. In these intervention types, the pharmacists identify problems associated with medications and suggest alternative therapy to prescribers (Berhe, Gidey, Gudina, Hailu & Getachew, 2020), who either accepted or rejected the recommendations. All the studies deployed “medication

review” with or without the use of tools as part of a cocktail of interventions. All of the studies assert that pharmacists, through various interventions, can significantly lower drug-related problems and consequently ADRs. A sweeping definition of prescribing error by Barber, Dean & Schachter (2000), which includes DRPs, results in different areas of the definition being analysed, making a comparison of studies a mammoth task (Cortejoso, Dietz, Hofmann, Gosch & Sattler, 2016). This review demonstrates that pharmacist interventions are more effective if carried out in a multidisciplinary setting. Medication reconciliations are complicated and several studies have attempted to examine them in real practice simulations (Brien, McLachlan & Mekonnen, 2016). In a busy setting, medication reviews are laborious and time-consuming, presenting an implementation challenge. Education interventions can be directed at both the patients and the prescribers, to optimise drug therapy.

The clinical significance as stated by Barber, Dean & Schachter (2000), was not clearly defined across studies. In this review, the acceptance rate by the prescribers ranged from 40.1% to 91.7% (median = 80%). It would therefore be reasonable to suggest that the acceptance rate correlates with the clinical relevance of and the impact on the DRPs. The higher the acceptance rate, the more clinically relevant the prescribing errors are and the greater the impact of interventions. The obstacles to acceptance need to be identified and tackled. This study could not establish a direct association between polypharmacy and the frequency of DRPs, by comparing the median number of drugs and DRPs prevalence. This is despite a plethora of literature citing polypharmacy as a determinant of DRPs. Because of the multifaceted approach to intervening, it is challenging to evaluate the success or failure of a single intervention.

The appropriateness of prescriptions was assessed using various inappropriate prescribing tools. Beers criteria and START/STOPP were the most widely employed. All tools have a general shortcoming as they fail to take into account differences in individuals within a specified patient grouping (Aguilar, da Costa & Marques, 2021). Pharmacist-led strategies are therefore impactful in improving prescription quality, reducing DRPs, including interactions between medicines and ADRs as well as improving the living standards in geriatrics.

This review, however, did not find evidence of the positive impact of pharmacist interventions on hospitalisation or rehospitalisation at one month, 6 months or 12 months post-discharge. Two studies suggested that pharmacist interventions had no impact on unplanned hospital visits. This is in sharp contrast with findings by Carlson, Kilcup, Wilson & Schultz (2015) and Bermejo et al. (2022), who not only found a reduction in readmission

rates but financial savings as well. It can be argued that it is not in the direct ambit of the pharmacist to reduce hospitalisation or rehospitalisation. However, it has to be acknowledged that pharmacist interventions impact admissions associated with drug therapy, which can be only one of the possible reasons for readmission. Drug toxicity accounts for 3 out of ten hospitalisations in older adults (Ocampo-Candiani, Pena-Lazo, Tamez-Pena, Tamez-Perez & Torres-Perez, 2014). A closer look at the study by Bruni et al. (2018) reveals that there is not much difference separating the intervention from the comparator group. The “intervention” by the pharmacists was already being carried out by the physicians. It is this author’s view that when pharmacists merely repeat what physicians do in terms of medicines reconciliation, that cannot be described as an intervention. Therefore, their findings are not surprising. Another paper that shares the same sentiment (Bertilsson et al., 2021) indicates that the only difference was the post-discharge follow-up. Anzuoni et al. (2021) support these findings asserting that there was no association between pharmacists’ measures and drug safety, although the research was greatly affected by recruitment problems. However, in a similar study, Buck et al. (2018), who had an “extended intervention” that included post-discharge follow-up, established that these multipronged strategies can reduce rehospitalisation shortly and long term. The studies under review also failed to make it clear what constitutes “drug-related readmission”, which directly influences findings. It is also important to deal with well-known confounders of hospitalisation or rehospitalisation, for instance, heart failure (Gustaffson et al., 2017). After accounting for heart failure, Gustaffson et al. (2017) found that the risk of rehospitalisation due to DRPs markedly dropped. There was no consistency in the effect of interventions across studies. This may be attributable to the varied quality of the studies (Bradley et al., 2018).

5.1 Limitations

An analysis of the risk of bias indicates that only 6 articles (54.5%) had a low risk of bias, representing a depleted body of evidence. It is well acknowledged that RCTs have a higher certainty of evidence due to their firm design (Chandler et al., 2021). However, this is not the case here as three RCTs were blighted by methodological feebleness such that their findings have to be cautiously treated. Therefore, the quality of the evidence can be described as low to moderate. The pharmacists and the prescribers were not characterised, which may influence the acceptance of recommendations (Andrinopolou, den Haak, van den Bemt, van Gelder, Vulto & Zaal, 2019).

The research study is limited by the retrospective nature, exposing it to random or systematic error. The study is also limited on account of lack of methodological expertise, poor access to some search engines due to costs, risk of selection bias and the short time frame within which it must be completed. Data collection was done by one person, with no checks and balances from another. The studies were not only small in number but also heterogeneous. Language bias may arise due to articles being limited to English publications.

5.2 Recommendations

The long-term impact of pharmacist interventions needs to be examined. Azhar, Babar, Curley, Khan, Kousar & Murtaza (2017) suggest that patients are seen to have improved within the first 180 days, which then wears off with time due to psychological reasons. Further study should also centre on the influence of pharmacist-initiated strategies on specific disease states. The pharmacy department heads must identify training needs and facilitate further training of all pharmacists at any given institution and equip them with clinical pharmacy skills, including geriatric pharmaceutical care. A hospital therapeutics committee should develop an inappropriate prescribing tool that is tailor-made to settings. Hospitals should develop SOPs and guidelines for pharmacist-led interventions, implement and monitor patients' outcomes and use the data for quality improvement purposes.

6 Conclusion

This research paper sought to analyse the impact of pharmacist-initiated strategies in recognising, detecting and mitigating prescription errors and drug-related issues as well as improving geriatric patient outcomes in a hospital environment. Through the modern clinical pharmacy, the role of pharmacists has grown and their initiatives have become pivotal to the patient treatment plan by simplifying drug treatment and curbing patient harm. Pharmacists position themselves to recognise and detect prescription errors by reconciling patients' medicines with or without tools. Pharmacists have a positive impact on many clinical outcomes in a broad array of disease states, including in elderly individuals.

Many studies have found that pharmacist-led interventions improve drug safety throughout the care process, implying that pharmacists perform a crucial role in geriatric care.

Appropriateness or otherwise, of a prescription, includes whether or not a medicine is safe considering its physicochemical characteristics, and whether or not cost-effectiveness is derived from its prescription. A list of high-risk medicines has been drawn which should at all costs be avoided in the elderly or used with extreme caution if benefits preponderate over

the risks. Expert committees have developed, mostly by consensus, several tools to monitor inappropriate prescriptions. Pharmacists can deploy these and optimise drug therapy for older patients. Beers criteria, together with the START/STOPP tool are the most widely used. The interventions are anchored on pharmaceutical care, the backbone of clinical pharmacy, involving pharmacists' activities that contribute to individual patient care to optimise the use of medicines and enhance outcomes. The general weakness of these tools is the failure to incorporate individual variability.

The primary outcome of interest was a change in inappropriate prescribing culminating in the reduction in drug-related issues and errors detected. Secondary outcomes entailed a change in the clinical course of the disease and subjective or objective information volunteered by the patient that included improved QoL. Two studies that measured QoL as a secondary outcome, as indicated by the patients, reported marked improvement, following interventions by pharmacists. Incidence of drug-related problems as well as adverse drug events was much lower after the interventions, indicating the impact of pharmacists in clinical care. Although this paper demonstrated that pharmacist strategies can improve therapy optimisation in the elderly, hospitalisation or rehospitalisation was not affected. The study failed to find any evidence that pharmacist-initiated interventions reduce drug-associated hospitalisations in the geriatric population.

It has been suggested that the effects of pharmacist interventions wear off in six months, which necessitates the examination of the long-term effects of such interventions in further studies. Research should also centre on the impact of pharmacist interventions on specific diseases. The study buttresses the importance of having pharmacists present in a geriatric care team. Training pharmacists in all aspects of clinical pharmacy, including geriatric care, is crucial.

The research study had limits due to the retrospective nature, exposing it to random or systematic error. The study was also limited by poor methodological expertise, lack of access to some search engines on account of costs, lack of prescriber and pharmacist characterisation, risk of selection bias and the short time frame within which it must be completed. Data collection was done by one person, with no checks and balances from another. Language bias may arise due to articles being limited to English publications.

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[Pallares/publication/351425706_Effects_of_hospital_pharmacist_interventions_on_health_outcomes_in_older_polymedicated_inpatients_a_scoping_review/links/60d2380a299bf19b8d9d8126/Effects-of-hospital-pharmacist-interventions-on-health-outcomes-in-older-polymedicated-inpatients-a-scoping-review.pdf](https://www.researchgate.net/profile/Manuel-Velez-Diaz-Pallares/publication/351425706_Effects_of_hospital_pharmacist_interventions_on_health_outcomes_in_older_polymedicated_inpatients_a_scoping_review/links/60d2380a299bf19b8d9d8126/Effects-of-hospital-pharmacist-interventions-on-health-outcomes-in-older-polymedicated-inpatients-a-scoping-review.pdf)

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Annexure 1: Data Collection Tool

[illegible]

Annexure 2: Risk of Bias

				RISK OF BIAS ASSESSMENT					Idea Generated from: CLARITY Group at McMaster University															
	Q1	Q2	Q3a	Q3b	Q3c	Q3d	Q3e	Q4	Q5	Q6	Total	RCT												
Adam et al (2021)	1	2	1	3	1	1	2	1	2	1	15	✓		Q1. Was the allocation sequence adequately generated?										
Alabdan et al (2019)	1	2	1	4	3	3	2	1	2	1	20			Q2. Was the allocation adequately concealed?										
Berhe et al (2021)	1	1	2	3	2	2	2	1	1	2	17			Q3.a. Were patients blinded?										
Bertilsson et al (2021)	2	3	4	4	2	2	2	1	2	2	24	✓		Q3.b. Were healthcare providers blinded?										
Blouin et al (2018)	2	3	4	3	3	3	2	2	2	2	26	✓		Q3.c. Were data collectors blinded?										
Bruni et al (2021)	1	4	4	4	4	1	1	1	1	1	22	✓		Q3.d. Were outcome assessors blinded?										
Chan et al (2018)	1	2	3	3	3	2	2	1	2	1	20			Q3.e. Were data analysts blinded?										
Chivapricha et al (2021)	2	3	3	3	3	3	2	2	2	2	25			Q4. Was loss to follow-up (missing outcome data) infrequent?										
Dilip & Shinu (2020)	1	2	1	4	2	2	2	1	2	1	18			Q5. Are reports of the study free of selective outcome reporting?										
Gustaffson et al (2017)	1	2	2	4		2	2	2	1	1	17	✓		Q6. Was the study apparently free of other problems that could put it at a risk of bias?										
Heppner et al (2019)	1	4	4	4	3	3	3	2	2	2	28		Answers to Questions				Risk Rating							
													Definitely Yes (Low Risk) = 1 Point				Low Risk 10-20 Points							
													Probably Yes = 2 Points				Moderate Risk 21-30 Points							
													Probably No = 3 Points				High Risk 31-40 Points							
													Definitely No (High Risk) = 4 Points											

Annexure 3: Ethics Approval and Conflict of Interest Declaration



Research Ethics Approval

The postgraduate dissertation study
ASSESSING THE EFFECTIVENESS OF PHARMACIST-INITIATED STRATEGIES ON PRESCRIPTION ERRORS AND DRUG-ASSOCIATED PROBLEMS AMONG GERIATRIC PATIENTS WITHIN A HOSPITAL SETTING

Submitted as part requirement for the completion of the program:
MASTERS IN HEALTHCARE MANAGEMENT

Did not require / required the approval of research ethics committee (please circle accordingly)

To be completed only if the study went through a research ethics committee:

Name of committee:

Conflict of Interest Declaration Title

of postgraduate dissertation:
ASSESSING THE EFFECTIVENESS OF PHARMACIST-INITIATED STRATEGIES ON PRESCRIPTION ERRORS AND DRUG-ASSOCIATED PROBLEMS AMONG GERIATRIC PATIENTS WITHIN A HOSPITAL SETTING

Please complete either a) or b)

a) I, ABRAHAM DONGO (name of student)
 hereby declare no conflict of interest for the postgraduate dissertation study submitted today as part requirement for completion of the program
MASTERS IN HEALTHCARE MANAGEMENT

b) I, (name of student)
 hereby wish to declare conflict of interest for the postgraduate dissertation study submitted today as part requirement for completion of the program

Please provide details regarding the conflict of interest declared:

Dissertation
(UU-MHM-595)

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