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The Role of Clinical Pharmacists in Preventing Medication-Related Harm in Older Adults: A Systematic Review

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Abstract

Background: Older adults carry a disproportionate share of medication-related harm because of multimorbidity, polypharmacy and age-related changes in drug handling. Clinical pharmacists are increasingly placed on wards, in clinics and in care homes to prevent this harm, yet trials report inconsistent results. In Saudi Arabia, where more than half of older outpatients receive at least one potentially inappropriate medication, controlled evidence from local practice is scarce.

Objective: To synthesise controlled-trial evidence on the effect of clinical pharmacist interventions on medication-related harm and its precursors in adults aged 65 years and older, and to set this evidence against the Saudi and Gulf context.

Methods: PubMed was searched for randomised and cluster-randomised trials published from January 2015 to 4 November 2026, following PRISMA 2020. Eligible trials tested a pharmacist-led or pharmacist-delivered intervention in older adults and reported prescribing appropriateness, drug-related problems (DRPs), adverse drug events (ADEs) or medication-related health-care use. Supplementary searches targeted Saudi Arabia and the Gulf Cooperation Council (GCC) countries. Results were synthesised narratively by outcome domain and care setting.

Results: Of 51 unique records, 18 trials (12,450 participants; 15 countries) met the criteria; one was conducted in the Middle East and North Africa (Jordan) and none in Saudi Arabia or the GCC. Twelve trials reported a statistically significant benefit on their primary harm-related outcome, two reported mixed results and four were null. Benefits were most consistent for prescribing appropriateness (6 of 8 trials) and for transitions of care, where pharmacist follow-up reduced repeat emergency visits and readmissions. Large pragmatic trials of discharge services showed little overall effect but signalled benefit in patients with low adherence or literacy. Physicians accepted a median of 84.0% of pharmacist recommendations (range 42.4%–94.8%).

Conclusions: Clinical pharmacist interventions reliably reduce inappropriate prescribing and DRPs in older adults and can lower medication-related hospital use when they bridge care transitions. Saudi and Gulf hospitals have high baseline rates of inappropriate prescribing but no controlled trials; locally conducted trials with clinical end points are needed.

Keywords: clinical pharmacist; older adults; medication-related harm; potentially inappropriate medications; deprescribing; medication reconciliation; Saudi Arabia

1. Introduction

Medicines are the most common health-care intervention in later life, and they are also a leading source of preventable harm. With advancing age, renal and hepatic clearance decline, body composition changes and sensitivity to centrally acting drugs increases. Most older adults also live with several chronic conditions,

each with its own guideline-driven regimen. Polypharmacy follows almost automatically, and with it come drug–drug interactions, prescribing cascades and medicines whose risks now outweigh their benefits. The American Geriatrics Society Beers Criteria, last updated in 2023, list the drug classes that older adults should usually avoid and are now used worldwide to measure inappropriate prescribing (American Geriatrics Society Beers Criteria Update Expert Panel, 2023).

Saudi Arabia shows the same pattern at a high level. In a cohort of 23,417 outpatients aged 65 years or older at a Riyadh tertiary hospital, between 57.2% and 63.6% received at least one potentially inappropriate medication (PIM) each year from 2017 to 2019, and the prevalence rose over the period (Jabri et al., 2023). A three-year trajectory analysis of 9,887 older adults from the same centre found that more than four in five had at least one PIM dispensed and that over half had PIMs dispensed persistently (Jabri et al., 2025). Among frail inpatients in Riyadh, 45.8% used a PIM (Alsaad et al., 2022), and in the Eastern Province polypharmacy and Beers-listed medicines were each associated with falls risk in older outpatients (AlHarkan et al., 2023). At hospital admission, pharmacist-obtained medication histories revealed reconciliation errors in 54% of patients, with age 65 or older an independent risk factor (Mazhar et al., 2017).

Clinical pharmacists address these problems through medication review, medication reconciliation, deprescribing, patient education and follow-up across transitions of care. International meta-analyses suggest these services can reduce hospitalisation and mortality among older people (Kim et al., 2024) and reduce PIM use in emergency departments (Skains et al., 2025), but others find pooled effects on medication counts and clinical outcomes uncertain (Tesfaye et al., 2026) or absent for home-visit models (Abbott et al., 2020). The evidence base has also grown quickly: several large trials have been published since 2024, including a pragmatic United States trial of more than 6,000 hospitalisations (Pevnick et al., 2026).

Two gaps remain. First, earlier reviews tended to focus on one setting (hospital, emergency department, care home or home visit), which makes it hard to see where pharmacist input works best across the patient journey. Second, Saudi and Gulf health systems are expanding clinical pharmacy services under national transformation programmes, yet it is unclear whether local controlled evidence exists to guide that expansion. This review therefore aimed to (1) synthesise recent randomised evidence on clinical pharmacist interventions to prevent medication-related harm in adults aged 65 years and older across care settings, and (2) compare that evidence with what is known from Saudi Arabia and the wider Gulf region.

2. Methods

2.1 Design and reporting

This systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement. Because outcomes and measures differed widely between trials, a narrative synthesis was planned instead of a meta-analysis. The protocol was not registered.

2.2 Eligibility criteria

Eligibility was defined with the PICOS framework:

- **Population:** adults aged 65 years or older, or trials whose participants had a mean or median age of at least 65 years, in any care setting.
- **Intervention:** a service led or delivered by a pharmacist, alone or within an interprofessional team, such as medication review, medication reconciliation, deprescribing, transition-of-care follow-up or an embedded pharmacist role.
- **Comparator:** usual care or an alternative service without the pharmacist component.
- **Outcomes:** medication-related harm or its direct precursors: prescribing appropriateness (PIMs, Medication Appropriateness Index [MAI], medicine burden), DRPs, ADEs, or medication-related emergency visits, readmissions and hospitalisations.

- **Study design:** randomised or cluster-randomised controlled trials published in English or Spanish from January 2015 to November 2026.

Trial protocols, systematic reviews, secondary or process analyses of trials, and trials of disease-specific targets without a medication-harm outcome (for example, glycated haemoglobin alone) were excluded. Systematic reviews were retained as background for the Discussion.

2.3 Information sources and search strategy

PubMed was searched on 4 November 2026. The primary search combined pharmacist terms (*clinical pharmacist*, *pharmacist-led*, *pharmacist intervention*), older-adult terms (*older adults*, *elderly*, *geriatric*, MeSH *Aged*) and harm terms (*adverse drug events*, *medication-related problems*, *drug-related problems*, *potentially inappropriate medications*), limited to the publication types randomised controlled trial or systematic review and to 2015–2026. To capture regional evidence, four supplementary PubMed searches combined pharmacist, deprescribing, reconciliation and PIM terms with Saudi Arabia, Riyadh, Qatar, Kuwait, the United Arab Emirates, Oman, Bahrain and Jordan. Records from these searches were reviewed to identify Saudi and Gulf evidence for contextual comparison and were not counted in the PRISMA flow.

2.4 Study selection and data extraction

Titles and abstracts were screened against the eligibility criteria, and the PubMed record of each potentially eligible trial was then assessed in full. Data were extracted into a standard form: first author and year, country, setting tag (Saudi, GCC-MENA or International), care setting, design, sample size, age, intervention, primary harm-related outcome, main finding, and the proportion of pharmacist recommendations accepted or implemented where reported.

2.5 Appraisal and synthesis

Methodological features relevant to bias were recorded for each trial (randomisation unit, sample size, blinding of outcome assessment where stated, and whether the primary outcome was clinical or a process measure). Each trial's primary harm-related outcome was classified as showing a statistically significant benefit, a mixed result (benefit on some primary or key secondary outcomes but not others, or benefit restricted to a subgroup), or a null result. Trials were grouped by outcome domain and by care setting, following the Synthesis Without Meta-analysis (SWiM) approach. Acceptance rates were summarised as median and range.

3. Results

3.1 Study selection

The primary search returned 52 records; one duplicate was removed, leaving 51 for screening. Twenty-nine records were excluded at title and abstract stage: 14 systematic reviews or meta-analyses, 12 trials in populations that were not older adults and 3 trial protocols. Of the 22 reports assessed for eligibility, three were secondary or process analyses of trials and one reported only glycaemic outcomes, leaving 18 trials for synthesis (Figure 1). The supplementary Saudi and Gulf searches identified no controlled trial of a pharmacist intervention in older adults; their relevant observational studies are summarised in Section 3.5.

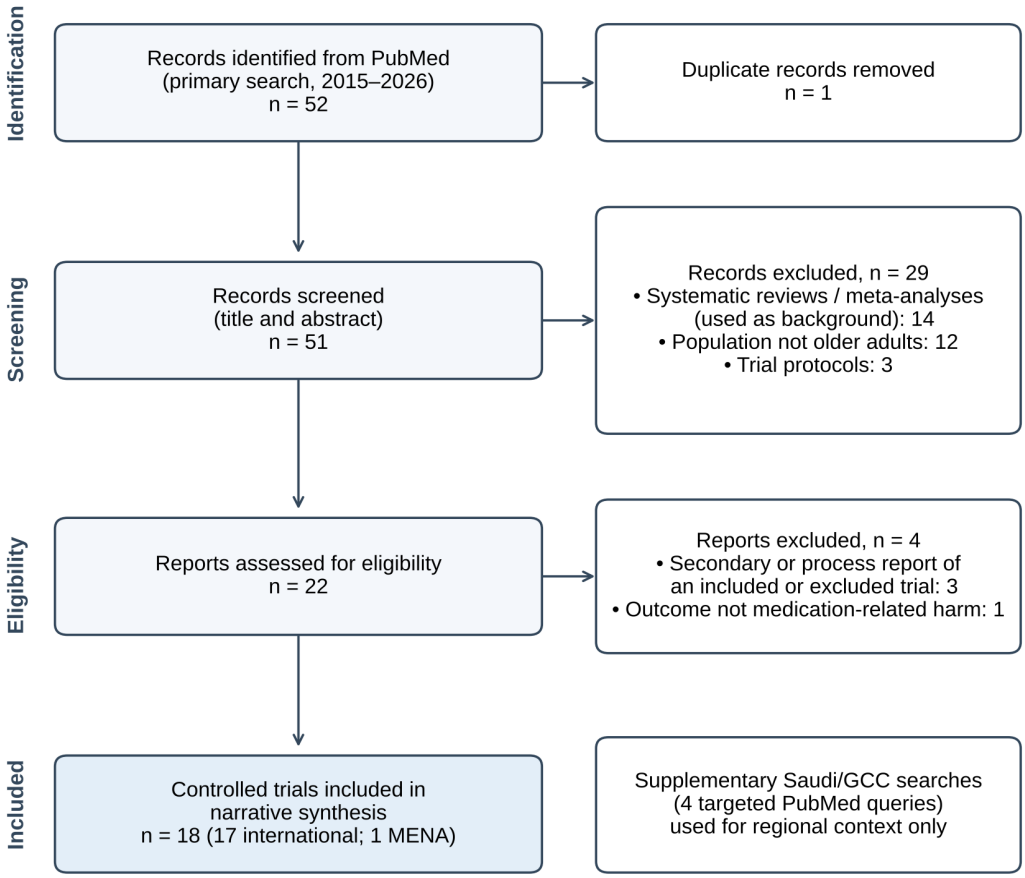


Figure 1. PRISMA 2020 flow diagram of study selection. The primary PubMed search (January 2015 to 4 November 2026) was screened at title and abstract level and eligible reports were assessed against PICOS criteria. Supplementary Saudi and Gulf searches were used to identify regional contextual evidence and are not counted in the flow. MENA = Middle East and North Africa; GCC = Gulf Cooperation Council.

3.2 Characteristics of included trials

The 18 trials enrolled 12,450 participants, from 32 in a Korean pilot trial (Lee et al., 2023) to 6,428 analysed hospitalisations in the PHARM-DC trial (Pevnick et al., 2026). They were conducted in 15 countries across Europe (9 trials), North America (3), Asia-Pacific (4), Türkiye (1) and Jordan (1). Eleven trials took place in hospitals, emergency departments or across the hospital-to-home transition; three in nursing homes or residential aged care; and four in primary care, community pharmacy or specialist outpatient clinics. Fourteen were individually randomised and four were cluster-randomised. Table 1 summarises the trials.

Table 1. Characteristics of the 18 included trials (ordered by year of publication).

Study	Country (setting tag)	Care setting	Design	n	Age	Pharmacist intervention
Basger et al. (2015)	Australia (International)	Hospital / transition	RCT	183	≥65	Discharge counselling and medication review with criteria-set; recommendations to GP
Martin et al. (2018)	Canada (International)	Community / primary care	Cluster RCT	489	mean 75	Pharmacist-led deprescribing education (patient brochure + evidence-based opinion to physician)
Graabaek et al. (2018)	Denmark (International)	Hospital / transition	RCT (3-arm)	600	older acute medical	Medication review and interview on admission ± inpatient review and discharge counselling
Huiskes et al. (2019)	Netherlands (International)	Community / primary care	RCT	175	mean 66	Computer-assisted pharmacist medication review before cardiology outpatient visit
Balsom et al. (2020)	Canada (International)	Long-term care	RCT	45	nursing-home residents	Deprescribing-focused pharmacist medication review

Study	Country (setting tag)	Care setting	Design	n	Age	Pharmacist intervention
Liou et al. (2021)	Taiwan (International)	Long-term care	RCT	100	≥65	Intensive pharmacist medication review with reconciliation in a veterans nursing home
Jošt et al. (2021)	Slovenia (International)	Hospital / transition	RCT	120	median 72	Pharmacist-led medication reconciliation at admission
Martínez-Sotelo et al. (2021)	Spain (International)	Community / primary care	Cluster RCT	549	≥65, ≥5 drugs	Pharmacist PIM detection (explicit + implicit) and recommendations to physician
Lee et al. (2023)	South Korea (International)	Hospital / transition	RCT	32	≥65	Comprehensive medication reconciliation with PIM review and regimen simplification
Haider et al. (2023)	Australia (International)	Long-term care	Cluster RCT	1,297	aged-care residents	On-site pharmacist embedded in aged-care facility team for 12 months
Marinović et al. (2024)	Croatia (International)	Hospital / transition	RCT	353	≥65	Hospital pharmacist-led care-transfer model (admission to post-discharge)
Hammad et al. (2025)	Jordan (GCC-MENA)	Hospital / transition	RCT	128	>65	Pharmacist-led medication reconciliation within 24 h of admission
Villiet et al. (2025)	France (International)	Hospital / transition	RCT	330	median 71	ED pharmacist transition-of-care calls and letter to GP and community pharmacist
Sosyal et al. (2025)	Türkiye (International)	Hospital / transition	RCT	400	mean 67–68	Structured PCNE medication review for antithrombotic therapy on ward rounds
Christensen et al. (2025)	Denmark (International)	Hospital / transition	RCT	151	≥65	Interprofessional medication review (pharmacist + geriatrician) in the ED
Kocklaeuner et al. (2025)	Germany (International)	Community / primary care	Cluster RCT	245	people with dementia	Comprehensive pharmacist medication review with GP feedback
Hellemans et al. (2026)	Belgium (International)	Hospital / transition	RCT	825	mean 86.3	Multifaceted pharmacist medication review on an acute geriatric ward (ASPIRE)
Pevnick et al. (2026)	USA (International)	Hospital / transition	Pragmatic RCT	6,428	mean 75.5	Peri- and post-discharge pharmacist medication management (PHARM-DC)

Note. n = participants randomised or analysed as reported in the trial record. RCT = randomised controlled trial; GP = general practitioner; ED = emergency department; PIM = potentially inappropriate medication; PCNE = Pharmaceutical Care Network Europe.

3.3 Effects on medication-related harm

Twelve of the 18 trials reported a statistically significant benefit on their primary harm-related outcome, two reported mixed results and four found no difference (Table 2; Figure 2). The pattern differed by outcome domain.

Prescribing appropriateness. Six of eight trials improved appropriateness. In Canadian community pharmacies, a pharmacist-led educational deprescribing intervention more than tripled the discontinuation of Beers-listed medicines at six months (43% vs 12%; Martin et al., 2018). Embedding a pharmacist in Australian aged-care facilities halved the odds of a resident taking a PIM (odds ratio 0.50; Haider et al., 2023), and in the Belgian ASPIRE trial, a multifaceted pharmacist review on an acute geriatric ward reduced STOPP-defined PIMs at discharge and one month later (Hellemans et al., 2026). Similar gains were reported in Spanish primary care (Martínez-Sotelo et al., 2021), in German outpatients with dementia (Kocklaeuner et al., 2025) and in a Canadian nursing home, where residents took almost three fewer medicines after deprescribing-focused review (Balsom et al., 2020). The two null trials both relied on others to act on the pharmacist's advice: an Australian discharge service in which general practitioners implemented 42.4% of recommendations (Basger et al., 2015), and a Danish emergency-department review whose MAI improvement did not differ from usual care (Christensen et al., 2025). Notably, ASPIRE improved appropriateness without lowering the number of medicines, showing that the work often replaces inappropriate drugs with appropriate ones rather than simply removing them (Hellemans et al., 2026).

Drug-related problems. Two of three trials reduced DRPs. Pharmacist review before a cardiology outpatient visit lowered mean DRPs at one month from 0.8 to 0.3 per patient (Huiskes et al., 2019), and structured review of antithrombotic therapy on a Turkish cardiology ward reduced clinically significant

DRPs (Sosyal et al., 2025). A Taiwanese nursing-home trial reduced DRPs within the intervention arm, but most between-group outcomes did not differ (Liou et al., 2021).

Adverse drug events. Only two trials measured ADEs directly. In a small Korean trial, no ADEs occurred in the intervention group at 30 days after discharge compared with five in the control group (Lee et al., 2023). A Slovenian trial of admission reconciliation found no reduction in discrepancies or ADEs; only 29% of unintentional discrepancies were communicated to physicians in person, which points to an implementation failure rather than an ineffective service (Jošt et al., 2021).

Medication-related health-care use. Three of five trials reduced hospital use. A French emergency-department transition-of-care programme cut repeat emergency visits for the same medication-related event from 22.1% to 3.0% at six months (Villiet et al., 2025). A Croatian pharmacist-coordinated care-transfer model reduced hospital and emergency readmissions over one year (Marinović et al., 2024), and pharmacist-led reconciliation in Jordan was associated with about 70% lower odds of readmission or emergency visit at 30 days (Hammad et al., 2025). In contrast, a three-arm Danish trial found few medication-related readmissions in any group, leaving little room to show an effect (Graabaek et al., 2018). The largest trial, PHARM-DC, found no overall reduction in 30-day unplanned use (25.6% vs 26.4%) but a 10.4-percentage-point reduction among patients with low medication adherence and health literacy (Pevnick et al., 2026).

Table 2. Primary harm-related outcomes and main findings of included trials, grouped by outcome domain.

Study	Outcome domain	Main finding	Result
Basger et al. (2015)	Prescribing appropriateness	No difference in appropriateness criteria met at 3 months; 42.4% of recommendations implemented by GPs	Null
Martin et al. (2018)	Prescribing appropriateness	Inappropriate prescription discontinued in 43% vs 12% at 6 months (RD 31%, 95% CI 23–38)	Benefit
Balsom et al. (2020)	Prescribing appropriateness	2.68 fewer medicines at 3 months and 2.88 fewer at 6 months; 85.1% of recommendations implemented	Benefit
Martínez-Sotelo et al. (2021)	Prescribing appropriateness	Patients with PIM fell 13.7 points more (95% CI 9.3–18.2); no difference in morbidity, mortality or costs	Benefit
Haider et al. (2023)	Prescribing appropriateness	Residents on ≥1 Beers PIM: OR 0.50 (95% CI 0.34–0.75); lower anticholinergic burden	Benefit
Christensen et al. (2025)	Prescribing appropriateness	MAI improvement 2.2 vs 1.2 points at 8 weeks (P = .3)	Null
Kocklaeuner et al. (2025)	Prescribing appropriateness	Modified MAI and DRPs fell significantly in the intervention arm (P < .001)	Benefit
Hellemans et al. (2026)	Prescribing appropriateness	STOPP PIMs fell (β −0.85, P < .0001); total medicine count unchanged	Benefit
Huiskes et al. (2019)	Drug-related problems	Mean DRPs at 1 month 0.3 vs 0.8 (P < .001); 74% vs 14% of baseline DRPs resolved	Benefit
Liou et al. (2021)	Drug-related problems	DRPs fell after intervention (P < .01); PIM prevalence 74.3% at baseline with no between-group difference in most outcomes	Mixed
Sosyal et al. (2025)	Drug-related problems	Fewer clinically significant DRPs per patient (P < .05); 94.8% of recommendations accepted	Benefit
Jošt et al. (2021)	Adverse drug events	No difference in unintentional discrepancies (P = .481) or ADEs (P = .801); 51 ADEs arose from discrepancies	Null
Lee et al. (2023)	Adverse drug events	30-day post-discharge ADEs: 0 vs 5 events (P = .039); 83% acceptance	Benefit
Graabaek et al. (2018)	Health-care utilisation	920 MRPs identified; no difference in 30-day medication-related readmissions	Null
Marinović et al. (2024)	Health-care utilisation	Fewer total and emergency readmissions over 12 months (P = .005 and P = .008)	Benefit
Hammad et al. (2025)	Health-care utilisation	94.2% of recommendations accepted; about 70% lower odds of 30-day readmission/ED visit; ADEs not different	Benefit
Villiet et al. (2025)	Health-care utilisation	ED revisit for the same medication-related event 3.0% vs 22.1% at 6 months (RD −19.1 pp)	Benefit
Pevnick et al. (2026)	Health-care utilisation	30-day unplanned use 25.6% vs 26.4% (NS); 10.4-point reduction in patients with low adherence and literacy	Mixed

Note. Benefit = statistically significant improvement on the primary harm-related outcome; Mixed = benefit on some outcomes or in a subgroup only; Null = no significant difference. ADE = adverse drug event; DRP = drug-related problem; MAI = Medication Appropriateness Index; MRP = medication-related problem; OR = odds ratio; RD = risk difference; pp = percentage points; NS = not significant.

By setting, all four community and primary-care trials and two of three long-term-care trials showed benefit. Hospital and transition trials were more varied: six of 11 showed benefit, one was mixed and four were null (Figure 2B). The null hospital trials shared features: low baseline event rates, reliance on advice passed to other prescribers, or interventions delivered at a single point rather than across the transition.

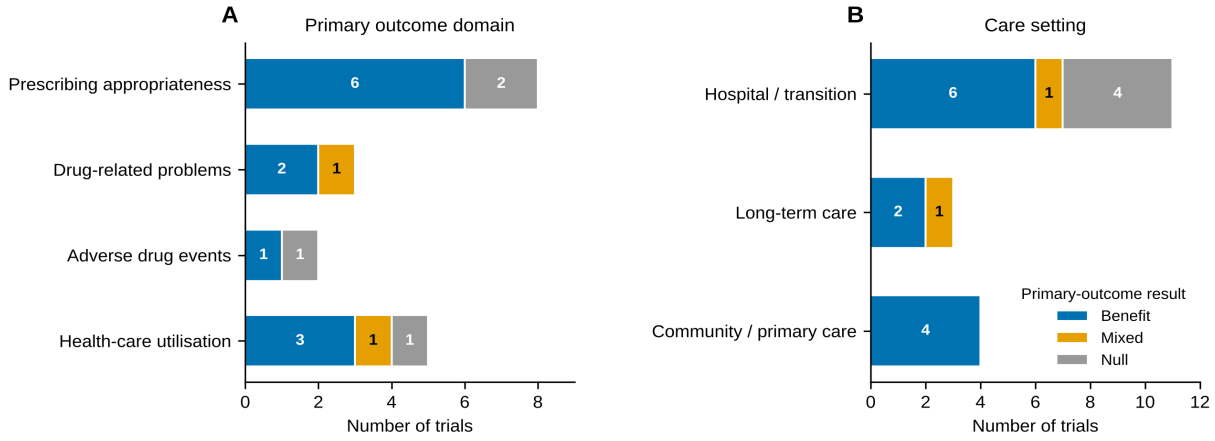


Figure 2. Direction of effect on the primary harm-related outcome in the 18 included trials, by (A) outcome domain and (B) care setting. Bars show the number of trials with a statistically significant benefit (blue), a mixed result (orange) or no significant difference (grey). Data are taken from Table 2.

3.4 Acceptance of pharmacist recommendations

Six trials reported how often prescribers accepted or implemented pharmacist recommendations. The median was 84.0%, ranging from 42.4% when advice was sent to general practitioners after discharge (Basger et al., 2015) to 94.8% when recommendations were made face to face on ward rounds (Sosyal et al., 2025). The Jordanian trial reported 94.2% acceptance (Hammad et al., 2025). Trials with acceptance above 80% were also those that reported benefit on their primary outcome (Figure 3).

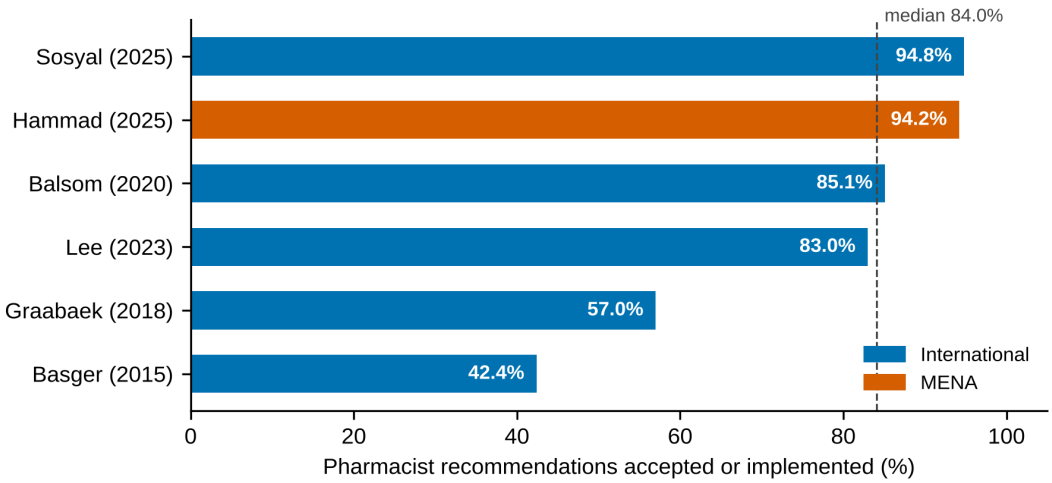


Figure 3. Proportion of clinical pharmacist recommendations accepted or implemented by prescribers in the six trials that reported it. The dashed line marks the median (84.0%). The orange bar is the only trial from the Middle East and North Africa region (Jordan). Values are those reported in the trial records (Table 1 and Section 3.4).

3.5 Evidence from Saudi Arabia and the Gulf region

No randomised or controlled trial from Saudi Arabia or the GCC met the inclusion criteria. The regional literature consists mainly of observational studies that describe the size of the problem and the conditions for pharmacist services (Table 3). These studies agree that PIM exposure among Saudi older adults is high and persistent, that reconciliation errors at admission are common and more likely in older patients, and that physicians see clinical pharmacists as facilitators of deprescribing but also report concerns about inter-

professional conflict and time pressure (AlRasheed et al., 2018). In Qatar, the number of clinical pharmacist interventions per patient in a rehabilitation hospital rose with age (Naseralallah et al., 2025), and older patients attending Kuwaiti geriatric clinics reported a high willingness to deprescribe, especially when their physician advised it (Alshammari et al., 2024).

Table 3. Contextual evidence from Saudi Arabia and the Gulf region on medication-related risk in older adults and pharmacist services.

Study	Country (tag)	Design and sample	Key finding relevant to this review
Mazhar et al. (2017)	Saudi Arabia (Saudi)	Prospective; 328 admitted patients, pharmacist-obtained medication histories	491 reconciliation errors affecting 54% of patients; 17.7% potentially harmful; age ≥65 years was an independent risk factor
AlRasheed et al. (2018)	Saudi Arabia (Saudi)	Qualitative focus groups; 15 family physicians, Riyadh	Clinical pharmacists seen as facilitators of deprescribing; barriers included fear of conflict, poor documentation and crowded clinics
Alsuwaidan et al. (2019)	Saudi Arabia (Saudi)	Retrospective; 3,009 patients ≥65 years	55% had polypharmacy; hypertension, dyslipidaemia and diabetes were the commonest conditions
Meraya et al. (2021)	Saudi Arabia (Saudi)	Retrospective; 1,300 older psychiatric outpatients, Jazan	68% received potentially inappropriate psychotropics; 77.7% had psychotropic polypharmacy
Alsaad et al. (2022)	Saudi Arabia (Saudi)	Retrospective; 358 inpatients ≥65 years, Riyadh	45.8% used a Beers-listed PIM; PIM use associated with frailty, comorbidity and medication count
AlHarkan et al. (2023)	Saudi Arabia (Saudi)	Cross-sectional; 387 outpatients ≥60 years, Khobar	Polypharmacy 50.9% and Beers-positive prescribing 51.4%; both associated with falls risk
Jabri et al. (2023)	Saudi Arabia (Saudi)	Repeated cross-sectional; 23,417 outpatients ≥65 years, Riyadh	Annual PIM prevalence 57.2%–63.6%, rising over 2017–2019; ≥5 medicines strongly associated with PIMs
Jabri et al. (2025)	Saudi Arabia (Saudi)	Cohort; 9,887 outpatients ≥65 years	Over 82% dispensed ≥1 PIM; 55.9% followed a sustained PIM trajectory
Alshammari et al. (2024)	Kuwait (GCC-MENA)	Cross-sectional; 388 older adults in geriatric clinics	High willingness to deprescribe, especially if advised by the physician; lower among men and those on >5 medicines
Naseralallah et al. (2025)	Qatar (GCC-MENA)	Cross-sectional; 3,807 pharmacist interventions in 815 rehabilitation patients	Number of interventions per patient increased with age; 79.8% judged of moderate severity
Hammad et al. (2025)	Jordan (GCC-MENA)	RCT; 128 inpatients >65 years (included trial)	94.2% of recommendations accepted; lower 30-day readmission and emergency visits

Note. Only the Jordanian study is a controlled trial; the remaining studies are observational or qualitative and were used for context. PIM = potentially inappropriate medication; RCT = randomised controlled trial.

4. Discussion

4.1 Principal findings

Across 18 recent trials in more than 12,000 older adults, clinical pharmacist interventions most consistently improved the quality of prescribing: fewer inappropriate medicines, fewer unresolved DRPs and better appropriateness scores. Effects on hard clinical end points were less uniform. Pharmacists reduced repeat emergency visits and readmissions when they followed patients across the transition from hospital to home and communicated directly with the next prescriber, but single-point services and large pragmatic programmes delivered to unselected patients often showed little effect. The trials also show that the benefit depends on whether advice is acted on: acceptance rates above 80% went with positive trials, whereas low implementation went with null ones.

4.2 Comparison with previous reviews

These findings agree with earlier syntheses. A review of deprescribing trials in hospitalised older adults found that seven of nine reduced PIMs but that clinical outcomes were seldom improved significantly (Thillainadesan et al., 2018). In residential aged care, 43% of pharmacist-led interventions reduced ADEs (Ali et al., 2021), and a review of deprescribing in frail older people reported that 72%–91% of recommendations were implemented without signals of harm (Ibrahim et al., 2021). The emergency-department meta-analysis by Skains et al. (2025) found that pharmacist review reduced PIMs (odds ratio 0.68) without changing admissions or length of stay, a pattern that our review also observed in hospital-based trials. The Asian meta-analysis by Kim et al. (2024), which pooled hospitalisation and mortality (both

risk ratios 0.57), is more favourable than the mixed utilisation results here; differences in baseline care and in the intensity of follow-up may explain the gap. The most recent meta-analysis of pharmacist-led deprescribing found pooled effects on total medicine count that were not statistically significant (Tesfaye et al., 2026), which is consistent with the ASPIRE finding that appropriateness can improve while the number of medicines stays the same (Hellemans et al., 2026). Pharmacist home visits alone have not reduced admissions (Abbott et al., 2020), and in primary care, pharmacist-led and algorithm-based deprescribing outperformed reviews performed by family physicians alone (Oliveira et al., 2026).

4.3 Why some trials were null

Three explanations recur. The first is a low event rate: when medication-related readmission is rare in the control group, even a well-delivered service cannot show a difference without a very large sample (Graabaek et al., 2018). The second is incomplete delivery. In the Slovenian reconciliation trial, most discrepancies were never discussed with the treating physician (Jošt et al., 2021), and in the Norwegian IMMENSE trial only about half of patients received every planned step, although two-thirds of identified problems were solved (Johansen et al., 2021). The third is dilution. When a service is applied to all eligible patients, those at low risk add cost and noise without much benefit; the PHARM-DC subgroup result suggests that targeting patients with poor adherence or low health literacy would be more efficient (Pevnick et al., 2026).

4.4 Implications for Saudi Arabia and the Gulf

The regional evidence shows a large target for pharmacist services. PIM prevalence among older Saudi outpatients (57%–64%) is at the upper end of international estimates (Jabri et al., 2023), more than half of older patients receive five or more medicines (Alsuwaidan et al., 2019) and admission reconciliation errors are common (Mazhar et al., 2017). The only Arab-region trial in this review, from Jordan, showed high physician acceptance and fewer readmissions (Hammad et al., 2025), which suggests that the international benefits are achievable in neighbouring health systems. However, no controlled trial has yet tested a pharmacist service for older adults in Saudi Arabia or the GCC.

Based on what has worked elsewhere, Saudi hospitals planning or strengthening geriatric clinical pharmacy services could:

- concentrate pharmacist time on high-risk older patients (polypharmacy, frailty, recent admission, high-risk medicines, low adherence or literacy) rather than covering all admissions thinly;
- link admission reconciliation, inpatient review and discharge counselling with a direct handover to the primary-care physician and community pharmacy, using the national e-prescribing platform where possible;
- deliver recommendations in person on ward rounds or in shared clinics, and track acceptance as a quality indicator;
- adopt explicit tools such as the 2023 Beers Criteria or STOPP/START alongside clinical judgement; and
- evaluate new services with controlled designs that report clinical outcomes, including ADEs, falls, emergency visits and readmissions, not only process measures.

Pharmacy technicians also have a role in these models, for example by collecting best possible medication histories and preparing reconciliation lists, which frees pharmacist time for clinical review.

4.5 Strengths and limitations

This review brings together recent trials from all major care settings, including several large trials published in 2025 and 2026, and places them alongside the Saudi and Gulf evidence. It has limitations. Only PubMed was searched, so trials indexed only in Embase, CINAHL or regional databases may have been missed. Screening and data extraction were performed by a single reviewer, and eligibility and extraction were based

on PubMed records and abstracts rather than full texts, so some details of interventions and outcomes may be incomplete. A formal risk-of-bias assessment with the Cochrane RoB 2 tool was not possible on this basis. Heterogeneity in interventions, outcomes and follow-up prevented meta-analysis, and vote counting by direction of effect does not weigh trials by size or precision. Finally, the regional searches were used for context only and were not screened with the same eligibility process.

5. Conclusion

Clinical pharmacists consistently improve prescribing quality and resolve drug-related problems in older adults, and they reduce medication-related emergency visits and readmissions when their work spans the transition from hospital to home and their advice reaches the next prescriber. Benefit is greatest when services target high-risk patients and when recommendations are delivered directly and accepted. Saudi Arabia and the Gulf have a high burden of inappropriate prescribing in older adults but no controlled trials of pharmacist services in this group. Well-designed local trials, with clinical end points and attention to implementation, should be a priority for hospitals expanding geriatric clinical pharmacy.

Declarations

Ethics approval and consent to participate: Not applicable. This review used published data only.

Funding: Not Applicable

Data availability: The search strategies, screening decisions and extraction data are available from the corresponding author on reasonable request.

Use of artificial intelligence: An AI assistant (Claude, Anthropic) was used to help run the PubMed searches, organise extracted data, generate figures and draft the text. The authors are responsible for verifying all content, citations and data before submission.

References

- Abbott, R. A., Moore, D. A., Rogers, M., Bethel, A., Stein, K., & Coon, J. T. (2020). Effectiveness of pharmacist home visits for individuals at risk of medication-related problems: A systematic review and meta-analysis of randomised controlled trials. *BMC Health Services Research, 20*(1), 39. https://doi.org/10.1186/s12913-019-4728-3
- AlHarkan, K. S., Alsousi, S., AlMishqab, M., Alawami, M., Almearaj, J., Alhashim, H., Alamrad, H., Alghamdi, L. M., Almansour, A., & AlOmar, R. S. (2023). Associations between polypharmacy and potentially inappropriate medications with risk of falls among the elderly in Saudi Arabia. *BMC Geriatrics, 23*(1), 222. https://doi.org/10.1186/s12877-023-03852-y
- Ali, S., Salahudeen, M. S., Bereznicki, L. R. E., & Curtain, C. M. (2021). Pharmacist-led interventions to reduce adverse drug events in older people living in residential aged care facilities: A systematic review. *British Journal of Clinical Pharmacology, 87*(10), 3672–3689. https://doi.org/10.1111/bcp.14824
- AlRasheed, M. M., Alhawassi, T. M., Alanazi, A., Aloudah, N., Khurshid, F., & Alsultan, M. (2018). Knowledge and willingness of physicians about deprescribing among older patients: A qualitative study. *Clinical Interventions in Aging, 13*, 1401–1408. https://doi.org/10.2147/CIA.S165588
- Alsaad, S. M., AlEraij, S., Alsaad, A. M., AlSaif, H. I., & Bawazeer, G. (2022). Potentially inappropriate medications among elderly with frailty in a tertiary care academic medical centre in Saudi Arabia. *Healthcare, 10*(8), 1440. https://doi.org/10.3390/healthcare10081440
- Alshammari, H., Al-Saeed, E., Ahmed, Z., & Aslanpour, Z. (2024). Deprescribing attitudes and predictors among older adults attending geriatric clinics in Kuwait. *PLoS ONE, 19*(12), e0311853. https://doi.org/10.1371/journal.pone.0311853
- Alsuwaidan, A., Almedlej, N., Alsabti, S., Daftardar, O., Al Deaji, F., Al Amri, A., & Alsuwaidan, S. (2019). A comprehensive overview of polypharmacy in elderly patients in Saudi Arabia. *Geriatrics, 4*(2), 36. https://doi.org/10.3390/geriatrics4020036

- American Geriatrics Society Beers Criteria Update Expert Panel. (2023). American Geriatrics Society 2023 updated AGS Beers Criteria® for potentially inappropriate medication use in older adults. *Journal of the American Geriatrics Society, 71*(7), 2052–2081. https://doi.org/10.1111/jgs.18372
- Balsom, C., Pittman, N., King, R., & Kelly, D. (2020). Impact of a pharmacist-administered deprescribing intervention on nursing home residents: A randomized controlled trial. *International Journal of Clinical Pharmacy, 42*(4), 1153–1167. https://doi.org/10.1007/s11096-020-01073-6
- Basger, B. J., Moles, R. J., & Chen, T. F. (2015). Impact of an enhanced pharmacy discharge service on prescribing appropriateness criteria: A randomised controlled trial. *International Journal of Clinical Pharmacy, 37*(6), 1194–1205. https://doi.org/10.1007/s11096-015-0186-0
- Christensen, L. W. S., Juul-Larsen, H. G., Nielsen, R. L., Bornæs, O., Treldal, C., Aharaz, A., Gemmer, M., Andersen, T. S., Long, D. H., Olsen, G. M., Sejberg, H. R. C., Jørgensen, L. M., Ramberg, E., Jawad, B. N., Iversen, E., Dalhoff, K. P., Andersen, O., Andersen, A. L., & Houlind, M. B. (2025). Efficacy of an interprofessional medication review among acutely admitted older medical patients: A randomized controlled trial. *British Journal of Clinical Pharmacology, 92*(4), 1221–1231. https://doi.org/10.1002/bcp.70399
- Graabaek, T., Hedegaard, U., Christensen, M. B., Clemmensen, M. H., Knudsen, T., & Aagaard, L. (2018). Effect of a medicines management model on medication-related readmissions in older patients admitted to a medical acute admission unit: A randomized controlled trial. *Journal of Evaluation in Clinical Practice, 25*(1), 88–96. https://doi.org/10.1111/jep.13013
- Haider, I., Kosari, S., Naunton, M., Niyonsenga, T., Koerner, J., Peterson, G., & Davey, R. (2023). Impact of on-site pharmacists in residential aged care facilities on the quality of medicines use: A cluster randomised controlled trial (PiRACF study). *Scientific Reports, 13*(1), 15962. https://doi.org/10.1038/s41598-023-42894-5
- Hammad, E. A., Khaled, F., Shafaamri, M., Amireh, B., Arabyat, R., & Abu-Farha, R. K. (2025). Impacts of pharmacist-led medication reconciliation on discrepancies and 30-days post-discharge health services utilization in elderly Jordanians. *PLoS ONE, 20*(4), e0320699. https://doi.org/10.1371/journal.pone.0320699
- Hellemans, L., Blocquiaux, L., Hias, J., Walgraeve, K., Liesenborghs, A., Lammens, A., Deschodt, M., Tournoy, J., & Van der Linden, L. (2026). Effect of a multifaceted pharmacist-led intervention on medication appropriateness and medication burden in patients admitted to an acute geriatric ward: Results from the ASPIRE trial. *Drugs & Aging, 43*(3), 293–306. https://doi.org/10.1007/s40266-026-01278-w
- Huiskes, V. J. B., van den Ende, C. H. M., Kruijtbosch, M., Ensing, H. T., Meijs, M., Meijs, V. M. M., Burger, D. M., & van den Bemt, B. J. F. (2019). Effectiveness of medication review on the number of drug-related problems in patients visiting the outpatient cardiology clinic: A randomized controlled trial. *British Journal of Clinical Pharmacology, 86*(1), 50–61. https://doi.org/10.1111/bcp.14125
- Ibrahim, K., Cox, N. J., Stevenson, J. M., Lim, S., Fraser, S. D. S., & Roberts, H. C. (2021). A systematic review of the evidence for deprescribing interventions among older people living with frailty. *BMC Geriatrics, 21*(1), 258. https://doi.org/10.1186/s12877-021-02208-8
- Jabri, F. F., Liang, Y., Alhawassi, T. M., Johnell, K., & Möller, J. (2023). Potentially inappropriate medications in older adults—Prevalence, trends and associated factors: A cross-sectional study in Saudi Arabia. *Healthcare, 11*(14), 2003. https://doi.org/10.3390/healthcare11142003
- Jabri, F. F., Liang, Y., Johnell, K., & Möller, J. (2025). Trajectories of potentially inappropriate medication use among older adults in Saudi Arabia. *Frontiers in Pharmacology, 16*, 1568160. https://doi.org/10.3389/fphar.2025.1568160
- Johansen, J. S., Halvorsen, K. H., Havnes, K., Wetting, H. L., Svendsen, K., & Garcia, B. H. (2021). Intervention fidelity and process outcomes of the IMMENSE study, a pharmacist-led interdisciplinary intervention to improve medication safety in older hospitalized patients. *Journal of Clinical Pharmacy and Therapeutics, 47*(5), 619–627. https://doi.org/10.1111/jcpt.13581
- Jošt, M., Knez, L., Mrhar, A., & Kerec Kos, M. (2021). Adverse drug events during transitions of care: Randomized clinical trial of medication reconciliation at hospital admission. *Wiener Klinische Wochenschrift, 134*(3–4), 130–138. https://doi.org/10.1007/s00508-021-01972-2
- Kim, I.-J., Ryu, G., Rhie, S. J., & Kim, H.-J. (2024). Pharmacist interventions in Asian healthcare environments for older people: A systematic review and meta-analysis on hospitalization, mortality, and quality of life. *BMC Geriatrics, 24*(1), 513. https://doi.org/10.1186/s12877-024-05089-9

- Kocklaeuner, M., Geschke, K., Fellgiebel, A., & Kraemer, I. (2025). Effect of pharmacist-led medication reviews on appropriateness of prescribing in patients with dementia: Results from the cluster randomized controlled "DemStepCare" study. *BMC Geriatrics, 25*(1), 842. https://doi.org/10.1186/s12877-025-06565-6
- Lee, S., Yu, Y. M., Han, E., Park, M. S., Lee, J.-H., & Chang, M. J. (2023). Effect of pharmacist-led intervention in elderly patients through a comprehensive medication reconciliation: A randomized clinical trial. *Yonsei Medical Journal, 64*(5), 336–343. https://doi.org/10.3349/ymj.2022.0620
- Liou, W.-S., Huang, S.-M., Lee, W.-H., Chang, Y.-L., & Wu, M.-F. (2021). The effects of a pharmacist-led medication review in a nursing home: A randomized controlled trial. *Medicine, 100*(48), e28023. https://doi.org/10.1097/MD.0000000000028023
- Marinović, I., Bačić Vrca, V., Marušić, S., Grgurević, I., Brkić, M., Jambrek, N., Mesarić, J., & Samardžić, I. (2024). Effect of care transfer model led by the hospital clinical pharmacist on reduction of hospital readmissions in the elderly. *Die Pharmazie, 79*(3), 91–96. https://doi.org/10.1691/ph.2024.3666
- Martin, P., Tamblyn, R., Benedetti, A., Ahmed, S., & Tannenbaum, C. (2018). Effect of a pharmacist-led educational intervention on inappropriate medication prescriptions in older adults: The D-PRESCRIBE randomized clinical trial. *JAMA, 320*(18), 1889–1898. https://doi.org/10.1001/jama.2018.16131
- Martínez-Sotelo, J., Pinteño-Blanco, M., García-Ramos, R., & Cadavid-Torres, M. I. (2021). Prescription appropriateness in elderly patients with polypharmacy in primary care: Cluster-randomized controlled trial PHARM-PC [in Spanish]. *Atención Primaria, 53*(10), 102124. https://doi.org/10.1016/j.aprim.2021.102124
- Mazhar, F., Akram, S., Al-Osaimi, Y. A., & Haider, N. (2017). Medication reconciliation errors in a tertiary care hospital in Saudi Arabia: Admission discrepancies and risk factors. *Pharmacy Practice, 15*(1), 864. https://doi.org/10.18549/PharmPract.2017.01.864
- Meraya, A. M., Banji, O. J. F., Khobrani, M. A., & Alhossan, A. (2021). Evaluation of psychotropic medications use among elderly with psychiatric disorders in Saudi Arabia. *Saudi Pharmaceutical Journal, 29*(6), 603–608. https://doi.org/10.1016/j.jsps.2021.04.021
- Naseralallah, L., Noureddine, Z., Ahmed, A., Al Hail, M., & Koraysh, S. (2025). Analysis of clinical pharmacists' interventions in a rehabilitation setting. *Journal of Pharmaceutical Policy and Practice, 18*(1), 2450593. https://doi.org/10.1080/20523211.2025.2450593
- Oliveira, E. M., Ferreira, L. C., Silva, M. C., & Hattori, W. T. (2026). Optimizing medication use in older adults in primary care: A systematic review of the effectiveness of deprescribing interventions. *Geriatrics & Gerontology International, 26*(7), e70677. https://doi.org/10.1111/ggi.70677
- Pevnick, J. M., Kennelty, K., Nguyen, A. T., Amer, K., Berdahl, C. T., Cook-Wiens, G., Fanikos, J., Fiskio, J., Gotanda, H., Guan, J., Henreid, A. J., Keller, M. S., Ko, E. M., Leang, D. W., Malkhasian, Y., Matta, L., Moriarty, D., Murry, L., Muske, A., … Schnipper, J. L. (2026). Pharmacist-led discharge care to reduce postdischarge health care utilization: A randomized clinical trial. *JAMA Network Open, 9*(3), e260719. https://doi.org/10.1001/jamanetworkopen.2026.0719
- Skains, R. M., Hayes, J. M., Selman, K., Zhang, Y., Thatphet, P., Toda, K., Hayes, B. D., Tayes, C., Casey, M. F., Moreton, E., Kennedy, R. E., Lee, S., & Liu, S. W. (2025). Emergency department programs to support medication safety in older adults: A systematic review and meta-analysis. *JAMA Network Open, 8*(3), e250814. https://doi.org/10.1001/jamanetworkopen.2025.0814
- Sosyal, D., Bektay, M. Y., Acikgoz, N., & Izzettin, F. V. (2025). Evaluation of clinical pharmacy services in patients receiving antithrombotic treatment in a randomized controlled trial. *Scientific Reports, 15*(1), 41692. https://doi.org/10.1038/s41598-025-25594-0
- Tesfaye, Z. T., Horsa, B. A., & Yismaw, M. B. (2026). Impact of pharmacist-led deprescribing interventions on medication related outcomes among older adults: A systematic review and meta-analysis. *BMC Geriatrics, 26*(1), 181. https://doi.org/10.1186/s12877-025-06964-9
- Thillainadesan, J., Gnjidic, D., Green, S., & Hilmer, S. N. (2018). Impact of deprescribing interventions in older hospitalised patients on prescribing and clinical outcomes: A systematic review of randomised trials. *Drugs & Aging, 35*(4), 303–319. https://doi.org/10.1007/s40266-018-0536-4
- Villiet, M., Laureau, M., Perier, D., Pinzani, V., Giraud, I., Lohan, L., Bobbia, X., Mercier, G., Jaussent, A., Macioce, V., Sebbane, M., Faucanié, M., & Breuker, C. (2025). Emergency department visits for medication-related events with vs without pharmacist intervention: The URGEIM randomized clinical trial. *JAMA Internal Medicine, 185*(6), 669–678. https://doi.org/10.1001/jamainternmed.2025.0640