International Journal of Scientific Research in Science and Technology
Available online at : www.ijsrst.com
OPEN ACCESS
Print ISSN: 2395-6011 | Online ISSN: 2395-602X
doi : https://doi.org/10.32628/IJSRST251269

Clinical Pharmacist Interventions in Reducing Cardiovascular Readmission

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ARTICLEINFO

Article History:

Accepted : 30 June 2025
Published: 11 July 2025

Publication Issue :
Volume 12, Issue 4
July-August-2025

Page Number :
222-238

ABSTRACT

Background: Substantial numbers of hospital readmissions occur due to medication-related problems. Pharmacists can implement different interventions at hospital discharge that aim to reduce those readmissions. It is unclear which pharmacist-led interventions at hospital discharge are the most promising in reducing readmission.

Aim: This scoping review aimed to summarize pharmacist-led interventions conducted at hospital discharge that demonstrated a reduction in readmission.

Method: We searched the MEDLINE, EMBASE and CINAHL databases up to February 2024. We included studies that focused on pharmacist-led interventions at hospital discharge and reported significant readmission reductions. One reviewer independently screened titles, abstracts and full texts. Data extracted included study characteristics, populations and the type of implemented pharmacist-led interventions along with the reduction in readmission rates achieved.

Results: We included 25 articles for data synthesis. Many of the studies included either implemented at least two interventions concurrently or were part of broader programmes involving other healthcare professionals. The most common pharmacist-led interventions associated with reduced readmission rates included medication reconciliation, counselling and post-discharge follow-up by telephone. Follow-up primarily aimed to improve patients' treatment adherence through education about their medications. Furthermore, many studies reported on multi-component interventions that began at hospital admission or during inpatient stays, not only at discharge.

Conclusion: Successfully reducing readmission through pharmacist-led

interventions at hospital discharge suggests the effectiveness of a holistic approach incorporating multiple interventions. While these findings offer insights for pharmacists, further research should focus on conducting high-quality studies using a multifaceted approach to identify the most appropriate timing and combination.

A multi-tiered intervention augmented by clinical pharmacy specialists demonstrates promising results for cost-effective reduction of 30-day HF readmission rates.

Keywords: Clinical pharmacy; Drug-related readmission; Hospital discharge; Pharmacist; Scoping review; Transition of care.

Reducing cardiovascular readmission through pharmacist-led interventions at hospital discharge

Impact statements

- Pharmacist-led interventions at hospital discharge can reduce the risk of medication-related readmission and therefore improve patient outcomes.
- A multicomponent approach—combining medication reconciliation, patient education, and follow-up—has proven effective in preventing readmission, addressing key challenges in the transition of care.
- The research gaps identified highlight the need for standardized protocols and Cost-effectiveness studies of pharmacist-led interventions to reduce medication-Related readmission.

I. INTRODUCTION

Reducing hospital readmission has become a priority for many healthcare systems as they lead to increased patient morbidity and mortality and, thus, an extra financial burden [1]. Readmissions are defined as any unplanned hospitalization that occurs within a specified time period after the initial discharge, with the 30-day threshold being the most common [2]. Readmissions can be attributed to various factors, but medication-related problems (MRPs), also referred to as drug-related problems (DRPs) in the literature, are significant among them. The Pharmaceutical Care Network Europe (PCNE) defines an MRP as “an event or circumstance involving drug therapy that actually or potentially interferes with desired health outcomes” [3]. One systematic review showed that around 21% of all readmissions were attributable to MRPs, and a median of 69% of these were preventable [4].

During inpatient stays, medications are often managed by healthcare professionals, and medication regimens are almost always changed during hospitalization [5]. This can pose significant challenges for patients after discharge. One study in the United Kingdom showed that 37% of all patients experienced MRPs within eight weeks of hospital discharge, with 81% of these categorized as severe [6]. MRPs causing readmission include but are not limited to inappropriate prescribing, non-adherence to treatment and

transition of care (TOC) problems [7,8,9,10]. Risk factors for medication-related readmission include polypharmacy, the prescription of specific medication groups like diuretics, insulin or anticoagulants and, once again, non-adherence to treatment [11, 12]. In this context, pharmacist-led interventions at hospital discharge have emerged as strategies to address these MRPs, by focusing on preventable factors such as prescribing problems and non-adherence, and by improving TOC [13,14,15]. These interventions include medication reconciliation, patient education, follow-up and enhancing TOC by communicating more effectively with subsequent institutions and healthcare professionals [16,17,18,19]. Patient education involves providing tailored information to patients about their medications, including purpose, proper use and potential side effects, to improve understanding and adherence whereas follow-up includes post-discharge counselling, often via telephone or in-person, to assess adherence, manage side effects and address any medication-related concerns [20, 21]. Enhancing TOC by communicating refers to facilitating effective information exchange between healthcare providers and institutions to ensure complete medication management information at the subsequent point of care [22].

Pharmacist-led interventions, including medication reviews, have been shown to be effective in reducing hospital readmission and improving patient outcomes. For example, systematic reviews by Daliri et al. and Bülow et al. demonstrated that these interventions during hospitalizations can significantly reduce readmission rates and adverse drug events [23, 24]. Several randomized controlled trials (RCTs) have researched how pharmacist-led interventions at hospital discharge affect readmission, but findings have been inconsistent. Gillespie et al. used medication reconciliation, patient education and follow-up visits, resulting in a significant decrease of 16% in all-cause readmission and 80% in medication-related readmission [25].

The OPTIMIST trial combined medication reviews, care coordination and follow-up calls and also significantly reduced readmission (HR 0.62 for 30-day and 0.75 for 180-day-readmissions) [26]. In contrast, the study by Gurwitz et al. focused on high-risk patients and integrated medication reviews and counselling but found no significant impact on readmission [27]. Similarly, Kempen et al. included medication reviews and follow-up but did not observe a reduction in readmission, indicating that the effectiveness of these interventions may depend on the specific intervention components and patient populations [25,26,27,28]. To the best of our knowledge, two published literature reviews have focused their investigations on different pharmacist-led interventions implemented at hospital discharge to reduce readmission [29, 30]. However, these two reviews only included studies conducted in the USA, and they included studies regardless of whether those interventions had positive effects on readmission rates or not [29, 30]. Therefore, a comprehensive understanding of precisely which pharmacist-led interventions at hospital discharge are the most promising for reducing readmission was still lacking.

Aim of the study

This scoping review aimed to systematically explore the existing literature on pharmacist-led interventions at hospital discharge that had demonstrated a positive impact on hospital readmission. By synthesizing the available evidence, this review could then inform pharmacists providing interventions at hospital discharge aimed at reducing readmission and identify gaps that can inform future research.

Objectives:

- To improve patient medication adherence
- To support effective discharge planning and follow-up
- To enhance patient outcomes and reduce healthcare costs.
- To identify and resolve drug related problems
- To reduce cardiovascular readmissions through pharmacist interventions.

II. METHODOLOGY

Information sources and search strategy

The reporting of this scoping review adhered to the preferred reporting items for systematic reviews and meta-analyses extension for scoping reviews (PRISMA-ScR) checklist [31]. The review protocol was not published separately but is available upon request from the corresponding author. We chose the scoping review methodology in order to provide a broad overview of pharmacist-led interventions that have effectively reduced readmissions and to identify publication trends and knowledge gaps.

To address our research question of "Which pharmacist-led interventions implemented during hospital discharge processes have effectively reduced readmissions?" we systematically searched the EMBASE, MEDLINE and CINAHL bibliographic databases. Using the Ovid interface for searching EMBASE and MEDLINE and EBSCOhost for searching CINHAL, our search strategy included articles from the databases' inception dates up to the final search conducted on 9 February 2024 for EMBASE and MEDLINE, and 12 February 2024 for CINAHL. We supplemented this with a backward citation search of the articles retained in the online search.

The search strategy involved combining subject headings, including 'readmissions', 'pharmacists' and 'hospital discharge', along with searching titles and abstracts for these subject headings and their synonyms in the free text. This combination was achieved using the Boolean operator "AND". Records in Ovid EMBASE were filtered to exclude conference materials. The three reviewers developed this search strategy together and optimised it through discussions with an expert from the University of Bern's medical library. The final search strategy is available in Supplementary File 1. Records were deduplicated using Zotero 6.0 software (2006, Center for History and New Media at George Mason University, Fairfax, USA).

Eligibility criteria

To be included in the review, publications needed to describe interventions conducted or initiated by pharmacists or pharmacy personnel, including pharmacy technicians, either at or shortly after hospital discharge. This inclusion criterion is referred to as "pharmacist-led interventions at hospital discharge". These interventions should have demonstrated a statistically significant reduction in readmissions among adult patients (> 18 years old). Readmissions were defined as any hospitalization within a specified timeframe following the initial discharge. We chose this approach to ensure a feasible and comprehensive overview of the literature, in line with the aim of a scoping review. A reduction was considered significant if the p-value was below 0.05, or if the 95% confidence interval for odds or hazard ratios did not include 1. We considered peer-reviewed journal articles published in English, German, Italian, French and Spanish. We excluded publications if the intervention described was not pharmacist-led or was initiated by pharmacists outside the hospital setting. This excluded interventions by community pharmacists. However, interventions provided by community pharmacists who were part of the hospital staff or acting under hospital guidance, for example in community pharmacies maintained on hospital ground with access to inpatient information, were included. Articles focusing on interventions not implemented at hospital discharge (e.g. during admission or hospitalization) were also excluded. Studies exclusively examining patients with specific diagnoses or procedures (e.g. only patients with heart failure or after a specific surgery) or specific medications (e.g. antimicrobial stewardship programmers) were also ineligible and excluded, as were conference materials, editorials, comments and literature reviews (further referred to as "wrong study type"). All other study types were included.

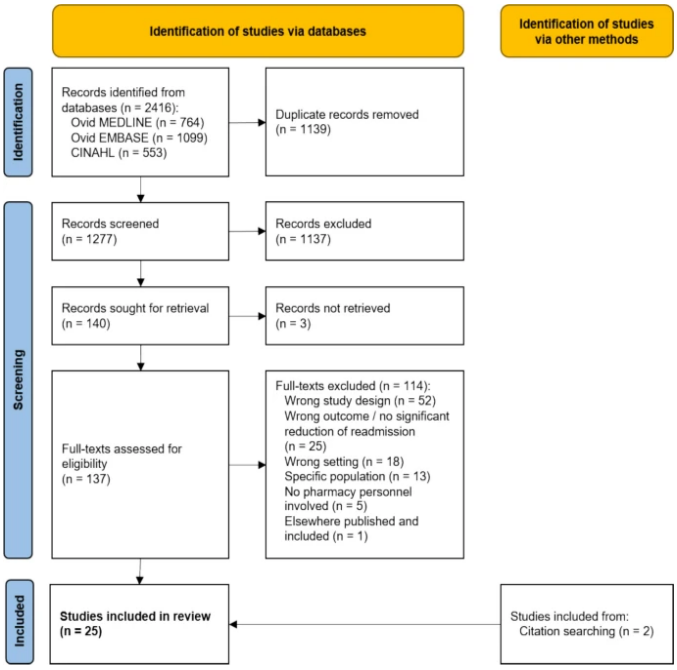
Study selection, data extraction and the synthesis of results. Two reviewers independently screened all the titles and abstracts for inclusion and then extracted

the data. Any discrepancies in the screening and data extraction processes were resolved through consensus and discussion, with the involvement of a third reviewer if necessary. One reviewer synthesized the data, and the second subsequently verified it. A data extraction table, developed by the three reviewers, guided the extraction of relevant variables (Supplementary File 2). Two reviewers independently charted the data and resolved any disagreements through discussion. Extracted data items included first author, year of publication, and country of origin, study population, population size, setting, objectives, methods, outcome measures, interventions described, results and authors' conclusions. Subsequently, we charted each encountered intervention from the included studies and summarized which interventions were conducted by each study. We classified the interventions as described in the original studies. If the description of the interventions lacked detail, we categorized them strictly based on the provided information, as we focused on pharmacist-led interventions and could not verify the involvement of pharmacy personnel in other processes.

III.RESULTS

Selection of studies

After deduplication, 1277 records were screened and we requested 140 full-texts for review, of which three could not be retrieved due to unavailable records, leaving 137 full texts for eligibility assessment (Fig. 1). Using the pre-established inclusion and exclusion criteria, 23 studies were deemed eligible for inclusion. Two more studies were included via backward citation searching. The most common exclusion criteria during full-text screening were wrong study type (n = 52) (e.g. editorials or commentaries), wrong outcome (i.e. no readmission analysis or no reduction in readmissions, n = 25), wrong setting (n = 18) and wrong population (n = 13).



Study characteristics

Study characteristics are summarized in Table 1, and a comprehensive data extraction table is presented in Supplementary File 2. Most of the studies were conducted in North America (n = 16), followed by Europe (n = 6), Asia (n = 2) and Australia (n = 1). We included a wide range of study designs as described by their authors, including RCTs (n = 8), quality improvement projects (n = 5), retrospective cohort studies (n = 3), pre–post studies (n = 3), non-randomized controlled trials (n = 2), prospective controlled studies (n = 2), a prospective cohort study (n = 1) and a clinical demonstration project (n = 1). The studies in Table 1 are listed chronologically from the most recent to the oldest publication. A minority of publications were published before 2010 (n = 6). The publication peak was in 2018 (n = 4), followed by 2020, 2016 and 2009 (n = 3 each). Notably, five of the six studies published before 2010 were RCTs or pilot RCTs. After 2010, only two RCTs met our inclusion criteria. Most studies focused on 30-day readmissions (n = 18) and specifically examined medication-related readmissions. The largest population involved a retrospective cohort study of 2253 patients. The smallest population consisted of 20 intervention patients included in a pilot RCT. In the RCTs

included, interventions were administered to a maximum of 995 patients.

Pharmacist-led interventions at hospital discharge

A summary of the interventions implemented in the studies retained in our review is shown in Table 2. It also indicates whether the pharmacy personnel delivered their intervention as part of an interprofessional team including other healthcare professionals. Table 2 includes information on whether the intervention at discharge had been accompanied by prior interventions at hospital admission or during the inpatient stay. The most prevalent interventions at hospital discharge were patient counselling and education about their medications (n = 16), medication reconciliation (n = 10), medication plan development (n = 7), medication reviews (n = 7) and improving communication with the patient's future primary care setting (n = 6). Twelve of the studies included provided post-discharge follow-up, the most common of which included patient counselling and treatment adherence measures (each n = 6), usually using follow-up telephone calls. All but one study [35] had provided either more than one intervention at hospital discharge or additional interventions at admission (n = 15) or during hospitalization (n = 6). Details on the provided interventions at admission or during hospitalizations can be found in Supplementary File 2. Seven studies had integrated pharmacists into a larger interprofessional intervention. There were no discernible trends in the interventions over time, except that none of the studies conducted before 2010 provided medication reviews at hospital discharge. However, some of those studies had provided medication reviews during the inpatient stay. The most common combination of interventions was the medication reconciliation followed by patient education conducted in nine studies, with three of them also providing medication reviews. Among the eight RCTs analyzed (see Table 3 for the results of this subgroup analysis), the most common interventions were completion of a medication plan (n = 6), patient counselling and education (n = 5), and improving communication with the patient's future primary care providers (n = 6). Five of these RCTs included post-discharge follow-up, during which patient education and counselling, as well as adherence-improving interventions, were most frequently provided (each n = 3).

Table 1 Overview of the characteristics and readmission rate reductions described in the studies included in the review

Table 1 Overview of the characteristics and readmission rate reductions described in the studies included in the review

First author (year, country)	Study design	Number of participants	Readmission rates
Lazaridis (2024, USA) [32]	Quality improvement project	1065 (all)	Lower readmission rates in two groups followed by population health pharmacists: 3% and 9% vs 23% (30 days), $P<0.01$ 9% and 14% vs 31% (60 days), $P<0.01$ 10% and 17% vs 35% (90 days), $P<0.01$
Gallagher (2022, USA) [33]	Quality improvement project	1569 (intervention) 1813 (comparison)	7-day readmission rate fell from 7.6% to 5.8% 14- and 30-day readmission rates showed no difference
Fosnight (2020, USA) [34]	Quality improvement project	284 (intervention)	30-day readmission rate reductions of 20.4% (partial intervention) and 10.2% (full intervention) ($P=0.016$) 30-day readmission rates fell from 21.0% (historical data) to 15.3% (intervention phase), 11.6% (with adherence interview) and 10.2% (all components)
Lam (2020, USA) [35]	Retrospective cohort study	2253 (intervention) 28,663 (comparison)	30-day readmission rate fell from 12.8% to 10.6% ($P=0.002$) Non-significant in multivariate analysis
McConachie (2020, USA) [36]	Retrospective cohort study	177 (intervention) 197 (comparison)	30-day readmission rate fell from 21.7% to 11.4% in patients who received additional pharmacist interventions (65 out of 177 intervention patients), $P=0.04$ 15-day readmission rate showed no difference
Odeh (2019, UK) [21]	Prospective quasi-experimental study	211 (intervention) 211 (control; propensity-score matched)	30-day readmission rate fell by 10% ($P<0.001$, OR 0.57) 90-day readmission rate fell by 15.2% ($P=0.021$, OR 0.53) Patients who received three telephone calls showed a 20.6% reduction in 30-day readmission rate ($P<0.001$, OR 0.22) and a 24.2% reduction in 90-day readmission rate ($P=0.012$, OR 0.34) Patients who received just one or two calls showed no fall in readmission rate
Chiu (2018, CN) [37]	Prospective controlled study	108 (intervention) 104 (control)	30-day readmission rate fell from 29.1% to 13.2% ($P=0.005$) 90-day readmission rate showed no difference
Ravn-Nielsen (2018, DK) [26]	Randomised controlled trial	498 (basic intervention) 497 (extended intervention) 503 (usual care)	Extended intervention reduced 30-day (HR 0.62, 95%CI=0.46–0.84) and 180-day readmission rates (HR 0.75, 95%CI=0.62–0.90) Basic intervention showed no reduction in readmission rates Changes in medication-related readmissions were not significant

Table 2: Summary of the interventions provided at hospital discharge. When a post-discharge follow-up was conducted, the specific interventions provided during this follow-up are shown in non-bold text in the subsequent lines that. Definitions of the interventions are provided in the table footnote

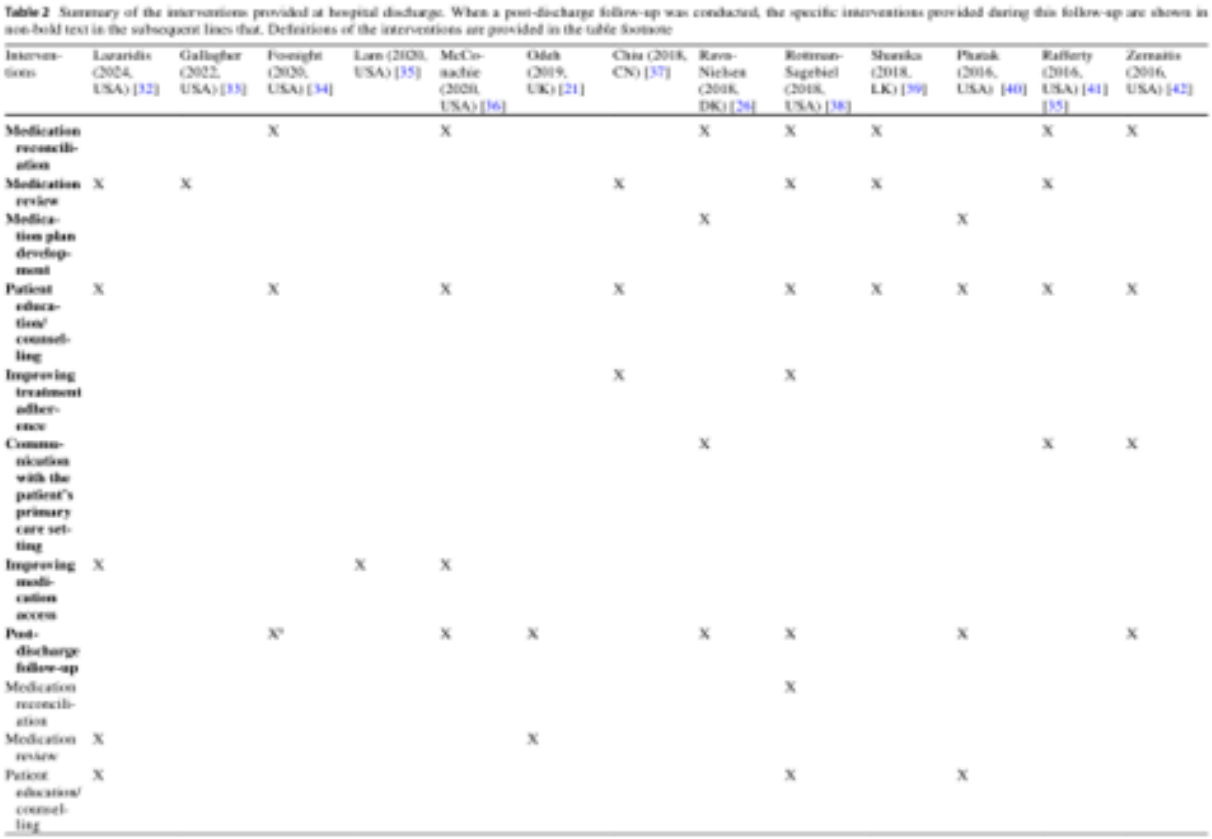


Table 2 Summary of the interventions provided at hospital discharge. When a post-discharge follow-up was conducted, the specific interventions provided during this follow-up are shown in non-bold text in the subsequent lines that. Definitions of the interventions are provided in the table footnote

Interventions	Lazaridis (2024, USA) [32]	Gallagher (2022, USA) [33]	Fosnight (2020, USA) [34]	Lam (2020, USA) [35]	McConachie (2020, USA) [36]	Odeh (2019, UK) [21]	Chiu (2018, CN) [37]	Ravn-Nielsen (2018, DK) [26]	Rottman-Sagebiel (2018, USA) [38]	Shanika (2018, LK) [39]	Phatak (2016, USA) [40]	Rafferty (2016, USA) [41] [35]	Zemaitis (2016, USA) [42]
Medication reconciliation			X		X			X	X	X		X	X
Medication review	X	X					X		X	X		X	
Medication plan development								X			X		
Patient education/ counselling	X		X		X		X		X	X	X	X	X
Improving treatment adherence							X		X				
Communication with the patient's primary care setting								X				X	X
Improving medication access	X			X	X								
Post-discharge follow-up			X[a]		X	X		X	X		X		X
Medication reconciliation									X				
Medication review	X					X							
Patient education/ counselling	X								X		X		

Table 2 (continued)

Interventions	Lazaridis (2024, USA) [32]	Gallagher (2022, USA) [33]	Fosnight (2020, USA) [34]	Lam (2020, USA) [35]	McConachie (2020, USA) [36]	Odeh (2019, UK) [21]	Chiu (2018, CN) [37]	Ravn-Nielsen (2018, DK) [26]	Rottman-Sagebiel (2018, USA) [38]	Shanika (2018, LK) [39]	Phatak (2016, USA) [40]	Rafferty (2016, USA) [41] [35]	Zemaitis (2016, USA) [42]
Improving treatment adherence	X					X		X	X		X		
Assistance organising follow-up									X				X
Communication with the patient's primary care setting						X		X					
Pharmacists were part of an interprofessional team	X	X	X										
Additional pharmacist intervention at admission	X	X	X		X		X	X		X	X	X	X
Additional pharmacist intervention during inpatient stay	X		X							X			

Table 3 Summary of the subgroup analysis of randomized controlled trials only. The interventions provided at hospital discharge are summarized. When a post-discharge follow-up was conducted, the specific interventions provided during this follow-up are shown in non-bold text in the subsequent lines. Definitions of the interventions are provided in the table footnote

Table 3 Summary of the subgroup analysis of randomised controlled trials only. The interventions provided at hospital discharge are summarised. When a post-discharge follow-up was conducted, the specific interventions provided during this follow-up are shown in non-bold text in the subsequent lines. Definitions of the interventions are provided in the table footnote

Interventions	Ravn-Nielsen (2018, DK) [26]	Phatak (2016, USA) [40]	Sanchez Ulayar (2012, ES) [48]	Gillespie (2009, SE) [25]	Jack (2009, USA) [49]	Koehler (2009, USA) [49]	Scullin (2007, UK) [51]	Crotty (2004, AU) [52]	Total
Medication reconciliation	X					X			2
Medication plan development	X	X	X	X			X	X	6
Patient education/counselling		X	X	X		X	X		5
Communication with the patient's primary care setting	X			X			X	X	4
Improving medication access							X		1
Post-discharge follow-up	X	X		X	X	X			5
Medication review					X				1
Patient education/counselling		X			X	X			3
Improving treatment adherence	X	X		X					3
Communication with the patient's primary care setting	X				X				2
Additional information									
Pharmacists were part of an interprofessional team					X	X		X	3
Additional pharmacist intervention at admission	X	X		X		X	X		5
Additional pharmacist intervention during inpatient stay				X		X	X		3

IV. DISCUSSION

Statement of key findings

This scoping review's key findings highlight the diverse range of interventions used by pharmacists at hospital discharge that demonstrated reduced readmission rates. The most common interventions included medication reconciliation, patient counselling, medication reviews and post-discharge follow-up. Notably, most studies implemented multiple interventions or were part of broader interprofessional team, suggesting that a holistic approach is often necessary to reduce readmissions effectively. Most studies combined medication reconciliation with patient education.

Strengths and weaknesses

To the best of our knowledge, this is the first scoping review to have comprehensively summarized pharmacist-led interventions at hospital discharge—from around the world—that were effective in reducing readmission rates. Nevertheless, some limitations should be considered when interpreting these results. One notable limitation is the heterogeneity in study designs, the interventions carried out and the different timeframes for readmissions, which precluded a quantitative synthesis of the results. The inclusion of study designs other than RCTs failed to control for potential confounding factors, and this may limit the generalizability of the results. Additionally, the inclusion criteria focused on studies demonstrating a reduction in readmissions, potentially introducing publication bias. Some of the studies retained failed to clearly describe whether and which pharmacist interventions the usual care group received, making it difficult to determine which pharmacist-led intervention was responsible for the reduced readmission rates. Furthermore, the studies retained often inadequately described their interventions, making it challenging to discern, for instance, which components of a medication review are the most effective in reducing readmissions. We acknowledge that our classification may not fully capture the sequence or complexity of activities performed due to limited descriptions in the original publications. To maintain methodological rigor and avoid bias, we did not infer additional steps, such as assuming that medication reconciliation preceded a medication plan development.

Interpretation

These results highlight the significant role pharmacists can play in addressing MRPs and improving TOC at hospital discharge, both of which are issues that contribute significantly to readmissions. This aligns with previous research, including a meta-analysis by Rodrigues et al., which showed that pharmacy-supported TOC interventions positively influenced 30-day readmission rates (OR = 0.68; 95%CI = 0.68–0.75) [30]. Similarly, one systematic review found that 89.4% of the studies it included had demonstrated reduction in 30-day readmission rates due to pharmacist-led interventions during TOC [29]. Ensing et al. conducted a systematic review exclusively focused on RCTs, and studied the effect of pharmacist-led interventions during hospitalization and post-discharge [54]. Their findings indicated significant variability in the effectiveness of these interventions, with strong evidence supporting the inclusion of medication reviews in comprehensive programmers [54]. Additionally, it highlighted the need for programmers that include medication reconciliation, patient counselling and the interprofessional collaboration across different TOC time points [54]. Our findings similarly highlight the importance of these interventions and the multicomponent approach, specifically at the point of hospital discharge. Research on discharge interventions in general has found that enhancing communication, providing patient education and adopting an interprofessional approach are effective in reducing readmissions, further aligning with the findings of this scoping review [55, 56]. Patient medication counselling at discharge was the intervention most frequently encountered by this

review. Counselling improves medication adherence, a factor often associated with readmissions [57,58,59]. Indeed, a previous meta-analysis demonstrated that pharmacist-led medication reconciliation during TOCs reduced readmission rates by 19% [17]. Post-discharge follow-up, provided in 16 of the 25 studies retained, was also effective in reducing readmissions. This intervention's effectiveness in reducing readmissions is highlighted in the meta-analysis by Rodrigues et al., where patient-centered follow-up was the only factor that reduced readmissions in a stratified analysis apart from the overall positive effect of all the interventions together [30]. Fragmented communication silos between healthcare settings and departments can impede TOC. Recent research by Marsall et al. showed that higher-quality TOCs correlated with fewer medication errors and improved patient health statuses [60]. This adds to the body of evidence that integrated, patient-centered follow-up can mitigate silo effects, enhance medication safety and thus reduce readmissions. Most of the studies retained were published after 2010, suggesting an increasing recognition of the importance of pharmacist-led interventions in transitional care and potentially reflecting the growing emphasis on aiming for fewer hospital readmissions as a quality metric and a cost-saving measure. The subgroup analysis of the eight RCTs included in this review yielded comparable results to those observed in the overall analysis. This further suggests that multicomponent interventions implemented at the time of hospital discharge may be an effective strategy for reducing readmissions, as all RCTs included in this review employed more than one intervention. The RCTs frequently included interventions such as patient education and counselling, improving communication, and post-discharge follow-up, which mirror the trends observed in the general analysis. It is noteworthy that none of the RCTs conducted medication reviews specifically at hospital discharge, although six included completion of a medication plan. It could be argued that a rigorously conducted medication plan development inherently involves elements of a medication review and reconciliation, as it typically requires an assessment of dosing, medication appropriateness and potential drug interactions. Furthermore, it is notable that medication reviews are frequently conducted during the hospitalization period [23]. This may contribute to their underrepresentation at the point of discharge in the RCTs analyzed because they have already been completed beforehand. It is important to note that the present scoping review only included studies demonstrating successful reductions in readmission rates following pharmacist-led interventions at hospital discharge. However, several RCTs have implemented similar interventions but have not found significant reductions in readmissions. For instance, the trial by Kempen et al. and the study by Gurwitz et al. used interventions like medication reconciliation, patient counselling and post-discharge follow-up, yet they failed to demonstrate any positive impact on readmission rates [27, 28]. Excluding these studies from our review does not diminish their importance or the quality of the research. Rather, it highlights the complexity of reducing readmissions and the potential influence of factors that go beyond pharmacist interventions alone, such as patients' characteristics, healthcare system structures and study designs. Moreover, the combination, intensity and quality of the provided interventions may play a role in their effectiveness. Another important factor to consider is the statistical power of the studies. It is possible that some studies were underpowered to detect a statistically significant effect, even if the intervention was beneficial or on the other hand found significant results by chance. This lack of power could lead to false negatives and false positive results. Additionally, the method of patient selection may influence outcomes. For example, Gallagher et al. used a readmission risk score to priorities patients who were most likely to benefit from their intervention, potentially leading to more effective results compared to studies that did not use such targeted approaches

[33]. This suggests that interventions may need to be tailored not only to the type of intervention but also to specific patient populations to maximize their impact. Contrasting findings highlight the need for further research to elucidate the optimal combination, timing and strategy for implementing pharmacist-led interventions to maximize their effectiveness in reducing readmissions across diverse healthcare settings and patient populations.

Further research

We have provided a comprehensive overview of studies providing pharmacist-led interventions at hospital discharge demonstrating reduced readmissions. Pharmacy policy-makers could use these findings to define or refine pharmacists' interventions at hospital discharge aimed at reducing readmissions. Further research should aim to standardize and evaluate the effectiveness of specific intervention components or combinations, as well as explore the optimal timing and duration of interventions. Additionally, studies should investigate how different co-interventions can be combined or sequenced to enhance overall effectiveness. Furthermore, research should be conducted into which professions should collaborate with pharmacists and how in order to reduce readmissions. Studies investigating the cost-effectiveness and long-term sustainability of these interventions would be valuable for informing healthcare policies and resource allocation

V. CONCLUSION

This scoping review summarized studies, irrespective of their study design, that reported on pharmacist-led interventions implemented at hospital discharge demonstrating reduced readmission rates. Since all but one of the included studies provided either more than one intervention at hospital discharge or additional interventions at admission or during hospitalizations, a multi-component approach might be beneficial. The most commonly implemented interventions were medication reconciliation, patient education and post-discharge follow-up by telephone. By addressing MRPs and thus improving TOC, pharmacists can play a crucial role in reducing the financial burden of hospital readmissions and improving patients' health outcomes.

Positive impact of a clinical pharmacy specialist-based intervention program on heart failure readmission rates

A recent scoping review has, for the first time, described pharmacist-led interventions at hospital discharge that reduce readmission rates.

Hospital readmissions frequently stem from medication-related problems, such as prescription errors or poor treatment adherence around transitions of care. Pharmacists, with their expertise in medication management, are uniquely positioned to address these gaps during the discharge process.

This study addressed the growing need to identify specific interventions that mitigate factors contributing to avoidable readmissions and lessen their overall impact. The authors synthesized data from 25 articles focusing on pharmacist-driven initiatives such as medication reconciliation, individualized patient education and ongoing collaboration with healthcare teams.

Study designs of included articles ranged from retrospective cohort analyses to randomized controlled trials (RCTs). Some studies incorporated pharmacists into broader care teams, while others examined direct pharmacist-patient interactions, underscoring the flexibility of pharmacist-led interventions across different healthcare environments.

The review revealed a wide variety of pharmacist-driven strategies at the time of discharge that successfully lowered readmission rates: medication reconciliation, patient education, medication reviews and arranging post-discharge follow-up.

In most cases, these activities were combined or integrated into broader interdisciplinary care,

implying the need for a more comprehensive approach to effectively decrease readmissions.

Several articles showed that structured post-discharge follow-up further reduced readmissions, highlighting the value of ongoing support.

All included RCTs employed more than one intervention, suggesting synergy in combining interventions.

Translating the findings of this study to practice, hospital pharmacists should consider adopting a multi-component strategy at discharge, with patient counselling emerging as the most common intervention.

The study authors indicated how this comprehensive review should encourage 'pharmacy policymakers [to] use these findings to define or refine pharmacists' interventions at hospital discharge aimed at reducing readmissions'. They went on to say that by adopting such an approach, 'pharmacists can play a crucial role in reducing the financial burden of hospital readmissions and improving patients' health outcomes'.

Future studies should standardize the specific components of pharmacist-led interventions, including their sequence, timing and synergy with other healthcare professionals, the authors concluded.

Cost-effectiveness and sustainability analyses would also inform resource allocation decisions. Expanding on the understanding of these interventions will hopefully lead to safer transitions of care and improved patient outcomes, they added.

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