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Invited Perspective

Medication management policy, practice and research in Australian residential aged care: Current and future directions

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ABSTRACT

Eight percent of Australians aged 65 years and over receive residential aged care each year. Residents are increasingly older, frailer and have complex care needs on entry to residential aged care. Up to 63% of Australian residents of aged care facilities take nine or more medications regularly. Together, these factors place residents at high risk of adverse drug events. This paper reviews medication-related policies, practices and research in Australian residential aged care. Complex processes underpin prescribing, supply and administration of medications in aged care facilities. A broad range of policies and resources are available to assist health professionals, aged care facilities and residents to optimise medication management. These include national guiding principles, a standardised national medication chart, clinical medication reviews and facility accreditation standards. Recent Australian interventions have improved medication use in residential aged care facilities. Generating evidence for prescribing and deprescribing that is specific to residential aged care, health workforce reform, medication-related quality indicators and inter-professional education in aged care are important steps toward optimising medication use in this setting.

1. Introduction

Residential aged care facilities (RACFs) in Australia, synonymous with nursing homes or long-term care facilities in other countries, provide supported accommodation for people with care needs that can no longer be met in their own homes [1]. Over 270,000 older Australians receive residential aged care over a 12-month period, corresponding to eight percent of all Australians aged 65 years and older [1].

Given the emphasis on supporting people to remain in their own homes for as long as possible, residents are increasingly older and frailer on entry to residential aged care. Residents often have complex medical needs, a high prevalence of geriatric syndromes and take multiple medications. Together, these factors place residents at high risk of adverse drug events (ADEs). Evidence suggests that 20% to 30% of unplanned hospitalisations for Australians aged 65 years and over are medication-related [2], and internationally,

Abbreviations: ACAT, Aged Care Assessment Team; ADE, adverse drug event; BZD, benzodiazepine; DAA, dose administration aid; DDD, defined daily dose; GP, general medical practitioner; HYVET, Hypertension in the Very Elderly Trial; MAC, Medication Advisory Committee; PARTAGE, Predictive Values of Blood Pressure and Arterial Stiffness in Institutionalized Very Aged Population; PRN, pro re nata (when required); QUM, Quality Use of Medicines; RACF, residential aged care facility; RMMR, residential medication management review.

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studies conducted in the residential aged care setting show there are between one and seven ADEs per 100 resident-months [3].

Ironically, while residents of aged care facilities are among the highest consumers of medications, they are also among the least researched. It has been estimated that only 2% of research studies involving older people are undertaken in the residential aged care setting [4]. Generating evidence that is specific to residential aged care is important because the benefit–to–risk ratio of pharmacotherapy is not static throughout older age. Age-related changes in pharmacokinetics and pharmacodynamics combined with changing goals of care mean that medications prescribed appropriately in community settings may be unnecessary or inappropriate in the residential aged care setting [5,6]. It may not be valid to extrapolate evidence from clinical and observational studies of community dwelling older people, who are typically more robust and independent in activities of daily living, to the residential aged care setting. For example, the Hypertension in the Very Elderly Trial (HYVET) demonstrated the benefits of antihypertensive treatment in patients aged 80 years and older but people with dementia and those who required nursing care were excluded [7]. The recent Predictive Values of Blood Pressure and Arterial Stiffness in Institutionalized Very Aged Population (PARTAGE) study reported that combination antihypertensive therapy was associated with increased mortality in nursing home residents with systolic blood pressure less than 130 mm Hg [8].

Polypharmacy is common among residents of aged care facilities, with international literature suggesting up to 74% of residents take nine or more medications [9]. Evidence from two Australian studies suggests between 39% and 63% of residents take nine or more medications on a regular basis [10,11], although these studies used different methods to count the number of medications. Furthermore, studies conducted in Australian RACFs between 1993 and 2009 demonstrate that up to two thirds of residents receive psychotropic medications [12–15]. Recent and unpublished data suggest the prevalence of antipsychotic use in RACFs may be decreasing over time, while the prevalence of antidepressant and opioid use is increasing [16,17]. Treatment with psychotropic medications such as antipsychotics, benzodiazepines or antidepressants is indicated for some residents; however, these medications are sometimes used inappropriately, for longer periods than necessary or in high doses [18]. Additionally, data from medication review reports for residents of aged care facilities in Australia report an average of two to five medication-related problems per resident [19]. Together, these findings suggest although care has improved, there is a need to further improve medication management among residents of aged care facilities.

Understanding medication-related policies and practices in residential aged care is essential to translate research and improve care in this setting. This paper provides an overview of medication management in Australian RACFs. Existing policies and practices to optimise medication use in this setting are discussed. We also review Australian research studies published in the last five years that report outcomes of interventions to optimise medication use within RACFs. Search terms are listed in Supplementary File 1.

2. Overview of medication management in Australian aged care facilities

Australian Government policy and clinical practice guidelines recognise that medication management in Australian RACFs requires a multidisciplinary approach [20,21]. Improving our understanding of this process, and times when medication safety can be compromised, can further optimise medication use in aged care facilities. The medication management cycle describes the key steps and background processes that underpin medication use in all settings, including RACFs (Fig. 1) [22]. Importantly, the cycle provides a framework for understanding and improving medication management.

Complex processes underpin prescribing, supply and administration of medications in RACFs [21,23]. Many residents consult a new general medical practitioner (GP) and have medications dispensed from a new community pharmacy after entering the facility. Medications are prescribed by GPs who visit the RACF periodically as required, but are not available onsite. In Australia, aged care providers do not routinely employ GPs, however some providers employ onsite nurse practitioners with prescribing rights [24]. Uptake is low but increasing, with nurse practitioners comprising 0.2% of the residential aged care workforce in 2012 [25]. The use of nurse practitioners is limited by their scope of practice, which is often focussed on a specific area of practice, such as palliative care. A randomised controlled trial of employing GPs in RACFs with primary outcomes including hospitalisations, falls and polypharmacy is currently underway in Tasmania [26].

Medications are dispensed by an off-site community pharmacy based on traditional prescriptions or the National Residential Medication Chart. The pharmacist is often requested to pack oral medications into dose administration aids (DAAs) (also referred to as medication organisers, blister packs or unit-dose sachets) to facilitate administration by RACF staff. Preparations such as inhalers, injections, topical products and medications that are unstable after removal from the original packaging are supplied separately. Medication changes need to be communicated to the community pharmacy in a timely manner so the pharmacy can repack DAAs and/or supply new medications [23]. The community pharmacy usually delivers medications directly to the RACF. At present, it is rare for aged care providers to directly employ pharmacists as members of staff to coordinate or deliver clinical medication services.

The physical separation between pharmacies, GPs and RACFs means that health care providers spend a considerable amount of time communicating between each other. In a previous Australian study, RACF staff reported contacting GPs or the community pharmacy a median of seven times per shift regarding medication issues, with 11% of RACF staff spending more than half an hour per shift communicating with the pharmacy and 13% spending more than half an hour communicating with GPs about medications [27].

The majority of residents are reliant on staff for medication administration. Although relatively uncommon in practice, residents can self-administer medications if they have been assessed as competent to do so [21]. In some RACFs, medications are administered by care workers, who receive additional training to be deemed competent to administer medications, but have less medication training than nursing staff [28]. Staff need to cross-check medication charts and DAAs before administering medications to each resident [28]. Medication administration can be challenging due to polypharmacy, complex medication regimens, resident swallowing difficulties and refusal to take medication [29]. Staff may need to request alternative dosage forms or crush certain medications for residents with swallowing difficulties. Observational data collected from one Australian RACF suggests that facility staff spend between 2.5 and 4.5 h in the morning medication round, averaging 200 s (±119 s) per resident [30]. Nurses and care workers also play a major role in the decision to administer 'pro re nata' (when required or prn) medications [29]. There is limited capacity to administer regular parenteral medications such as intravenous antibiotics and this may necessitate hospitalisation.

An increasing number of RACFs are using electronic medication charts in place of traditional paper-based medication charts. A new cloud-based electronic medication management system in which prescriptions issued by GPs populate RACF records and are sent directly to each resident's pharmacy has been trialled [31]. How-

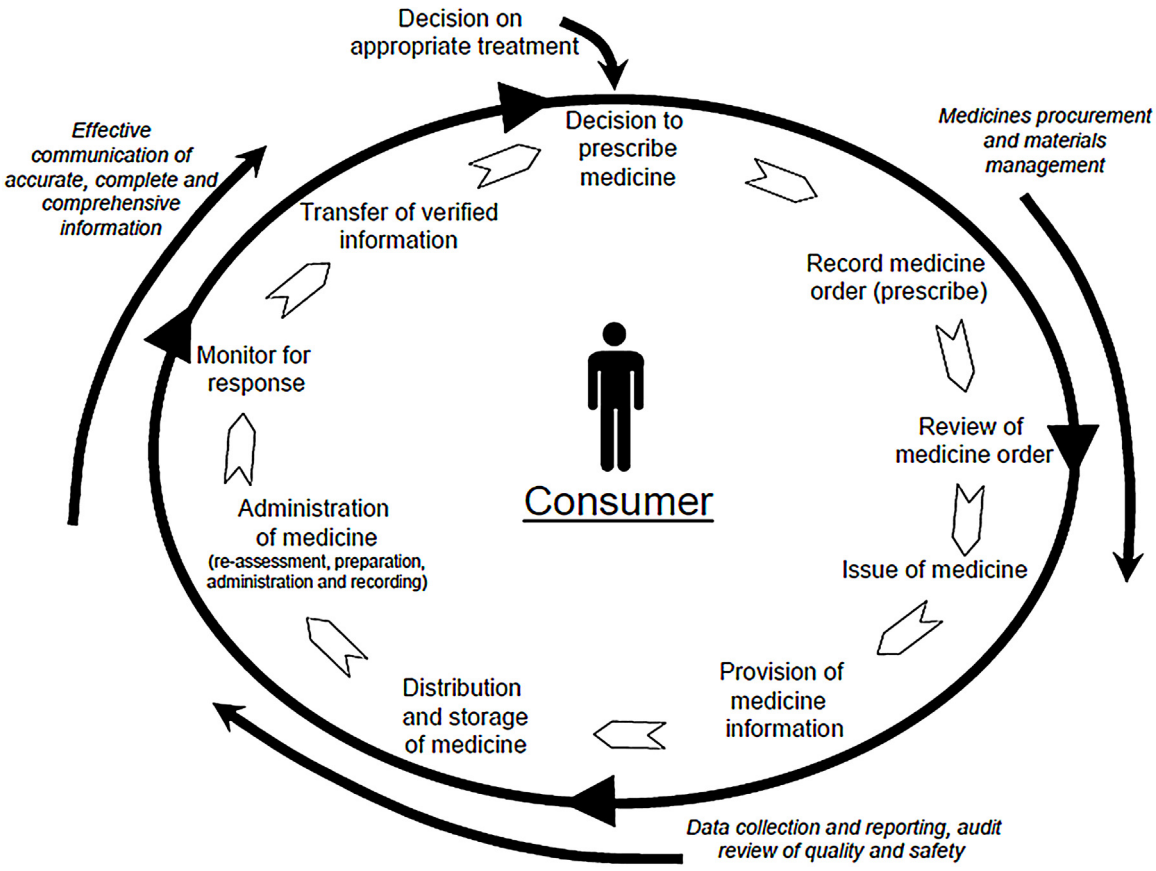

Fig. 1. The medication management cycle.

(Reproduced with permission from [22])

ever, uptake of these electronic prescribing systems within RACFs remains relatively low.

3. Policy support for Quality Use of Medicines in residential aged care

Quality Use of Medicines (QUM), defined in Table 1, is a phrase that is used to describe best-possible medication use (i.e. using medications in a way that maximises the benefits of treatment while minimising medication-related harm) [20,32]. There has been considerable investment in QUM in Australia, with a broad range of policies and resources targeting health professionals, organisations and consumers. Resources such as prescribing guidelines, professional standards and accreditation standards provide further support at the individual practitioner and facility level.

3.1. National Strategy for Quality Use of Medicines

Australia's *National Strategy for Quality Use of Medicines* was developed to guide consumers, health professionals, government, industry and other stakeholders to work together to achieve QUM. Since 1992, national policy and funding support for QUM has resulted in many initiatives to improve medication use, such as the Australian Medicines Handbook, the national therapeutics bulletin (Australian Prescriber), clinical medication reviews in the community and RACFs, consumer medicines information leaflets, a national medication disposal service, and NPS MedicineWise, an independent organisation established to improve the way medications are used in Australia [33].

Drawing on key behaviour change theories, the *National Strategy* also provides a framework for the design, implementation and evaluation of initiatives to improve medication use. The *National Strategy* emphasises the importance of consultation with all stakeholders and a needs assessment to identify the enablers and barriers to behaviour change before an intervention is designed. It is recognised that sustained change is more likely when all stakeholders are engaged and work in partnership, and when interventions support existing initiatives to improve care. Key elements also include the need for a systems-based approach, which encompasses multiple strategies to target stakeholders at each stage of the behaviour change process, while ensuring the consumer is placed at the centre of the intervention. These principles have been successfully applied in the Australian setting to deliver changes needed to achieve QUM [34].

3.2. Guiding principles for medication management in residential aged care facilities

Australia's *Guiding Principles* outlines 17 principles to support optimal medication use at the facility level [20]. These cover areas such as information resources for staff and residents, continuity in medication supply, crushing medications, medication storage and disposal [20]. The need for oversight by a multidisciplinary Medication Advisory Committee (MAC) with a mix of skills and expertise is also emphasised [20]. The MAC may be involved in reviewing policies and procedures, reviewing medication incidents and adverse drug reaction reports, advising on legislation and standards, reviewing the educational needs of staff and residents, and contributing to interventions to optimise medication use [20]. While anecdotal experience suggests most aged care providers operate local or regional MACs, there is considerable variation in the composition of MAC members and the types of activities

Table 1
Quality Use of Medicines (QUM) [32].

1. Carefully consider all available strategies for treating an illness or preventing disease, including non-pharmacological interventions, and decide whether a medicine is necessary.
2. If treatment is considered necessary, choose the most appropriate medicine and consider factors such as patient characteristics, dosage, drug interactions, treatment duration and cost.
3. Provide education and ongoing monitoring to ensure medicines are used safely and the goals of therapy are achieved.

undertaken, with some focusing mainly on logistical and technical functions and others taking a more clinical approach. A recent qualitative paper suggested that few RACFs used MACs to address the prevalence and appropriateness of psychotropic medication use [35]. There has been little published research into how RACF MACs can best support safe medication practices and this remains a gap in the literature.

3.3. National residential medication chart

Australian aged care facilities can opt to use the National Residential Medication Chart [36]. The chart was designed to improve medication safety and provide consistency for health professionals and other staff working across multiple facilities. Safety features include the ability to see the resident's details from each page of the chart, which supports correct identification at each step in the medication management cycle (Fig. 1). The chart includes sections for different types of medications, such as regular, prn, short term and variable dose medications, with distinct areas for recording relevant pathology results. Community pharmacies can now dispense most government-subsidised medications directly from the chart. Previously, pharmacists required a separate prescription for each medication, written by a GP or other health professional with prescribing rights, before the medication could be supplied. The new medication chart reduces administrative burden and the potential for prescribing and dispensing errors that may arise when prescriptions and medication charts are written separately (e.g. transcription errors). Improvements in medication management were observed after the chart was piloted in 22 aged care facilities in 2013 [37]. A substantial drop in the average number of medications prescribed to residents (from 13.8 to 5.7) and the rate of medication errors (from 9.2 errors to 3.5 errors per 1000 prescriptions) was observed eight months after the chart was implemented [37]. At present, there are no data available on uptake of the new RACF medication chart or wider impact on medication safety.

3.4. Residential medication management reviews and the QUM service

Accredited pharmacists receive Government remuneration to provide QUM services focused at the individual resident. Evidence suggests that collaborative medication reviews can identify and resolve medication-related problems and foster multidisciplinary care at the individual resident level [38]. Collaborative medication reviews in RACFs are known as residential medication management reviews (RMMRs) [39]. After receiving an RMMR referral, an accredited pharmacist visits the facility and conducts a clinical medication review [39]. The pharmacist then prepares a suggested plan to address any medication-related problems and then forwards this to the referring GP, who then uses the recommendations to develop a medication management plan for the resident [39]. The funding model requires pharmacists and GPs to discuss the recommendations made in the pharmacist's RMMR report but anecdotal evidence suggests this may not always occur.

The RMMR program commenced in 1997 and just over 102,000 government-subsidised reviews were undertaken in 2015 [40], meaning that approximately 38% of all residents of aged care facilities received an RMMR over a 12 month period. Recent changes to the criteria mean that residents are now eligible to receive an RMMR once every two years instead of annually, unless there is an urgent clinical need for another RMMR. Situations where an additional review may be indicated include recent hospitalisation, significant changes to medications, changes in physical or cognitive function, or suspected ADEs [39]. A limitation of the current RMMR criteria is that funding is not available for pharmacists to formally monitor the outcomes of pharmacotherapy changes that they recommend. A systematic review of the Australian literature focusing on RMMR processes and outcomes is currently in progress [41].

The QUM Service is a government-funded service provided by registered pharmacists that is designed to help the RACF to better meet their residents health care needs [39]. The aged care facility and the pharmacist providing the service work together to identify activities to optimise medication use in the facility based on local needs. These may include monitoring medication-related policies and procedures, staff education sessions and contributing to the MAC [39]. However, there has been little published research into the provision of QUM Services in Australian RACFs.

3.5. National residential aged care accreditation standards

Australian facilities are regularly audited by the Australian Aged Care Quality Agency, a national independent accreditation body, to ensure they meet national accreditation standards for residential aged care. There are four standards, encompassing 44 expected outcomes, including medication management, and facilities must demonstrate that medications are managed safely and correctly, medication management is compliant with relevant legislation and professional standards, and that staff adhere to these principles [42]. The standards also emphasise the need to ensure that residents and their families are satisfied with the medication management systems in place within the facility [42]. Facilities must demonstrate the standards are met to receive ongoing government funding. The Quality Agency conducts reaccreditation audits at regular intervals and conducts staff and resident interviews, and reviews evidence such as policies and procedures, MAC meeting minutes, self-medication assessments, medication incidents, and results of drug utilisation evaluations to ensure these outcomes are achieved. When the facility does not meet all 44 expected outcomes, the Quality Agency sets a timetable for improvement, generally three months, during which time the facility must demonstrate all outcomes are met [43]. Results suggest most facilities are compliant with medication management and other standards at the time of assessment. The Quality Agency conducted more than 5000 visits in 2014-15, including 1425 reaccreditation audits and 2878 unannounced visits for monitoring performance, and timetables for improvement imposed for 80 RACFs [43].

3.6. Medication-related indicators

All public sector RACFs in Victoria have been collecting and reporting five quality indicators since 2006. The five quality indicators are pressure injuries, falls and fall-related factures, use of physical restraint, unplanned weight loss and use of nine or more regular medications [44]. An evaluation of the quality indicator program reported they triggered reviews of individual residents,

staff practices and systems of care, with most RACFs reporting improved resident care [45]. Following the success of the program, a trial of three new medication sub-indicators will commence in Victoria in 2016. This initiative will be supported by the development of 'deprescribing scripts' to facilitate discussions between clinicians and residents about medication cessation. The National Aged Care Quality Indicator Programme was launched in January 2016, although currently this program does not include a medication indicator. Recent research has summarised the range of medication-related indicators currently used in Australia and internationally [46].

3.7. National stakeholders' meeting: Quality Use of Medicines to optimise ageing in older Australians

Increasing concern about the high prevalence of polypharmacy and potentially inappropriate medication use in older Australians resulted in a national meeting to identify priorities for improving medication use in this population [47]. More than 80 stakeholders attended the first meeting in August 2015 convened by the National Health and Medical Research Council (NHMRC) Cognitive Decline Partnership Centre in partnership with NPS MedicineWise. A five-year target of a 50% reduction in the prevalence of use of harmful or unnecessary medications was proposed and attendees identified seven key strategies to progress towards this goal, including the need for policies and guidelines to address polypharmacy and deprescribing, improved integration of care, monitoring polypharmacy using health data, incentivisation, education for health professionals, raising consumer awareness and the need for a national strategic plan [47]. Although these strategies are not specific to RACFs they are particularly relevant to this setting due to the prevalence of multimorbidity and polypharmacy. Working groups are now developing detailed action plans to guide further work in this area [47].

4. Recent interventions to optimise medication use in residential aged care

Descriptions of eight unique interventions targeting medication-related issues in the residential aged care setting were identified in peer-reviewed literature in the last five years (Table 2). The majority of the interventions focused on optimising the use of specific medications. Four interventions aimed to reduce the use of benzodiazepines and/or antipsychotics [48–52], targeting between two and 26 RACFs, while one pre-post study assessed the impact of an intervention to improve pain management and use of analgesics in five RACFs [53]. Other interventions included a quality improvement intervention aiming to reduce incidents involving DAAs supplied to RACFs [54] and implementation of an interim RACF medication administration chart to assist medication management immediately after hospital discharge [55]. Another study assessed the effects of deprescribing, defined as 'the process of withdrawal of an inappropriate medication, supervised by a health care professional with the goal of managing polypharmacy and improving outcomes' [56], on polypharmacy among residents [57] (Table 2). Investigators used a range of strategies to deliver the interventions, including educational workshops, printed educational materials, revised policies and procedures, academic detailing, audit and feedback and local champions. The primary outcome measures for each study assessed a change in medication use or medication incidents, with only three studies [52,53,57] also reporting clinical outcomes for residents (i.e. pain scores, falls, hospitalisations or mortality). In total, five of the eight interventions described statistically significant improvements in the main outcome of interest; however, most studies assessed outcomes soon after the intervention was implemented. Only three of the six studies demonstrated the effect of the intervention was sustained at 12 months post-intervention [50,53,57].

One intervention that did not have a significant impact incorporated a 30-min education session and a staff toolkit to improve the accuracy and suitability of medications packed into dose administration aids for residents of 45 RACFs [54]. The study investigators postulated the lack of effect could reflect the need to tailor the intervention to local needs and target particular types of incidents involving dose administration aids [54]. Another intervention aiming to optimise benzodiazepine use through the distribution of electronic educational materials showed no effect on the primary outcome [48]. This finding is in keeping with evidence suggesting that educational materials alone have little effect on prescribing behaviour and patient outcomes [58].

None of the papers explicitly state whether the interventions were underpinned by behavioural theories although several reflect principles described in the *National Strategy for Quality Use of Medicines* [32] in their design. The effect size was greatest for interventions that included a pre-intervention gap analysis or consultation, which is known to increase the likelihood of success [59]. Successful interventions generally incorporated educational resources with other strategies and usually involved multiple stakeholders, including facility staff.

Several interventions were successful in reducing antipsychotic use among residents of aged care facilities (Table 1). One of these interventions, the RedUSe project [49,50], has since been implemented nationally. Two other national quality improvement programs using multifaceted approaches to optimise medication use, including audit and feedback, have also targeted antipsychotic use. The Veterans' MATES program uses administrative health claims data to inform patient-specific prescriber feedback on medication use and health outcomes for Australian veterans [60,61]. While the impact on care for residents of aged care facilities has not been reported separately, an intervention to improve antipsychotic use among veterans with dementia had a significant effect on antipsychotic use in the general veteran population [60,61]. NPS MedicineWise, an independent organisation that runs national quality improvement programs, has collaborated with an industry provider to improve use of antipsychotics in residential aged care. Community pharmacists using the provider's software to create medication organisers for residents can now generate drug utilisation reports to track antipsychotic use and generate feedback for the aged care facility [62]. This intervention is timely as a recent national senate inquiry into care for Australians living with dementia recommended that aged care facilities report trends in antipsychotic utilisation as part of their annual accreditation audit [63].

4.1. Future directions

Evidence suggests the prevalence of polypharmacy in RACFs is increasing over time [64]. Reasons cited for increasing polypharmacy include changing resident mix and better adherence to clinical practice guidelines [64]. A recent initiative prioritized 16 possible interventions to address the increasing prevalence of polypharmacy in the RACF setting [65]. Implementing interventions to address polypharmacy and medication regimen complexity may be particularly warranted because there is emerging evidence to suggest an association with hospitalisation from RACFs [66]. It is recognised that medications prescribed appropriately in community settings may be unnecessary or inappropriate in the residential aged care setting [5,6] and that residents may receive medications for primary prevention that may not provide benefit during their expected lifespan [67]. Given that cardiovascular and endocrine disorders are strongly associated with polypharmacy and regi-

Table 2
Recent interventions to optimise medication management in Australian aged care facilities.

Author	Study design	Intervention dates	Target groups	Intervention strategies	Key findings
Interventions to improve prescribing					
Potter [57]	Open label RCT	Study entry between 2011 & 2013	95 residents in 4 RACFs (n = 47 intervention, n = 48 usual care)	Medication review, plan for withdrawal of non-beneficial medications (deprescribing).	Fewer regular medications in intervention group (mean change after 12 months: −1.9 ±4.1 vs. +0.1 ±3.5, p = 0.04). Trial was underpowered to detect changes in clinical outcomes.
Interventions to improve medication supply and administration					
Gilmartin [54,78]	Pre-post comparison without controls	Jun – Sept 2012; follow-up Sept 2012 to Jan 2013.	Staff at 14 pharmacies and 46 RACFs	Pre-intervention focus groups. Educational workshop, printed educational materials, staff toolkit, example policies and guidelines.	Incidents involving DAAs ↑ after at least 3 months follow-up (11.5% pre vs. 21% post, p < 0.001).
Interventions to improve medication use at care transitions					
Elliot [55]	Pre-post comparison without controls	Two 12-week intervention periods in 2009	2 hospitals; 128 RACFs	Pre-intervention consultation. Interim RACF medication administration chart prepared for residents by a pharmacist at hospital discharge.	Missed or delayed doses ↓ from 18% to 2.7% (p < 0.001). Medication charts written by a locum doctor ↓ from 32.7% to 11.1% (p < 0.001).
Interventions to optimise use of specific medication classes					
Smith [48]	Comparative study with concurrent controls	Oct 2007–Mar 2008	Medical centres, pharmacists, RACFs (2 intervention & 2 control areas)	Educational information for health professionals and consumers distributed via email, website and bookmarks.	No significant change in overall BZD use or prn use in intervention or control facilities.
Westbury [49,50]	Controlled trial	2008–2009, (6 months)	Pharmacists, GPs, RACF staff, residents (13 intervention RACFs, 12 controls)	Educational workshops, printed educational materials, guidelines, audit and feedback, academic detailing, individual sedative reviews for residents.	Use of antipsychotics ↓ (20.3% to 18.6%, p < 0.05) & BZD use ↓ (31.8% to 26.9%, p < 0.005) in the intervention facilities. Changes in antipsychotic use not sustained 12 months after the intervention was completed.
Pont [51]	Pre-post comparison without controls	Feb–July 2014	Pharmacists, GPs, RACF staff, residents (26 RACFs)	Pre-intervention focus groups identified barriers and enablers. Revised policies, educational materials, local champions, audit and feedback.	Antipsychotic use ↓ (9.5% to 4.5%, p < 0.001); Number of DDDs of antipsychotics ↓ (0.34 to 0.19, p < 0.001).
Ervin [52]	Comparative study with concurrent controls	Not provided	RACF staff (2 intervention RACFs, 1 control)	Educational workshops, printed educational materials, life stories collected for individual residents.	% prescribed antipsychotics ↓ post-intervention and ↑ at control site (small sample size (n = 47 residents) and no significance tests conducted).
Savvas [53]	Pre-post comparison without controls	2008–2009	RACF staff (5 RACFs)	Pre-intervention gap analysis. Revised procedures, educational workshops, local champions, printed educational materials	At baseline, analgesics prescribed to 85% of residents (44% regular, 24% regular + prn, 17% prn). Analgesic use ↑ at 12 months post-implementation (30% regular, 43% regular + prn, 21% prn) (p < 0.001). Pain scores improved for 50% to 60% of residents.

BZD, benzodiazepine; DAA, dose administration aid; DDD, defined daily dose; GP, general practitioner; prn, pro re nata (when required); RACF, residential aged care facility.

men complexity [9,10], important future directions may include further exploration of the benefits and risks of treatment, determining appropriate blood pressure and blood glucose ranges, or developing management guidelines specific to residents of aged care facilities. Recent steps in this direction include the *McKellar Guidelines for Managing Older People with Diabetes in Residential and Other Care Settings*, developed to enhance care and quality of life for residents with diabetes [68]. Additionally, the impact of specific prescribing patterns on resident quality of life is not widely studied in the RACF setting and there is a need for further research in this area. One recent cross-sectional study found no association between polypharmacy and medication-regimen complexity with staff-informant rated quality of life [69].

Another contributing factor to the increasing prevalence of polypharmacy in RACFs is the reluctance of one prescriber to discontinue medications initiated by another [64]. Deprescribing is an area of increasing focus within the residential aged care setting. The deprescribing process involves a review of current medications and indications for treatment; considering the overall risk of medication-related harm; assessing the potential for medication discontinuation by considering the expected benefits, harms and withdrawal symptoms for each medication; prioritising medications for withdrawal; and implementing a plan for discontinuation and patient monitoring [70]. Few studies have specifically explored deprescribing among residents of aged care facilities; however, evidence suggests the majority of residents are willing to have their medications deprescribed if their GP said it was possible [71]. Risk assessment tools can identify patients at risk of poor health outcomes based on medication use and these tools could be used to inform RMMRs and deprescribing in RACFs. The Drug Burden Index Calculator, for instance, has been successfully used by pharmacists to screen for medications associated with poor health outcomes while undertaking medication reviews for community-dwelling Australians [72].

While clinical pharmacy services are well established in many Australian hospitals, there is little research into clinical services to support medication management among residents of aged care facilities beyond RMMRs. Residents may have complex medication regimens on admission to RACFs and international evidence suggests that one in five residents have at least one medication discrepancy on admission to residential aged care [73]. Hospitalisation often results in changes to medications taken by residents of aged care facilities [67], leading to ADEs following transfer between hospital and RACFs [74]. Pharmacist involvement in simplifying medication regimens on admission to residential aged care and reconciling medications following discharge from hospital could further improve medication management in RACFs. One of the limitations of the current RMMR system is that many reviews are undertaken without input from other health professionals such as physiotherapists, nurses and occupational therapists [75]. Enhancing systems to support shared decision-making and interprofessional collaboration for residents that enable all aspects of care for a resident to be considered may also be beneficial.

While this review focuses on medication use in residential aged care, it is important to note that older Australians receive support to remain in their own home as long as possible before entering an aged care facility. Two and a half percent of all Australians aged 65 years and older receive government-subsidised home based care packages [1] and data from one care provider suggests that more than half of all home nursing visits are for medication assistance [76]. Emerging evidence suggests that people requiring medication assistance from a community provider are at risk of ADEs [76]. Pharmacist involvement and medication review at the time of an Aged Care Assessment Team (ACAT) assessment, which is used to assess care needs and refer for home-based services or residential aged care, can improve the identification and resolution of medication related problems [77]. There is a need for further research into strategies to optimise medication use among people with complex care needs prior to entering residential aged care.

5. Concluding remarks

Despite considerable investment in QUM in Australia, there is still more work to be done to optimise medication use in RACFs. Taking a systems based approach is vital to achieving QUM in this setting. Interventions such as medication reviews provide a patient-centred approach where one resident is targeted each time. There is scope to expand clinical services in Australian RACFs, particularly in areas such as simplification of medication regimens, deprescribing, and medication reconciliation following transitions of care.

Further opportunities exist to support medication use at the facility level or organisational level. While national indicators are available to optimise medication use in Australian hospitals, current national indicators for residential aged care do not specifically address medication-related issues. Strategies such as audit and feedback at the individual prescriber level and at the facility level may further optimise medication use among residents and support risk management. In the absence of a comprehensive national dataset, several interventions have utilised novel data sources or partnered with industry providers to deliver and/or evaluate an intervention. Strategies using these data sources have been effective; however, systems are required to support quality feedback between health professionals, aged care facilities and national bodies. National linked health datasets containing demographic, medication and clinical information for residents of aged care facilities are needed to monitor progress and inform interventions to improve care in the Australian setting. Generating evidence for prescribing and deprescribing that is specific to residential aged care, health workforce reform, medication-related quality indicators and inter-professional education in aged care are important steps toward optimising medication use in this setting.

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Conflict of interest statement

JS is a registered pharmacist and accredited to provide residential medication management reviews. KS and MC are employed by organisations providing residential aged care services. There are no other conflicts of interest to declare.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.phrs.2016.12.011.

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