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ALRUTHEA ET AL.

MANUSCRIPT TITLE

Interventions to Enhance Medication Safety in Residential Aged Care Settings: An Umbrella Review

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Intervention, Medication safety, Medication errors, Aged care, Umbrella review

ABSTRACT

Aim: To conduct a systematic synthesis of existing evidence reviews on interventions to enhance medication safety in RACS, to establish and compare their effectiveness.

Method: This umbrella review included examination of meta-analyses, scoping and systematic reviews. Four electronic databases were examined for eligible reviews. Two authors critically appraised those meeting the inclusion criteria using the JBI Critical Appraisal Instrument.

Results: Fifteen reviews covering 171 unique, primary studies were included. Of the variety of interventions identified in the literature, five main categories of interventions were commonly reported to be effective in promoting medication safety in RACS (medication review, staff education, multidisciplinary team meetings, computerised clinical decision support systems, and miscellaneous). Most reviews showed mixed evidence to support interventions' effectiveness, due to the significant heterogeneity between studies in their sites, sample sizes and intervention periods. In all intervention categories, pharmacists' collaboration was most beneficial, showing definitive evidence for improving medication safety and quality of prescribing in RACS. Eight reviews recommended multi-component interventions, particularly medication reviews and staff education, but specific details were infrequently provided. Only five reviews presented insights into implementation facilitators and barriers, while the sustainability of interventions was only discussed in one review.

Conclusion: There is strong evidence to support the four main categories of interventions identified. However, limited details are available regarding the most appropriate design and implementation of multi-component interventions, and the sustainability of all interventions; thus, solid recommendations cannot be made. Future research in this field should focus on producing theoretically informed, methodologically-robust, original research; particularly regarding the design, implementation and sustainability of multi-component interventions, which appears the most promising approach.

1.1 INTRODUCTION

Population ageing is a major global trend; therefore, to meet increased healthcare demand among the elderly, countries worldwide offer institutional care that provides long-term housing, living support and nursing care.¹ Medication management is one of the fundamental collaborative processes in these settings, which requires health care professionals, community pharmacies and aged care facilities to coordinate related activities like medication prescribing, ordering, delivery, administration and follow-up in an efficient manner. The complexity of these processes makes medication safety difficult to achieve.

Concerns about medication safety in residential aged care settings (RACS) are recognised worldwide by policymakers, academic researchers and the media. Various studies exploring medication safety in RACS report a higher rate of medication errors than in hospital settings.²⁻⁴ Medication errors can be defined as any error that occurs during prescribing, dispensing, or administering medications and results in the failure to give a patient the correct drug or proper dosage.⁵ Medication safety in RACS is an issue of heightened concern because residents are generally frail, with multimorbidity and polypharmacy, which increases the risk of adverse drug events (ADE).⁴

For the last decade, researchers have focused on identifying interventions that can enhance medication safety in RACS, producing a large body of literature. Prominent interventions include medication reviews, staff education, multidisciplinary team (MDT) meetings, and computerised clinical decision support systems (CCDSS). The volume and diversity of published research on this topic, including systematic reviews, makes it difficult for health policymakers and professionals to be familiar with the entire body of literature, covering the full range of interventions available, and identify which interventions are evidence-based and most likely to produce positive outcomes. Therefore, a contemporary, exhaustive identification and literature synthesis is necessary to inform efforts to address medication safety in RACS.

We conducted an umbrella review⁶ to systematically identify, appraise and synthesise all available reviews on interventions to reduce medication errors in RACS. Umbrella reviews offer an efficient method of scoping the content and study designs employed within a large field of study that has already been investigated via multiple, high quality systematic and scoping reviews.⁶ This

umbrella review aimed to systematically synthesise literature to answer the following question: what interventions enhance medication safety in RACS?

1.2 RESEARCH METHODS

This review was designed in accordance with the Joanna Briggs Institute (JBI) Manual for conducting umbrella reviews.⁶ The Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) was employed, in line with best practice.⁷ The JBI Critical Appraisal Instrument for Systematic Reviews and Research Syntheses was then also employed to ensure that the methods utilised in this umbrella review were rigorous.⁶

1.2.1 eligibility criteria

The eligibility criteria were based on the PICOS (Population, Intervention, Comparison, Outcome, and Study design) framework.⁸ Table 1 presents the eligibility criteria. A narrative description, in greater detail, is provided in supplementary appendix S1.

Table 1: Umbrella Review Eligibility Criteria

1.2.2 search strategy

In May 2021, four electronic databases (MEDLINE, EMBASE, CINAHL, and The Cochrane Library Database of Systematic Reviews) were systematically searched for published reviews and meta-analyses without date, language, or geographical limitations. Table 2 below shows the three search concepts utilised. Supplementary appendix S2 provides the precise search terms and strategies applied in each of the four databases.

Table 2: Umbrella Review Search Concepts

1.2.3 study screening and selection

Results were exported to EndNote X9.⁹ Duplicates were removed. The first author led the screening process, with a sample of 30 studies screened collaboratively with the final author (RH) for validation. There were three stages: title screening, abstract screening, and full-text screening. For the first two stages, a separate group named 'Inclusion' was created to categorise reviews to be either included or

excluded based on their relevancy to the review's aim. The included reviews were then moved to a new group set named 'Eligibility' for the third stage. Reviews that failed to meet the eligibility criteria were excluded, with reasons for exclusion detailed.

1.2.4 quality assessment

Following the requirements of the JBI umbrella review manual, included reviews were assessed by three authors (SA, PB, RH) for methodological validity using the JBI Critical Appraisal Instrument for Systematic Reviews and Research Syntheses.⁶ This instrument contains eleven questions (see supplementary appendix S3) that evaluate whether rigorous methods have been utilised. Each question is answered with 'yes', or 'no' or 'unclear'.

The quality of each included review was assessed using the following categories: low quality (met \leq 33% of the criteria), medium quality (met 34 to 66% of the criteria), and high quality (met \geq 67% of the criteria). Regardless of the quality score, all reviews that met the eligibility criteria were appraised and included in the data extraction table (Supplementary appendix S5).

1.2.5 data extraction and synthesis

The data were extracted in accordance with the JBI Data Extraction Form for Review for Systematic Reviews and Research Syntheses.⁶ The following data were extracted: 1) authors and year of publication; 2) type of review; 3) objectives; 4) participants; 5) settings; 6) interests; 7) the number of searched databases; 8) date range of included studies; 9) number, type, and country of origin of included studies; 10) appraisal instrument and rating; 11) outcomes, which in this case are the suggested interventions to enhance medication safety; and 12) results and findings.

The extracted findings are presented narratively in the Review Findings (section 1.3.4) and in a tabular format in the Summary of Evidence (1.4). The authors, who possess aged care and literature review expertise, extracted the data and collaboratively determined the findings and implications. The last author (RH) reviewed the completed data extraction form for three included studies to ensure accuracy and consistency.

1.3 RESULTS

1.3.1 review inclusion and exclusion

A total of 1010 reviews were retrieved from the initial databases search. Figure 1 below indicates the PRISMA flow chart for the search process. After removing duplicates and non-English language reviews, 819 reviews were eligible for title and abstract screening. This process resulted in 44 reviews being identified for full-text assessment. Of these, 29 reviews were excluded (Supplementary appendix S4), leaving 15 reviews eligible for inclusion.

The reasons for excluding the 29 reviews after the full-text assessment were: 14 were deemed irrelevant based on their study type; 7 did not relate to medication safety; 7 did not focus on RACS's residents (e.g. home care, acute care, and hospital care); and one had been updated, with only the newest version included. Supplementary appendix S4 provides a list of the excluded reviews with reasons for their exclusion.

Figure 1: PRISMA Flow chart of review selection and inclusion process.⁷

1.3.2 methodological quality and strength of scientific evidence

The critical appraisal results for each of the 15 reviews are summarised in Table 3. Fourteen of the 15 included reviews were deemed high quality, and one was of medium quality. The lowest score was six and the highest was 11, out of a possible 11. However, only five of the 15 reviews discussed the strength of scientific evidence and included detailed tables assessing the quality of evidence of the primary studies.¹⁰⁻¹⁴

Despite accurate calculation of error rates being integral to robust evaluations, only six (40%) of the include reviews critically examined this issue. Of the reviews that did¹⁴⁻¹⁹, authors generally observed health-related outcomes such as hospital admissions, number of falls, mortality, ADE, and quality of life. Only two of the reviews that examined error rates commented on the robustness of the primary studies.^{14,15} Challenges to obtaining accurate estimates were also identified, such as variability in the design of primary studies, risk of bias, inconsistency, and imprecision.¹¹

Table 3: Critical Appraisal Results for Included Studies

1.3.3 characteristics of included reviews

The publication dates of the 15 included reviews ranged from 2009 to 2021.¹⁰⁻²³ Thirteen were systematic reviews, and two were scoping reviews. Three of the systematic reviews had embedded meta-analyses.^{14,17,19} The total number of unique, primary studies within the 15 reviews was 172; 52 primary studies were included in multiple reviews.

The number of databases searched in each review ranged from three to 12. The most frequent databases searched were MEDLINE, EMBASE, the Cochrane Library, and CINAHL. RACS were referred to using synonyms such as nursing homes (n=4), residential aged care facilities (RACF) (n=5), long-term care facilities (LTCF) (n=3) and care homes (n=3). This can be explained by the diverse lexicon used to describe this domain in different countries.

The reviews were grouped according to intervention type, using four categories that emerged from the initial analysis: medication review (n=13 reviews), staff education (n=8 reviews), MDT meetings (n=6 reviews), and CCDSS (n=5 reviews). Additional interventions were also identified, which did not fit into these categories; therefore, they were included in a separate intervention category named 'miscellaneous interventions' (n=3 reviews). No further interventions were identified in the included studies. Figures 2 and 3 below summarise the categories of interventions and countries of origin for the included reviews. Some of the reviews^{11,16} described various interventions that fell into multiple intervention categories. Table 4 illustrates the general characteristics of included reviews, and supplementary appendix S5 provides greater details.

Figure 2: Types of Interventions and Countries of Origins of Included Review

Table 4: General Characteristics of Included Reviews

1.3.4 key findings

The umbrella review findings are described narratively, as all but three included reviews conducted narrative syntheses only. The findings are categorised based on the types of interventions (as shown in Figure 3 below) and presented in order of their publication dates.

Figure 3: Main Categories of Interventions Investigated in the Review

1.3.4.1 Medication Review

Thirteen reviews representing 159 unique studies examined the effects of medication review interventions on medication safety in RACS.^{10-14,16-19,21-24} These medication review interventions aimed to address issues related to patients' use of medications and, by doing so, improve health outcomes.¹⁴ Medication review interventions were performed by pharmacists, physicians (General Practitioners or Geriatricians), nurses, and MDTs.

All 13 reviews examined pharmacists' involvement in medication review interventions.^{10-14,16-19,21-24} Pharmacist-led medication review was identified as important for enhancing medication safety and appropriate usage in RACS. Five reviews^{10,13,17,22,23} indicated that multidisciplinary medication review teams (involving physicians, pharmacists, nursing staff, and other allied health care professionals) were important in optimising prescribing in RACS. Only three reviews^{10,13,22} investigated physicians' (GPs and Geriatricians) involvement in medication review. These reviews did not evaluate the specific effectiveness of physicians' involvement, but rather, the effectiveness of the medication review teams of which they were members.

1.3.4.2 Staff Education

Eight reviews representing 70 unique studies examined the effects of RACS' staff education on medication safety.^{10-14,16-18} Staff education interventions involved face-to-face educational sessions with relevant health care professionals, such as nurses or prescribers, to discuss relevant practices.¹⁴ The following education and training styles were featured: educational meetings combined with at least one other type of intervention; educational outreach initiatives; distribution of educational materials; and pharmacist-led educational sessions.

All eight reviews indicated that staff education effectively enhances medication safety.^{10-14,16-18} Kröger et al¹³ indicated that the most effective educational interventions involved interactive educational approaches with direct feedback. Three reviews indicated that educational outreach initiatives are effective.^{10,12,13} These initiatives include outreach visits, educational materials for staff and on-demand prescription advice by phone to physicians.^{10,12,13} Two reviews indicated that pharmacist-led education sessions for RACS staff helped to improve their prescribing practice by increasing geriatric pharmacotherapy and disease management knowledge.^{10,14}

Two reviews indicated that interactive staff education techniques such as academic detailing showed the most promise for optimising prescribing patterns.^{16,18} Academic detailing is an educational outreach that involves face-to-face interaction between prescribing physicians and a group of experts.¹⁶ Finally, Alldred et al¹¹ mentioned clinical coaching and gerontology education for nurses and caregivers as an intervention; however, they did not report whether it was effective.

1.3.4.3 Multidisciplinary Team Meetings

Six reviews representing 45 unique studies examined the effects of MDT meetings on medication safety in RACS.^{11-14,16,17} Team meetings involved multiple clinical disciplines, such as physicians (GPs or Geriatricians), pharmacists, nurses, and other allied health care professionals. The MDT meeting interventions included in the reviews were convened either face-to-face, by video conference, phone, or a combination. Irrespective of mode, they similarly aimed to discuss and improve medication usage in RACS.¹⁴

Five reviews examined the effectiveness of case conferencing team meetings.^{11,13,14,16,17} They found that conducting the meetings in teams that involved physicians, pharmacists, nursing staff, and other allied health care professionals played a significant role in enhancing medication safety in RACS. Two reviews^{14,16} emphasised the importance of pharmacists' involvement in MDT meetings and indicated that their involvement enhanced medication safety in RACS.

Conversely, Thompson Coon et al¹² investigated in-reach service interventions, which involved MDTs working with a pharmacist or psychiatric team and spending time physically at RACS to support the staff. This intervention's effectiveness could not be determined rigorously due to a reduction of prescribing rates in both control and intervention groups.

1.3.4.4 Computerised Clinical Decision Support Systems

Five reviews representing 23 unique studies examined CCDSS impacts on medication safety.^{11,15-17,20} The included reviews discussed CCDSS designed with different technologies, including computerised physician order entry (CPOE), bar-code medication administration (BCMA), and electronic medication administration records (eMARs). CCDSS are employed during prescribing, management, or monitoring to detect and prevent medication-related problems.²⁰

One review²⁰ concluded that the evidence indicates that CCDSS should be considered among the most promising interventions to improve medication safety due to their efficient provision of recommendations to improve the quality of prescribing decisions related to dosing, drug interaction errors, and medication avoidance. Another review¹⁵ indicated that while the body of supportive evidence is increasing, there remains a clear need for further investigation to evaluate BCMA and eMAR systems' effectiveness on medication errors and patient safety in RACS.

The two remaining reviews investigated CPOE.^{11,16} Alldred et al¹¹ found it ineffective in reducing medication errors, while Loganathan et al¹⁶ labelled it as resource-intensive, potentially limiting its applicability for mass adoption in RACS.

1.3.4.5 Miscellaneous Interventions

Three reviews representing 22 unique studies examined the effects of five miscellaneous interventions on medication safety^{10,11,19}: transferring medicines information; geriatric assessment teams; activity program interventions for residents; early psychiatric interventions; and pharmacist documentation. These five interventions did not fit clearly into any of the abovementioned categories.

The first review¹¹ found that transferring medicines information from hospitals to GPs, RACS staff, and community pharmacists could improve appropriate prescription and medication use. The second review by Forsetlund et al¹⁰ mentioned three interventions. They indicated that a geriatric assessment team's medical care helped significantly in reducing the number of prescribed medications.¹⁰ The mean difference of prescribed medications was 2.3 fewer medications for the intervention group (95% CI: -4.58, -0.02) at three months.²⁵ However, due to the low quality of evidence and the small number of participants (n=33) in the primary study included in Forsetlund et al¹⁰'s review, the intervention's effectiveness could not be proven conclusively. Additionally, an activity program intervention for residents, identified in one primary study²⁶, failed to produce any statistically significant effects on the use of medications within six months of implementation.

The review by Forsetlund et al¹⁰ also cited a primary study that investigated early psychiatric intervention by a psychogeriatric team. The intervention was effective, but the small sample size prevented firm conclusions.²⁷ Finally, the third review by Sadowski et al¹⁹ investigated the impact of pharmacists' documentation on medication safety, but the evaluation findings were limited due to the presence of confounders.

1.3.4.6 Multi-component Interventions

Eight of the 15 included reviews recommended implementing a combination of interventions (multi-component interventions) to ensure medication safety in RACS.^{10-14,16,18,24} One review¹⁰ indicated that the combination of educational outreach, on-site education interventions, in addition to pharmacist-led medication review, might reduce inappropriate use of medications in RACS. Two reviews^{16,18} revealed that staff education, including academic detailing, showed the most promise, but the combination of at least two interventions (staff education, MDT meetings, pharmacist-led medication reviews, and CCDSS) was required to optimise prescribing in RACS. Kröger et al¹³ also found that multi-component intervention programs were essential to improve medication use among vulnerable seniors living in RACS. Their review's interventions were staff education programs, MDT meetings or case conferencing, and medication reviews.

Thompson Coon et al¹² investigated the effects of multi-component interventions through five eligible studies. The complexity of multi-component interventions ranged from three to seven components within the eligible studies. Components included audit and feedback, change to service delivery, education, structural changes, and changes to facilitate continuity of care. All five studies showed effectiveness associated with the multi-component interventions in reducing antipsychotic prescribing rates (ranging between 5% and 66%). However, two out of five studies reported a return to baseline prescribing levels after completing the intervention period.

Allred et al¹¹ indicated that appropriate use of medication in RACS could be enhanced through multi-component intervention programs involving the transfer of information, pharmacist-led medication review, and multidisciplinary case conferencing. Lee et al¹⁴ found that pharmacists' involvement in the suggested interventions (staff education, MDT meetings, and medication reviews) increased the quality use of medications in RACS.

McDerby et al²⁴ investigated multi-faceted medication reviews, where multidisciplinary collaboration and education were included as supporting interventions. They concluded that multi-

component interventions, including medication review, education and the involvement of multidisciplinary care providers and family members enhances patient-centred approaches to medication management in RACS dementia residents.²⁴

1.3.5 Consideration of Implementation factors

Four of the eight included reviews that recommended multi-component interventions mentioned the roles and impacts of implementation facilitators and impediments.^{10,12,16,24} Forsetlund et al¹⁰ emphasised the significance of senior leaders and practitioners perceiving interventions as being important, in order for them to produce positive impacts. McDerby and Thompson Coon et al^{12,24} discussed the critical role of organisational factors, such as time commitment and physician acceptance of pharmacist recommendations, in mediating the impacts of interventions. Loganathan et al¹⁶ presented the high costs associated with implementing interventions as an impediment. Only one study that investigated single-component interventions discussed implementation issues, identifying the key role of physicians' acceptance of pharmacists interventions.²¹

Within all 15 reviews, only one¹² investigated the long-term effects (sustainability) of interventions, concluding that there is limited information available to make such judgments. Six reviews briefly mentioned the concept, without examining it in any level of depth.^{10,11,13,14,16,18}

A final issue raised in the literature concerned the theoretical foundations of primary studies. Only three reviews^{10,12,24} discussed conceptual and practical issues regarding RACS staff behaviour change. Two reviews^{17,18} mentioned the limited theoretical basis for research in this field, presenting it as a weakness that needs to be addressed.

1.4 SUMMARY OF EVIDENCE

The JBI Umbrella review manual⁶ recommends including a tabular presentation of review findings and summary of evidence tables for both qualitative and quantitative research syntheses. Table 5 summarises the key findings, with details of interventions coloured, based on their effectiveness. Green indicates the intervention is effective, yellow indicates that effectiveness is unclear or might be achieved in some circumstances, while red indicates the intervention is not effective.

Table 5: Summary of the Review's Findings

1.5 DISCUSSION

1.5.1 main findings

This umbrella review summarised evidence from 15 systematic reviews, meta-analyses and scoping reviews representing 171 unique, primary studies conducted in 18 countries. These reviews focused on synthesising evidence on various interventions designed to improve medication safety in RACS. To the best of our knowledge, this is the first umbrella review on this topic. Based on the collective findings reported in the included reviews, the interventions that showed effectiveness were multidisciplinary medication review teams, educational workshops and RACS staff meetings, academic detailing, educational outreach initiatives, case conferencing, and CCDSS.

Medication errors in RACS are issues of concern not only due to their volume, but also their severity. Therefore, some interventions might be ineffective in enhancing medication safety overall, but on the other hand, they may be effective in reducing specific types of errors that cause more severe outcomes. Greater appreciation of this issue offers an opportunity to enhance future evidence reviews on this topic. Furthermore, it is essential not only to investigate the effectiveness of interventions, but also to reflect upon their context-specific implementation, particularly in resource-limited environments, to identify factors that can mediate their effectiveness.²⁸

Most of the included reviews showed mixed evidence to support interventions' effectiveness due to the significant heterogeneity between primary research studies regarding sites, sample sizes, and intervention periods. A key exception concerns the role of pharmacists in improving medication safety. In all intervention categories, pharmacists' collaboration with other health care professionals was beneficial, showing definitive evidence for improving medication safety and the quality of prescribing in RACS.

Pharmacists' roles varied from conducting medication reviews to coordinating and teaching, and engaging with other health care professionals in MDT meetings. However, their involvement does not negate the importance of physician involvement. None of the included reviews evaluated the effectiveness of physician involvement (alone) in medication reviews. Instead, all reviews discussed physicians' involvement as a part of a review team.

It is evident from this umbrella review that medication review interventions can decrease inappropriate use of medications, promote appropriate polypharmacy, identify actual and potential

ADEs, and encourage medication adherence. Further, medication review might also help identify and resolve complex medication issues for RACS staff and caregivers, such as reducing the number of doses and simplifying medication regimes.²⁹

To ensure the effectiveness of educational interventions, customised programs that engage several complementary techniques might be needed.¹⁶ Academic detailing with educational support and follow-ups should focus on all health care professionals in RACS and possibly family members.^{16,18} However, both Forsetlund and O'Brien et al^{30,31} found that educational interventions alone might not change behaviours when practitioners and leaders do not perceive it to be important, or when the change is multi-faceted and involves the interaction of many people.

The most persuasive evidence for enhancing medication safety in RACS concerned medication review, along with staff education. However, it was clear in those reviews that the interventions were most successful when they involved MDTs.^{11,18,22,23} These findings align with broader literature, such as in Sketris et al³², who found that combining two or more different interventions has more power than using one intervention alone to enhance medication safety.

There is growing evidence regarding the potentially beneficial role of other interventions, such as standardised medication charts, medication quality indicators, and facility accreditation standards, yet these interventions were not identified in the included reviews.³³⁻³⁵ Opportunities are available for future reviews in this field to synthesise evidence regarding those intervention categories.

A significant finding of this umbrella review is that, despite several reviews reporting the effectiveness of multi-component interventions,^{10-14,16,18,24} specific details of what they constitute were infrequently presented. Only two reviews provided detailed information about which multi-component interventions should be implemented together to ensure meeting the desired outcomes.^{11,18} There was limited insight within the included reviews regarding implementation factors that determine the effectiveness of multi-component interventions. Questions remain unanswered, such as whether the relative effectiveness of multi-component interventions is due simply to the number of interventions implemented and the overall level of resourcing provided to organisations, or whether it is more due to each specific intervention addressing the needs of different healthcare professionals involved in medication safety?

Clearly, stakeholders involved in efforts to enhance medication safety in RACS need to consider local barriers and enablers, and seek to incorporate them into intervention design or co-

design (in partnership with stakeholders) to support existing activities.³⁶ The implementation factors mediating intervention effectiveness is a topic that clearly requires further exploration to strengthen this body of literature. This is not only essential for original studies, but also future literature reviews, which were found in the present study to infrequently discuss or examine the topic in any level of depth.

It was surprising that, considering its importance, only seven of the included reviews discussed the sustainability of interventions.^{10-14,16,18} Two of these reviews suggested that more extended follow-up periods and progressive in-house training are essential to ensure sustainability.^{16,18} This alludes to the fact that interventions are most effective when they take a systems approach and target multiple stakeholders at different stages of change.³⁷ As noted above, interventions investigated in this umbrella review are known to be context-dependent.³⁸ Contextual factors that can mediate effectiveness include: organisational characteristics; strategic approaches to, and resourcing of, implementation; the degree of support by organisational leaders; and local organisational and disciplinary cultures.¹⁰ More detailed descriptions of study settings, interventions and implementation processes are required to strengthen the evidence-base regarding interventions to address medication safety in RACS.¹⁰

1.5.2 implications for policy and practice

As the proportion of people aged 65 years or over and their life span continues to increase worldwide, the need for RACS is becoming more critical.³⁹ Therefore, there is a mounting requirement for effective policies and procedures that directly support medication safety in RACS.

Clear evidence of effectiveness in enhancing medication safety in RACS is reported for interventions such as medication review, staff education, the use of CCDSS, MDT meetings, and efficient transfer of medication information between hospitals and RACS. Policymakers and RACS interested in improving medication safety are encouraged to implement those interventions. However, there is still a lack of sufficient information to support the impact of the miscellaneous interventions such as clinical coaching and gerontology education for nurses and early psychiatric intervention by a psychogeriatric team; therefore, these should be implemented with caution.

To improve medication safety in RACS, it is recommended that health policymakers and organisations explore a combination of at least two interventional strategies. This may include, in particular, medication review and staff education. This should be done in full consideration of the fact

that the use of multi-component intervention programs can be more resource-intensive, making it harder to isolate the contribution to effectiveness provided by the specific components.

1.5.3 Limitations

This umbrella review has several limitations. First, some of the included reviews only presented their results qualitatively, impeding meta-analyses' capability to produce more robust conclusions. Second, the results of a relatively small number of primary studies informed the syntheses and conclusions of several of the included reviews, which may have biased the key findings of this umbrella review. For instance, two primary studies (RCTs) by Furniss⁴⁰ and Zermansky⁴¹ were included in 10 out of the 14 included reviews. Third, some reviews might be considered outdated because physicians' training and prescribing guidelines have continued developing over time, impacting medication error rates and the effectiveness of different types of interventions. The fourth limitation concerns terminology. Yu et al⁴² highlighted the numerous definitions, terms, and functional meanings ascribed to medication safety. The complexity regarding terminology may have resulted in some reviews being omitted from this umbrella review. A similarly designed umbrella review that synthesised evidence to investigate medication safety measures in acute care has also noted this limitation.⁴³ Fifth, one of the reviews¹⁶ recommended multi-component interventions, despite this being based on only one primary study. Finally, and potentially most importantly, the reviews included in this study were diverse, in terms of the interventions and outcome measures examined. This increased the challenge of articulating detailed, common themes, and resulted in a propensity for broad description, as opposed to more nuanced examination of specific issues. Nonetheless, the heterogeneity of interventions and issues described and compared in this study ultimately increases its value for busy healthcare professionals and other stakeholders responsible for developing and implementing approaches to promote medication safety in RACS, as it presents a broad corpus of literature, evidence and concepts within a single paper.

1.6 CONCLUSION AND RECOMMENDATIONS

This review aimed to identify the effectiveness of interventions used to improve medication safety in RACS. The effective interventions identified in the literature are medication review, staff education, MDT meetings, CCDSS, and transferring medicines information between health care settings. There is evidence to suggest the combination of two or more of these interventions is the most promising

ALRUTHEA ET AL.

approach, but further research on that topic is required before strong conclusions can be made. Robust experimental primary studies of multi-component interventions and standardisation of medication safety terminology are recommended to strengthen the future evidence base.

CONTRIBUTORS

All authors were involved across all stages of the study concept and design, analysis and interpretation of data, drafting and final approval of the manuscript.

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CONFLICT OF INTERESTS

The authors declare that they have no conflict of interest.

PATIENT CONSENT FOR PUBLICATION

Not required.

DATA AVAILABILITY STATEMENT

Data extracted from the included systematic reviews are available upon reasonable request.

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