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A pre–post study of pharmacist-led medication reviews within a hospital-based residential aged care support service

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Abstract

Background: Hospital-based residential aged-care support service teams typically consist of doctors and nurses who provide hospital substitutive care to aged-care residents. There is limited literature evaluating the pharmacist's role in such aged-care support teams.

Objective: To analyse the effect of residential aged-care support service pharmacist-led medication reviews on polypharmacy, drug burden index, potentially inappropriate medications, and potential prescribing omissions for aged-care residents.

Methods: Residents referred to a residential aged-care support service pharmacist for medication review over a 12-month period were included. The pharmacist communicated medication-related problems and recommendations to the resident's general practitioner and residential aged-care support service medical practitioner. Residents' medication histories were obtained at baseline and one-month postintervention. The number of medications and their associated drug burden indices were compared using paired *t*-tests; potentially inappropriate medications and potential prescribing omissions were compared using Wilcoxon's signed rank test.

Key findings: Of 175 residents (mean age 84 years) referred for pharmacist-led medication review, 146 had postintervention evaluation after one-month (median 29 days). Mean number of medications reduced from 12.47 at baseline to 11.84 postintervention (mean difference (95% CI): 0.63(0.33–0.93), $P < .001$). Mean drug burden index score reduced from 1.54 at baseline to 1.37 postintervention (mean difference (95% CI): 0.17(0.10–0.24), $P < .001$). More residents experienced a decrease in inappropriate medications (median (IQR) pre: 2(1–3), post: 1(0–2), $P < .001$) and prescribing omissions (median (IQR) pre: 0(0–1), post: 0(0–0), $P = .003$) compared with those that had an increase.

Conclusions: Medication reviews performed by pharmacists embedded in hospital-based residential aged-care support services may improve medication prescribing. Further research into such preventative health service models is required.

Keywords: homes for the aged; medication review; nursing homes; pharmacists

Introduction

Compared with historical measures, residents of Australian Residential Aged Care Facilities (RACFs) are taking more medications, have increased frailty, and are living longer [1]. This population is at increased risk of medication-related harm due to age-related changes in pharmacokinetics and pharmacodynamics, and the presence of multi-morbidities.

Polypharmacy (defined as the concurrent use of five or more medications) and overuse of anticholinergic and sedative medicines is prevalent in aged care [2]. Australian RACF residents are prescribed an average of 11 medications per person [3]. Polypharmacy has been associated with poor clinical outcomes including mortality, falls, disability, and frailty [4].

Sometimes, the potential risks of medications may outweigh their benefits. In 2015, amongst a cohort of 541 Australian RACF residents, 81% were exposed to at least one potentially inappropriate medication (PIM) [5]. Use of PIMs may increase the risk of hospitalization, with one study finding that 17% of unplanned hospitalizations were attributed to PIM use [6]. Conversely, potential prescribing omissions (PPOs) occur when clinically appropriate medications have not been prescribed for a person. These two medication misadventure outcomes are often addressed by pharmacists in collaboration with prescribers [7].

A comprehensive medication review (CMR) involves a systematic assessment of a patient's medication management to identify medication-related problems and provide evidence-based, patient-centred recommendations to optimize the safe and quality use of medicines. One such service, the Residential Medication Management Review (RMMR),

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is an Australian government-funded service provided by an accredited pharmacist to a RACF resident after referral by a general practitioner (GP) [8]. However, such medication review services are underutilized, and further support is required to service this at-risk population [9].

Models of care are therefore continually evolving within Australian community and hospital settings. Hospital avoidance programs, such as the hospital-based Residential Aged-care Support Service (RaSS), are models of care providing support to residents when their care needs exceed the capacity of RACF staff and GPs [10]. RaSS aims to improve safety and quality of health care, minimize unnecessary and unplanned hospital presentations, and enhance patients' choice of care setting [11]. RaSS teams typically consist of geriatric-trained hospital doctors and nurses who, based on an assessment of the resident's acute care needs, may visit the RACF to provide emergency or hospital substitutive care, facilitate streamlined pathways for hospital admission, and/or provide follow-up care after hospital discharge.

In recent times, pharmacists have become members of RaSS teams. RaSS pharmacists play an important role in ensuring timely medication review, advice, and information transfer at transitions of care. Our hospital was the first RaSS service to pilot an embedded pharmacist [12]. Since doing so, pharmacists have become integral members of RaSS teams in Queensland and similar services have emerged interstate. In the Australian context, RaSS pharmacist-led CMRs differ from and are complementary to RMMRs: they are conducted at a time of acute need when hospitalization may become necessary, are performed by hospital-based pharmacists, and are funded by the RaSS-containing health service. Evidence suggests that RMMRs improve medicines use by reducing inappropriate prescribing and drug burden index (DBI) scores [3, 13, 14]. Pharmacist interventions in aged care settings internationally have mixed results [15]. However, there is limited evidence on whether RaSS pharmacist-led CMR similarly improves outcomes for RACF residents.

Aim

To investigate whether RaSS pharmacist-led medication review for older adults living in RACFs results in improved medication use.

Ethics approval

The study was granted ethics approval by The Prince Charles Hospital Human Research Ethics Committee (Project ID 47148) in Brisbane, Queensland, Australia. Patient informed consent was not deemed necessary as this was a quality assurance project with minimal risk to staff and patients. No information was gathered beyond that of routine care, and all data was de-identified for statistical analysis.

Methods

Study design, participants, and setting

This single group pre–post study was conducted prospectively over 12 months between 1 November 2018 and 31 October 2019. The study sample consisted of RACF residents within the Metro North Health catchment in Brisbane, Queensland, Australia, which comprises a population of over 9000 people residing in 99 RACFs. All residents who were referred to the RaSS pharmacist for CMR were eligible for inclusion in the study.

Two geriatric-trained RaSS pharmacists with postgraduate qualifications in clinical pharmacy and experience in the conduct of CMRs delivered the intervention and collected data.

Data collection

RACF residents could be referred to the RaSS team by GPs and RACF staff, as well as hospital-based medical, nursing, and allied health practitioners from within the emergency and inpatient settings. Referrals were sent to the generic RaSS team email account and accepted by the RaSS nurse or medical officer if it was deemed that the resident's care needs exceeded the RACF nursing staff and GP's capacity, and resident care could benefit from RaSS involvement. Reasons for referral could include requests for postdischarge follow-up, treatment or intervention, advice, second opinion, or to establish a diagnosis. Referrals were subsequently passed on to the RaSS pharmacist if the receiving RaSS clinician identified concerns that warranted specialist pharmacist input (e.g. suboptimal medication response, high-risk medicines, need for medication rationalization, possible adverse drug reaction, or another complex medication-related issue). GPs, RACF staff, and hospital clinicians could also refer residents for CMR by contacting the RaSS pharmacist directly.

CMRs were conducted using the process outlined in Supplementary File 1, in accordance with the Society of Hospital Pharmacists of Australia Standard of Practice in Clinical Pharmacy Services [16]. CMR findings and recommendations were documented by the pharmacist on a standardized GP report template (see Supplementary File 2) and forwarded to the resident's GP for consideration and action as appropriate. CMRs conducted in response to referrals from RaSS clinicians were communicated to the RaSS medical practitioner using the Pharmacist Assessment form (see Supplementary File 3). In addition to written communication, the pharmacist also liaised verbally with the GP or RaSS clinician on a case-by-case basis, when further clarification was warranted or to ensure resolution of urgent concerns.

A second medication history was obtained from the community pharmacy or RACF one-month postintervention to evaluate the effect of RaSS pharmacist-led CMR on medication outcomes. Residents who had died or were receiving end-of-life care were excluded from analysis of pre–post change. While an attempt to establish the nature of the deaths was made, given the RACFs were external facilities, it was not possible to access this data as it would require the collection of information beyond that of routine care and compromise patient confidentiality.

Outcome measures

Various pharmacological parameters are used to identify inappropriate prescribing including the Screening Tool of Older Person's Prescriptions (STOPP) and Screening Tool to Alert to Right Treatment (START) criteria, DBI score, and degree of polypharmacy [4, 17, 18]. Impact of RaSS pharmacist-led CMR was measured using this methodology, which is common in geriatric medication safety literature.

The STOPP/START criteria are explicit tools for identifying PIMs and PPOs [17]. STOPP consists of 80 PIM indicators, which commonly cause drug–drug and drug–disease interactions, unnecessary therapeutic duplication, and increased risk of cognitive decline and falls in older people.

START consists of 34 indicators for PPOs which identify medications that should be considered for a list of medical conditions, provided no contraindication to prescription exists. Application of STOPP/START criteria has been shown to improve medication appropriateness and reduce medication costs, falls, and adverse drug reactions in multi-morbid older people [7].

The DBI is a pharmacological risk assessment tool that measures the effect of cumulative exposure to both anticholinergic and sedative medications on physical and cognitive function in older adults [18]. Increasing DBI scores have been associated with poorer physical function, falls, frailty, hospitalization, and mortality [19].

Data analysis: geriatric medicine appropriateness scores

The number of regular medications prescribed was defined as the sum of all regular prescription and nonprescription medications, excluding short-course medications (e.g. antibiotics). The number of 'pro re nata' (PRN) medications was defined as the sum of all prescription and nonprescription medications prescribed on an 'as required' basis. Each active ingredient contained within a combination product was counted once (e.g. combination product containing docusate with senna). Medications listed both regularly and 'as required' were counted once in each category.

The number of PIMs and PPOs were identified according to the STOPP/START criteria: version 2 [17].

To calculate a DBI score, exposure to anticholinergic and sedative drugs was identified from a review of medication histories [18]. Medications with clinically significant anticholinergic or sedative effects were identified using MIMS Australia and the Australian Medicines Handbook [20, 21]. The drug burden attributable to each anticholinergic or sedative medication was calculated using the following equation:

$$\mathrm{DBI} = \Sigma\, D/(\sigma+D)$$

where D is the daily dose of anticholinergic or sedative medication and σ is the minimum efficacious dose as approved by the Australian Therapeutic Goods Administration. The total drug burden was calculated as the sum of the drug burden of all prescribed anticholinergic or sedative medications for the resident. Complementary medications, health supplements, and medications prescribed on an 'as required' basis were excluded from DBI calculations. This methodology is consistent with the original study guidelines for calculating DBI scores [18].

Statistical analysis

Continuous variables were summarized using the mean (standard deviation (SD)) if normally distributed, or otherwise, the median (interquartile range (IQR)). Resident characteristics and baseline medication measures were compared by follow-up status using an independent-samples t-test, Wilcoxon's rank-sum test, or Pearson's chi-squared test as appropriate. Changes in continuous variables pre and postintervention were tested using a paired t-test (if approximately normally distributed) or Wilcoxon's signed-rank test otherwise. Differences in the presence of any PIM or PPO were tested using McNemar's test. Analyses were performed using the Stata statistical software package (version 15) [22].

Results

A total of 175 residents (mean age 84 (SD ± 9.5) years, 62% female) were included in the study. These residents had all been referred to the RaSS pharmacist and had a CMR conducted. Residents had an average of 8 (SD ± 3) comorbidities. A formal diagnosis of dementia was documented for 49% (n = 85) of the residents. The most common reason for referral was a history of falls (34%, n = 59).

A second medication history was obtained one-month postintervention for 146 (83%) of the study participants, of whom 63% (n = 92) were female. Death (11%, n = 20) and end-of-life status (n = 3) were common reasons for exclusion from postintervention evaluation. Baseline characteristics and baseline medication measures did not differ significantly between those included/not included in pre–post analyses. The median interval between CMR and post-CMR evaluation was 29 (IQR: 26–36) days.

Person-level changes in the number of regular medications and DBI score pre and postintervention are shown in Fig. 1, and summary measures are shown in Tables 1 and 2. Small but significant reductions pre and postintervention were observed for the mean number of regular medications (12.47 (SD ± 4.29) vs. 11.84 (SD ± 4.52)) with a mean reduction of 0.63 (95% CI: 0.33–0.93; P < .001) and mean DBI score (1.54 (SD ± 0.99) vs. 1.37 (SD ± 0.95)), with a mean reduction of 0.17 (95% CI: 0.10–0.24; P < .001). However, the number of PRN medications remained unchanged. Although the median change was zero for PPOs and PIMs, more residents experienced a decrease in PPOs and PIMs postintervention (6 and 27, respectively) compared with those that had an increase (0 and 1, respectively).

Table 3 provides an example of specific medication changes made for one of the study participants. At one-month postintervention, the prescriber had actioned several pharmacist recommendations, resulting in an increased number of regular medications from 15 (at baseline) to 18 (postintervention), and a reduction in DBI from 2.98 (at baseline) to 2.70 (postintervention).

Discussion

In this study, we observed statistically significant reductions in mean number of regular medications and DBI scores (0.63 and 0.17, respectively) at one-month post-RaSS pharmacist-led CMR. Pharmacist-mediated intervention thus showed potential to improve medication appropriateness, with more residents experiencing a decrease in PPOs and PIMs postintervention compared with those that experienced an increase.

To the best of our knowledge, this is the first study to evaluate the impact of CMRs conducted by clinical pharmacists within a hospital-based RaSS. By working closely with specialist medical practitioners within the RaSS team, the RaSS pharmacists were uniquely positioned to provide responsive medicine recommendations to address the acute care needs of RACF residents. Our study offers 'real-world' data from an established hospital-based aged care support service and thus, gives valuable insight into the impact pharmacists can have in this context.

In our study, residents referred for CMR had an average of eight comorbidities and an average of 12.47 regular medications, which is higher than the reported Australian

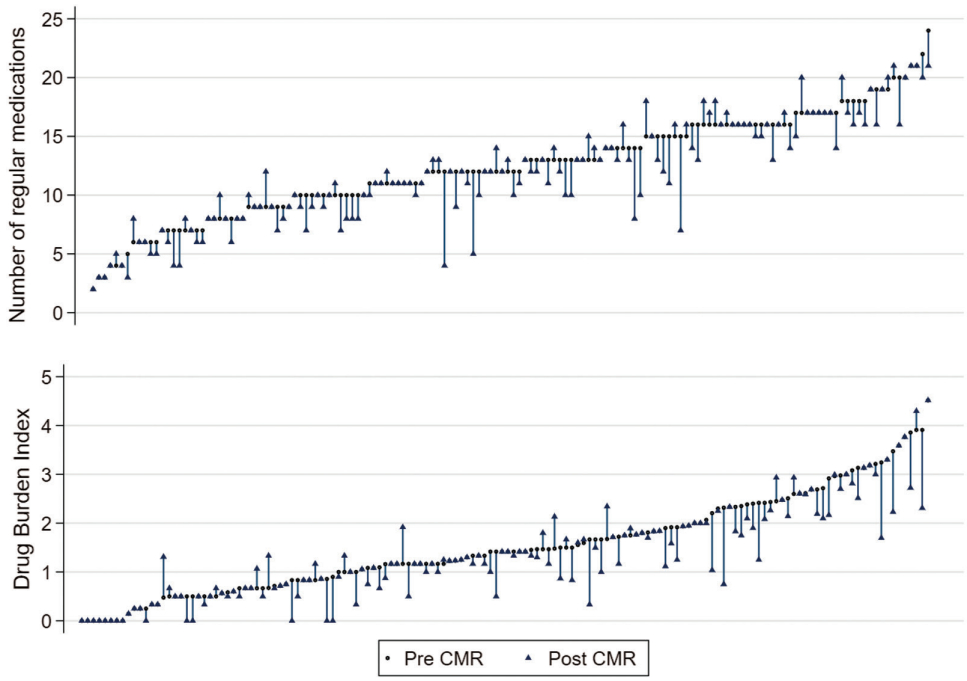

Figure 1. Resident-level changes in medication count and drug burden pre and postclinical medication review (CMR) (*n* = 146).

Table 1. Comparison of summary measures of medication prescription pre and postclinical medication review (CMR) (*n* = 146).

Variable	Pre-CMR	Post-CMR	Change	*P*-value
Number of regular medications[a]	12.47 (4.29)	11.84 (4.52)	−0.63[b] (−0.93 to −0.33)	<.001
Number of PRN medications[a]	6.27 (3.82)	6.17 (3.67)	−0.10[b] (−0.12 to 0.33)	.37
Drug Burden Index[a]	1.54 (0.99)	1.37 (0.95)	−0.17[b] (−0.24 to −0.10)	<.001
Number of potential prescribing omissions[c]	0 (0 – 1)	0 (0 – 0)	0 (0–0)	.003
Number of potentially inappropriate medications[c]	2 (1 – 3)	1 (0 – 2)	0 (−1 to 0)	<.001

[a]Mean (SD), [b]Mean paired difference (95% CI), *P*-value from paired *t*-test; [c]Median (IQR), *P*-value from Wilcoxon's signed rank test.

Table 2. Comparison of number of residents with potential prescribing omission (PPO) or potentially inappropriate medication (PIM) pre and postclinical medication review (CMR) (*n* = 146).

Measure	Time		Post-CMR			
			No	Yes	Total	*P*-value[a]
Any PPO	Pre-CMR	No	107	0	107 (73%)	.003
		Yes	6	33	39 (27%)	
		Total	113 (77%)	33 (23%)	146 (100%)	
Any PIM	Pre-CMR	No	33	1	34 (23%)	<.001
		Yes	27	85	112 (77%)	
		Total	60 (41%)	86 (59%)	146 (100%)	

[a]Number (%) with *P*-values derived from McNemar's test.

average of 11 medications per RACF resident [3]. This is not surprising given previous studies have found the number of medications taken by a RACF resident to be predictive of adverse drug events and hospitalization, whilst the number of comorbidities is an independent risk factor for adverse drug events [23]. Hence, our study sample is likely to be representative of resident characteristics that would trigger RaSS pharmacist referrals in other geographical locations. It would be worthwhile conducting further research to identify specific groups of older adults that would benefit most from CMR.

Further, the measured impact of pharmacist recommendations is likely to be underestimated in this study, due to the short evaluation timepoint of one-month. Repeated evaluation over a longer time period may have shown an increased uptake of pharmacist recommendations, since multiple medication changes are not generally recommended to occur simultaneously, and may be actioned sequentially. Residents are usually referred to the RaSS due to acute health concerns. Hence, a longer evaluation period than one-month may be required to allow residents to recover, before

Table 3. Example of medication changes made for a study participant.

Resident characteristics	Medication changes at 1-month post-CMR			Number of regular medications			Drug burden index (DBI)			Comments
	Pharmacist recommendations actioned by prescriber	Pharmacist recommendations not yet actioned by prescriber	Changes made on prescriber's own accord	Pre-CMR	Post-CMR	Change	Pre-CMR	Post-CMR	Change	
Unique identifier: #23 Male Age: 90 years Reason for referral: advanced chronic obstructive pulmonary disease (COPD) and increased anxiety	Commenced: • Docusate for constipation • Senna for constipation • Colecalciferol for vitamin D deficiency Dose increased: • Mirtazapine increased from 30mg to 45mg for ongoing anxiety/depression • Morphine liquid uptitrated to manage shortness of breath Dose reduced: • Tramadol SR reduced by 50mg given nil issues with pain (with plan to continue slow wean with aim to cease) Ceased: • Zopiclone cessation trialled but unsuccessful and restarted	• Add inhaled corticosteroid to indacaterol/glycopyrronium given two COPD exacerbations requiring hospitalization in the past few months • Trial wean off pantoprazole (taken long term for reflux)	Olanzapine trialled for 13 days then ceased.	15	18	+3	2.98	2.70	−0.28	Number of medications increased despite reduction in DBI. The new medications and increase in doses were deemed necessary to improve patient quality of life, despite the potential risk of adverse effects. Medication changes occurred gradually rather than simultaneously so that individual response could be observed. The follow-up time of 1 month limited ability to ascertain whether tramadol was eventually ceased and whether the outstanding pharmacist recommendations were actioned at a later time. Despite the prescriber's attempt to cease zopiclone on pharmacist advice, the patient subsequently wanted it reinstated.

prescribers can enact changes based on RaSS pharmacist recommendations. Other similar studies have utilized longer evaluation times of 2, 3, and 6 months [2, 13].

Our study did not collect any data on whether the GP agreed with the pharmacist's recommendations and how they planned to implement the suggested changes. Therefore, it remains uncertain whether having a longer evaluation period than one-month would have altered the measured impact of the pharmacist intervention.

Our study relied on DBI, PIMs, PPOs, and number of medications as surrogate markers of clinical outcomes. Process or intermediate outcomes measuring the impacts of deprescribing interventions are common, as highlighted by a systematic review where only three of 26 studies examined clinical outcomes [14]. Use of the DBI has been validated in several older populations worldwide, including the Australian aged care population, with many studies showing an association between the DBI and outcomes including hospitalization, physical and cognitive function [19]. Application of STOPP/START criteria has also been shown to have tangible clinical benefits in older populations across several countries, including aged care settings [7]. While polypharmacy is associated with negative clinical consequences, an optimal number of medications to achieve meaningful outcomes is yet (and unlikely) to be established [4].

Table 3 highlights the complex factors that may impact the numbers of medications prescribed/deprescribed, DBI scores, and the feasibility of enacting pharmacist recommendations promptly. For this individual, although the number of medications increased from 15 to 18, a reduction in DBI score of 0.28 and a focus on improving patient quality of life was observed. Our example illustrates the necessity of using multiple medication outcome measures in deprescribing studies to understand the impacts of pharmacist interventions on individual patients. Further research is required to establish clinical outcome measures that more accurately characterize the impact of interventions on patient care.

Due to the importance of maintaining a consistent clinical pharmacy service for all residents referred to the RaSS pharmacist, a suitable comparator group was not possible, and a pre–post study design was selected. While recognizing that confounding factors may exist, our study results are nevertheless encouraging and suggest RaSS pharmacist services are beneficial.

There is limited evidence to guide interpretation of the clinical impact that deprescribing has on a person [24]. A previous trial showed a reduction of 2.13 regular medications per resident was associated with a reduced number of falls and adverse drug reactions, and lower depression and frailty scores at 6-months postdeprescribing [2]. In comparison, our real-world study showed a smaller average reduction of 0.63 regular medications per resident. The aforementioned study similarly found a statistically significant reduction only in the number of regular medications, while the number of 'as required' medications remained unchanged by the intervention [2].

While the clinical significance of a mean reduction of 0.63 regular medications is uncertain, DBI provides a better measure of the overall pharmacological burden.

Studies conducted on Australian RACF residents have demonstrated an association between higher DBI scores and important adverse outcomes, including falls and lower quality of life [25, 26]. In well-functioning community-dwelling older people, one study found each additional unit of the DBI was associated with a negative effect on physical function as measured by the Health ABC score, similar to having an additional three physical comorbidities. Further, each additional unit of the DBI had a negative effect on the digit symbol substitution test, similar to that of having four additional physical comorbidities [18]. The potential clinical benefit derived from RaSS pharmacist-led CMR was demonstrated by the statistically significant reduction in the mean DBI score of 0.17 ($P < .001$), representing an 11% decrease in mean DBI from baseline. Our reduction in DBI is similar to the results of a retrospective Australian study evaluating collaborative GP-pharmacist RMMRs, which showed a 12% decrease in mean DBI from baseline [13]. More studies are required to understand how older people perceive such changes.

In our study, although the median change was zero for both PPOs and PIMs, a statistically significant improvement was found. Overall, a greater number of residents experienced a decrease in PPOs ($P = .003$) and PIMs ($P < .001$) postintervention compared with those that experienced an increase. Of note, a systematic review and meta-analysis of trials showed that applying STOPP/START criteria may improve prescribing quality, reduce delirium episodes, reduce care visits (primary and emergency), and lead to fewer falls [27].

Future directions

Being a relatively new service, the RaSS pharmacists had limited time to build rapport with GPs and RaSS clinicians. Insufficient buy-in from medical practitioners may have impacted the acceptance of pharmacist recommendations, which would lead to an underestimation of the potential impact of RaSS pharmacist-led CMR. Research shows that building good working relationships between GPs and pharmacists can improve collaboration and increase the uptake of pharmacist recommendations [28]. We plan to explore this in a future study now that the RaSS pharmacist role is established within our service.

Given almost half of the study participants had a formal diagnosis of dementia, it was often not feasible to communicate directly with the resident to gather information for the CMR. Alternative information sources were required, including liaison with RACF staff, family members, GP, community pharmacy, and hospital clinicians, as well as objective data obtained from relevant medical tests and reports. Whilst outside the scope of this study, it would be useful for future studies to assess differences in outcomes achieved with information gathered in different modalities (i.e., conducting CMRs face-to-face versus remotely).

Successful implementation of RaSS pharmacist recommendations relies heavily on prescribers to enact the proposed changes. While a number of countries including New Zealand and the UK recognize prescribing as being within a pharmacist's scope of practice, pharmacists in Australia are not yet able to prescribe under the current legislation. We observe with interest as studies, such as the Care Homes Independent Pharmacist Prescriber Study (CHIPPS) conducted in the UK, demonstrate that integrating pharmacist-independent prescribers into RACFs can have a significant impact on the speed of implementation of medication changes [29]. Future research into the impact of integrating pharmacist-independent prescribers into hospital-based RaSS teams is warranted.

Conclusions

This study suggests an association between hospital-based residential aged care support service pharmacist-led medication review, and improved medication outcomes for RACF residents. By working closely with hospital and community-based clinicians, RaSS pharmacists are uniquely placed to conduct CMRs to optimize medicine use in this vulnerable population. Prospective studies are needed to assess the direct impact on clinical outcomes, such as reduced hospital presentations and improvements in quality of life for older people living in RACFs.

Supplementary data

Supplementary data are available at *International journal of Pharmacy Practice* online.

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Author contributions

J.C. and R.B. contributed to the study's conception and design. Material preparation and data collection were performed by J.C. and R.B. Data analysis was performed by K.H. The first draft of the manuscript was written by J.C. and R.B. F.Y. provided academic supervision for iterative manuscript revisions. All authors reviewed previous versions of the manuscript, contributed to, and approved the final manuscript.

Conflict of interest

The authors have no relevant financial or non-financial conflicts of interests to disclose.

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Data access

J.C. and R.B. had complete access to the study data. K.H. was provided with deidentified study data for the purposes of statistical analysis and consultation. F.Y. was provided limited access to the study data during 2022. J.C.'s access to the data is ongoing.

Data availability

The data underlying this article cannot be shared publicly for privacy reasons. Deidentified data may be shared on reasonable request to the corresponding author.

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