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Medication-related quality of care in residential aged care: an Australian experience

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Abstract

Objective: To describe medication-related quality of care (MRQOC) for Australian aged care residents.
Design: Retrospective cohort using an administrative healthcare claims database.
Setting: Australian residential aged care.
Participants: A total of 17 672 aged care residents who were alive at 1 January 2013 and had been a permanent resident for at least 3 months.
Main outcome measures: Overall, 23 evidence-based MRQOC indicators which assessed the use of appropriate medications in chronic disease, exposure to high-risk medications and access to collaborative health services.
Results: Key findings included underuse of recommended cardiovascular medications, such as the use of statins in cardiovascular disease (56.1%). Overuse of high-risk medications was detected for medications associated with falls (73.5%), medications with moderate to strong anti-cholinergic properties (46.1%), benzodiazepines (41.4%) and antipsychotics (33.2%). Collaborative health services such as medication reviews were underutilised (42.6%).
Conclusion: MRQOC activities in this population should be targeted at monitoring and reducing exposure to antipsychotics and benzodiazepines, improving the use of preventative medications for cardiovascular disease and improving access to collaborative health services. Similarity of suboptimal MRQOC between Australia and other countries (UK, USA, Canada and Belgium) presents an opportunity for an internationally collaborative approach to improving care for aged care residents.

Key words: medications, quality of care, aged care, retrospective cohort

Key points

- Australian aged care residents are clinically frail and exposed to multiple medications therefore, it is imperative to monitor and optimize medication use in this population.
- Application of the evidence-based MRQOC indicators in this study has highlighted that MRQOC activities in this population should be targeted at monitoring and reducing exposure to anti-psychotics and benzodiazepines. Further, improving the use of preventative medications for cardiovascular disease and improving

access to collaborative health services will help to improve MRQOC with potential health outcomes for Australia's growing residential aged care population.
- Results from this study are comparable to other countries (UK, Canada, USA and Europe) indicating that suboptimal MRQOC has some common elements. Australian and international studies have recommended using comprehensive geriatrician review and medication reviews to improve MRQOC in aged care.

Introduction

Globally, the world's population is ageing. In almost every country the proportion of the population older than 65 years is growing faster than any other age bracket [1]. Between 2015 and 2030 the number of people aged 65 years and older world-wide is predicted to increase from 900 to 1400 million [1]. This tsunami of older people will significantly increase the demand for aged care services. In Australia it is predicted that by 2050, over 3.5 million older Australians will require aged care services, of which 20% will require permanent aged care accommodation (long-term care or nursing home) [2].

Reports of poor quality of care for aged care residents are not uncommon, with medications often implicated [3]. Medication-related adverse health outcomes for the older population include falls, strokes, delirium and death [4, 5]. The older population living in aged care facilities are particularly susceptible to these adverse outcomes due to their physical and psychological frailty and use of multiple medications [6, 7]. The combination of expanding aged care populations and concerns regarding the variability in quality of care has prompted the development of quality of care indicator sets with the goal of monitoring and improving medication use over time. Indicators are the gold standard for evaluating the quality of many aspects of health care [2, 8, 9]. More specifically, medication-related quality of care (MRQOC) indicators are summary measures to be used as a guide to monitor, evaluate and improve medication use affecting quality of care and patient outcomes [10].

The most notable indicator set for aged care is the US Medicare minimum dataset (MDS) which involves mandated quarterly reporting of aged care (long-term care residents in the USA) residents' physical and psychological status including the use of psychotropics and vaccinations [11]. In the UK, reporting quality of primary care for the whole population (including aged care residents) is linked to remuneration and includes ~140 indicators for chronic disease management, many focusing on medication use (Quality and Outcomes Framework) [12]. In Australia, an opt-in programme for reporting quality of care in residential aged care was recently introduced and includes three indicators: use of physical restraints, unplanned weight loss and pressure injuries [13]. The lack of recognition of medications in this current Australian indicator set may reflect an uncertainty in the aged care sector regarding how best to evaluate medication use.

By determining the MRQOC for the aged care population through a comprehensive set of valid and reliable indicators, interventions could be accurately targeted to areas where use of medication may be suboptimal. This creates an opportunity to minimize adverse outcomes related to medication use and to improve the quality of life for aged care residents. The aim of this study was to use a previously developed parsimonious evidenced-based indicator set to evaluate MRQOC for the Australian residential aged care population.

Methods

Design and data

A longitudinal retrospective cohort study was conducted between 1 January and 31 December 2013. The data used in this study were from the Australian Government Department of Veterans' Affairs (DVA) administrative healthcare claims database. The DVA database contains details of all prescription medications, medical and allied health services and hospitalizations subsidized for a treatment population of 220 000 veterans, war widows and widowers [14].

Within this database medications are coded according to the World Health Organization's Anatomical and Therapeutic Classification system (ATC) [15] and the Australian Pharmaceutical Benefits Scheme (PBS) item codes [16]. Hospital admissions are coded using the Australian Modification of the International Classification of Diseases, version 10 (ICD-10 AM) [17]. General practitioner services are coded using the Australian Medicare Benefits Scheme item numbers [18]. This database has been used extensively for health research [19].

Sample

This study included all permanent aged care residents at 1 January 2013, aged at least 65 years, entitled to complete coverage of all health care expenses for at least 12 months prior to 1 January 2013 and with no <3 months continuous residence.

Measures

The study outcome variable was the proportion of residents who met the criteria for each MRQOC indicator. The development of the indicator set used in this study has been described elsewhere [10]. Briefly, a systematic review was undertaken to identify evidence-based MRQOC indicators appropriate for the older Australian population and endorsed by the international community. Of the original 28 indicators in the minimum indicator set, 22 were included in this analysis. For six of the original indicators (supply of vaccinations, falls due to medications, dose of digoxin and policy/procedure information) data were not available in the DVA database. An indicator related to use of statins in residents with dementia was added after a review of the original systematic review which showed this indicator met the inclusion criteria for the minimum indicator set as it reflected the current international consensus on use of preventative medications in people with moderate to advanced dementia.

Exposure to medications in the MRQOC indicators was determined by at least one supply of a medication during the study period of 12 months (as defined by the corresponding ATC and PBS codes listed in Appendix A). For the indicator evaluating exposure to two distinct medications from the same therapeutic class, exposure was determined by at least one dispensing of each medication in the 12-month period. For two indicators evaluating concomitant exposure to select medications, the period of exposure was shortened to 3 and 6 months to maximize detecting concomitant exposure.

Hospital admission diagnostic codes and supply of indication-specific medications via the PBS were used to identify chronic conditions included in the MRQOC indicators (Appendix A). The presence of chronic diseases was defined in the 12 months prior to the study index date of 1 January 2013.

Analysis

Demographic variables for the cohort were determined using descriptive statistical methods including means, medians and interquartile ranges where appropriate. Differences in variables were analysed using either two-tailed *t*-tests or Wilcoxon ranked sum test where appropriate. *P*-value was set at 0.05 for significant findings.

For twenty of the indicators, the proportions of residents meeting each indicator criteria were determined using Kaplan Meier survival analysis methods (reporting Kaplan Meier cumulative failure probabilities and 95% confidence intervals (CI)). This method allowed for adjustment for residents who died during the study

period [20, 21]. Population estimates were stratified by age (< 85 years and 85+ years) and gender (male and female) with a log rank test for homogeneity to determine if there were significant differences between groups (significance set at $P < 0.05$). Population estimates were further age-standardized to the Australian aged care population at 30 June 2013 using the direct method [22]. Prescription count (number of refills) is reported as a proxy for persistence with high-risk medications in the 12-month analytic period [23].

For the three indicators which evaluated the use of various combinations of concomitant medications, the proportion of residents exposed was reported.

Analysis was undertaken using the statistical software SAS V 9.1 (SAS institute, Cary, NC, USA).

Results

There were 17 672 DVA gold card holding, permanent, aged care, residents at 1 January 2013. The median age of the study population was 90.1 years (IQR = 87.5–92.7 years). One-third of the population (32.4%) were men.

Indicators for medication appropriateness in the most prevalent conditions

Use of recommended medications in chronic diseases (indicators 1–5), ranged from 52.9% for use of a statin in residents with a history of ischaemic heart disease/ post myocardial infarct to 73.6% for use of an antiplatelet medication in residents with a history of

Table 1 MRQOC indicators for medication appropriateness in the most prevalent conditions

Indicator description (n = eligible residents)	Resident characteristics % (95% CI)							
	% Proportion of eligible residents supplied the medication	% Age standardized proportion[a]	% Age < 85 years (n = 1991)	% Age ≥ 85 years (n = 15 673)	P value[b]	% Female (n = 11 950)	% Male (n = 5722)	P value[b]
Recommended use of medications in chronic disease								
1. β-Blocker use post myocardial infarct or ischaemic heart disease (n = 836)	53.9 (50.2–57.6)	59.0 (52.4–65.4)	68.7 (58.4–78.5)	52.0 (48.1–55.9)	<0.01	57.8 (48.1–64.4)	48.1 (42.6–54.0)	0.15
2. Statin use post myocardial infarct or ischaemic heart disease (n = 836)	48.3 (44.8–52.0)	52.9 (46.3–59.6)	61.9 (51.4–72.4)	46.4 (42.7–50.3)	0.04	43.3 (38.8–48.1)	55.5 (50.0–61.2)	<0.01
3. Antiplatelet use post myocardial infarct or ischaemic heart disease (n = 836)	72.3 (68.8–75.7)	73.6 (67.3–79.4)	76.0 (66.1–84.8)	71.8 (68.1–75.5)	0.41	72.2 (67.0–76.6)	72.6 (67.0–78.0)	0.54
4. ACEI or A2RB in history of hypertension or congestive heart disease (n = 3365)	54.0 (52.2–55.8)	56.1 (53.2–59.5)	60.2 (54.9–65.5)	53.2 (51.3–55.1)	0.02	57.3 (55.1–59.6)	48.3 (45.4–51.3)	<0.01
5. Antiplatelet use post stroke or transient ischaemic attack (n = 401)	57.9 (52.1–63.3)	58.8 (49.0–68.9)	60.3 (44.6–76.4)	57.7 (52.1–63.4)	0.89	58.7 (52.1–65.5)	56.69 (48.3–65.8)	0.94
6. Avoid use of NSAIDs in history of cardiovascular disease (n = 3556)	4.0 (0.0–10.2)	9.0 (7.6–11.6)	10.0 (7.2–13.7)	8.3 (7.9–10.1)	0.37	8.4 (7.2–9.8)	10.1 (8.4–12.2)	0.20
7. Avoid use of medications with moderate to strong anticholinergic properties in history of dementia (n = 3225)	50.8 (49.0–52.7)	51.6 (30.4–58.2)	53.1 (48.2–58.2)	50.5 (48.5–52.5)	0.10	47.0 (44.8–49.3)	58.6 (55.3–61.9)	<0.01
8. Avoid use of statins in history of dementia (n = 3225)	27.7 (26.1–29.3)	28.4 (25.8–31.5)	30.0 (25.8–34.8)	27.3 (25.7–29.1)	0.38	27.1 (25.2–29.1)	29.0 (26.3–31.9)	0.28
9. Avoid use of medications which increase risk of falling in history of falls (n = 3168)	73.6 (71.9–75.2)	73.5 (69.7–76.6)	73.1 (67.7–78.2)	73.6 (73.4–75.4)	0.75	73.0 (71.0–75.1)	74.9 (71.8–77.8)	0.79

Age adjusted to the total Australian residential aged care population at June 2013[a], log rank test for homogeneity[b].

ischaemic heart disease/post myocardial infarction. The younger cohort (<85 years) was more likely to be supplied a ß-blocker (68.7 vs 52.0%), statin (61.9 vs 46.4%) and angiotensin converting enzyme inhibitor/angiotensin-2 receptor blocker (ACEI/A2RB) (60.2 vs 53.2%) than residents aged 85 years or older. Men were more likely than women to be supplied a statin (55.5 vs 43.3%) but less likely to be supplied an ACEI/A2RB (48.3 vs 57.3%) (Table 1 and Fig. 1).

For the indicators related to medications to avoid in chronic conditions (indicators 6–9), the least prevalent was for residents with a history of cardiovascular disease supplied a NSAID (9.0%) and the most prevalent was for medications recommended to be avoided in residents with a history of falls (73.5%).

Indicators for general medication appropriateness

For six of the nine indicators in this group (indicators 10–18), the proportion of residents exposed to the associated medications to avoid was <10% (Table 2). The three MRQOC indicators in this category where more than 10% of residents were exposed included the following medications: benzodiazepines (40%), typical and atypical antipsychotics (46.1%) and medications with moderate to strong anticholinergic properties (33.2%) (Table 2 and Fig. 2).

Younger residents (< 85 years) were more likely to use a benzodiazepine than the older residents (43.3 vs 40.0%). Men (46.6 vs 43.7%) and younger residents (<85 years) (43.3 vs 40.0%) were more likely to use medications with moderate to strong anticholinergic properties than women and older residents, respectively. Again, men (33.1 vs 30.5%) and younger residents (<85 years) (36.8 vs 30.6%) were more likely to use these medications then women and older residents, respectively.

Indicator for duplication of therapy within a therapeutic class

For the high-risk medication classes included in this analysis (medications recommended to avoid in the MRQOC indicators—indicator 19), the proportion of residents exposed to two or more distinct medications within a therapeutic class was minimal with the majority at 0%. The highest was for benzodiazepines with 7.7% of the cohort exposed to two or more medications from this therapeutic class within a 12-month period.

Indicators for concomitant use of medications to avoid

The proportion of residents who were exposed to both aspirin and warfarin (MRQOC indicator 20) in the first 6 months of 2013 was 1.0%. The proportion of residents who were exposed to an ACEI/A2RB, diuretic and a NSAID (MRQOC indicator 21) in the first 3 months of 2013 was 2.3%.

Indicators for access to MRQOC health services

The proportion of residents who had at least one medication review (MRQOC indicator 23) in 2013 (RMMR) was 42.6 and 5.3% of residents with diabetes had a completed annual cycle of diabetes care (MRQOC indicator 22).

Discussion

This study used an administrative health claims database to describe MRQOC using an indicator set developed specifically for the Australian residential aged care population. Whilst there was evidence of good MRQOC for several of the indicators, the results highlight specific conditions and services where evidence-based practice gaps in medication management in the Australian residential aged care population exist.

MRQOC for most the prevalent conditions

The results from the five MRQOC indicators addressing medications recommended for use to treat the most prevalent conditions (heart failure, hypertension, ischaemic heart disease and stroke) estimated that between half and three quarters of eligible residents were supplied the recommended medications. There are no comparative studies with respect to these types of MRQOC indicators in the Australian residential aged care population [10].

A study undertaken in the UK, which applied evidence-based clinical indicators to 10 000 nursing home residents, reported underutilization of ß-blockers in residents with a history of coronary heart disease or heart failure and underuse of an ACEI/A2RB post myocardial infarction or in heart failure [24]. This UK study also found
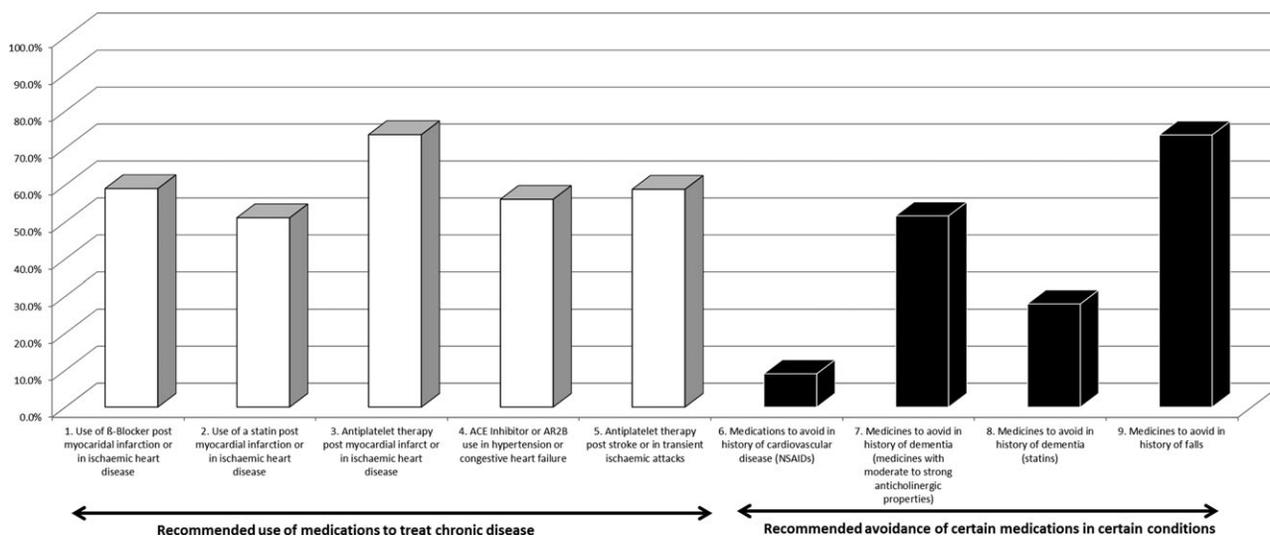

Figure 1 Proportion of eligible residents supplied medications included in MRQOC indicators for medication appropriateness in the most prevalent conditions.

Table 2 MRQOC indicators of general medication appropriateness. Age adjusted to the total Australian residential aged care population at June 2013[a] and log rank test for homogeneity[b]

Indicator description (n = 17 673)	Prevalence of indicators % (95% CI)		% Age-adjusted proportion[a]	% Age < 85 years (n = 1991)	% Age ≥85 years (n = 15 673)	P value[b]	% Female (n = 11 950)	% Male (n = 5722)	P value[b]
	% Proportion of residents supplied medication	Mean number of prescriptions supplied (95% CI)							
10. Avoid use of benzodiazepines—short and long acting	40.4 (39.8–41.3)	7.6 (7.4–7.8)	41.4 (40.1–42.8)	43.3 (41.0–45.6)	40.0 (39.4–40.8)	<0.01	40.2 (39.2–41.1)	41.4 (40.0–42.9)	0.69
11. Avoid use of medications with moderate to strong anticholinergic properties	44.6 (43.8–45.4)	6.1 (5.9–6.2)	46.1 (45.1–47.5)	48.8 (46.5–51.2)	44.1 (43.2–44.9)	<0.01	43.7 (42.8–44.7)	46.6 (45.2–48.1)	0.02
12. Avoid use of certain anti-arrhythmics	2.0 (1.8–2.2)	6.5 (6.1–7.0)	2.3 (1.9–2.9)	2.7 (2.1–3.9)	2.0 (1.8–2.2)	0.04	2.2 (1.9–2.4)	2.0 (1.6–2.4)	0.41
13. Avoid use of certain antidepressants	7.7 (7.3–8.1)	6.8 (6.5–6.7)	7.9 (7.1–8.7)	8.3 (7.1–9.7)	7.6 (7.1–8.0)	0.31	8.2 (7.7–8.7)	6.6 (5.9–7.3)	<0.01
14. Avoid use of typical and atypical antipsychotics	31.3 (30.6–32.0)	5.7 (5.6–5.9)	33.2 (31.8–34.9)	36.8 (34.6–39.1)	30.6 (29.8–31.4)	<0.01	30.5 (29.6–31.4)	33.1 (31.8–34.5)	<0.01
15. Avoid use of certain antispasmodics and muscle relaxants	4.5 (4.2–4.8)	2.1 (1.9–2.3)	4.3 (3.8–4.8)	4.0 (3.2–5.0)	4.6 (4.2–4.7)	0.44	4.0 (3.7–4.5)	5.6 (5.0–6.4)	<0.01
16. Avoid use of select α-blockers	1.5 (1.3–1.7)	4.5 (4.1–4.9)	1.5 (1.2–2.0)	1.6 (1.1–2.3)	1.5 (1.3–1.7)	0.69	0.7 (0.5–0.8)	3.2 (2.8–3.8)	<0.01
17. Avoid use of centrally acting α-agonists	1.1 (0.9–1.2)	7.6 (6.8–8.4)	1.3 (1.1–1.8)	2.0 (1.4–2.8)	1.0 (0.8–1.1)	<0.01	1.3 (1.1–1.5)	0.6 (0.4–0.9)	<0.01

that residing in a nursing home significantly reduced the odds of being exposed to a recommended medication by up to 30% (OR = 0.70, 95% CI: 0.65–0.75) [24].

The MRQOC indicators which addressed recommended medications reflect the current international consensus for treating chronic disease in the older vulnerable population [10]. Taking into consideration that a proportion of residents may have a genuine clinical exemption from the indicator criteria, up to 48% of the residents in our study population did not receive the recommended treatment for their condition and this presents an opportunity to improve MRQOC in this population.

A review of the literature investigating the causes and consequences of underprescribing in the older population found that cardiovascular medications, were frequently under prescribed across multiple countries (UK, USA, Austria, Belgium, France, etc.) due to multimorbidity, ageism and economic limitations [25]. Consequently, the patient is exposed to an increased risk of cardiovascular morbidity and mortality. The authors of this review suggested the use of comprehensive geriatric assessments to address under prescribing and to ensure there are genuine reasons for omission of recommended medications in the older population.

MRQOC for general medication appropriateness

The high degree of exposure to antipsychotic medications and benzodiazepines in the residential aged care population is of concern given the prevailing evidence-base of increased risk of serious adverse events such as falls, cognitive decline, stroke and death in the older population [26].

The results from our study are comparable to international reports of antipsychotic exposure rates in nursing homes. In Canada, it is reported that one quarter of newly admitted nursing home residents will receive an antipsychotic in their first year of residency [27]. In the USA, ~29% of all residents received at least one antipsychotic in a 12-month period [28]. The Food and Drug Administration reported that up to 10.4% of residents taking atypical antipsychotics were on an excessive dose and 9.4% were exposed for an excessive duration [29]. The Centres for Medicare Advocacy in the USA reported that 23.9% remained on antipsychotic medications even after a national drive to reduce antipsychotic use in nursing homes [30]. They recommend stronger enforcement of legislation to prevent unnecessary use of these medications [30].

In Australia, risperidone is currently approved for the short-term treatment of behavioural and psychological symptoms of dementia (BPSD) [16]. BPSD has been reported to be more difficult to manage in male compared to female patients [31, 32]. This may account for the higher exposure to antipsychotics in male residents compared to female residents observed in our study. Promotion of alternative non-pharmacological measures for managing BPSD should target males.

The problematic use of benzodiazepine medications in Australian has been well known for over two decades and this issue is not unique to Australia [33, 34]. In Australia benzodiazepines are available on the PBS for short-term use due to increased risk of addiction and adverse outcomes [16, 26, 35]. The prevalence of conditions for which benzodiazepines are used is high in the aged care population, with insomnia reported to affect between 13 and 30% of residents [36]. Dementia, depression and pain are three conditions found to be predictive of insomnia in the aged care population [36, 37]. Targeting interventions at residents at risk of insomnia may help to improve MRQOC with respect to reducing exposure to benzodiazepines [37].
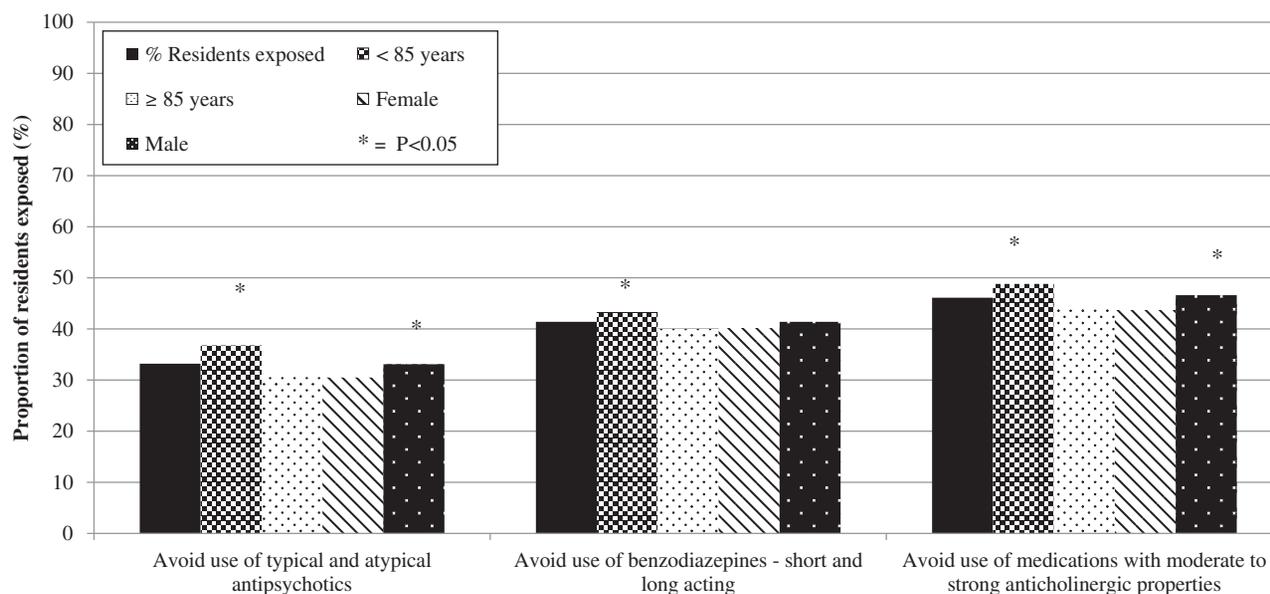
Figure 2 MRQOC indicators for general medication appropriateness where proportion exposed >10%.

This study found that exposure to benzodiazepines, antipsychotics and medications with moderate to strong anticholinergic properties was higher in younger residents compared to residents aged 85 years or older. This indicates a degree of avoidance of use of these high-risk medications in the older, more vulnerable aged care population.

Another positive finding in this study was that for the remaining MRQOC indicators which recommended medications to avoid in the older population, prevalence of exposure was low. This may be due to several factors. Firstly, past educational campaigns have influenced prescribers to avoid these medications (e.g. NSAIDs in heart disease) [38]. Secondly, some of the medications included in these indicators have been superseded by either non-pharmacological alternatives or medications with safer adverse effect profiles (e.g. anti-arrythmics for rate control) [39]. Thirdly, exposure to some of these medications may be for specific clinical scenarios, such as the short-term use of antispasmodics and muscle relaxants in palliative care [40].

When analysing the exposure to multiple medications this study found minimal exposure (<10%) which shows a low risk of adverse events due to duplication of therapy or high-risk combinations of medications.

MRQOC indicators for health care access

The utilization of government funded health services associated with MRQOC including 'Medication review (RMMR)' and 'Annual cycle of care for residents with diabetes', were both low, particularly for the provision of an annual diabetes cycle of care where only 5% of the eligible residents had claims for this service. In Australia, the annual diabetes cycle of care can be claimed once all the individual components have been undertaken and therefore this may be an underestimation of the services provided to residents with diabetes [18].

Reports of studies previously undertaken in the Australian aged care population consistently show low uptake of these types of services in the aged care population [41, 42]. These types of collaborative services are designed to provide an opportunity to address many of the MRQOC gaps identified in our study. Collaborative medication reviews have been shown to improve MRQOC in the aged-care population [43].

Limitations of study

The criteria used in this study to determine exposure to medications have several limitations. Firstly, using any exposure in a twelve month period does not distinguish between incident and prevalent users nor does it inform duration of use of medications or seasonal use [44]. However, prevalence data are acceptable for fulfilling the aim of this study which was to show compliance with the indicator criteria. For the high-risk medications we analysed the mean number of prescriptions dispensed over the study period which is a proxy for persistence. Secondly, the criteria for the indicators analysing concomitant exposure could result in under estimation of the prevalence of these combinations due to lower numbers of supplies in the first quarter of each calendar year (Australian safety net phenomenon). Over-estimation is also possible as only co-supply within the designated time periods was determined rather than actual number of days of overlapping supply.

The criteria for identifying residents with chronic disease for the relevant indicators in this study used hospitalization codes and medication use in the 12 months (1 January to 31 December 2012) prior to the study index date (1 January 2013). This method will identify residents with recent hospital visits and medication use but potentially misclassify those diagnosed or using medications prior to 1 January 2012.

This study was not designed to determine if residents had clinical or personal contraindications to medications recommended in some of the MRQOC indicators. Underutilization of recommended medications may be reflective of considered avoidance of these medications in a frail, older population.

Conclusion

Application of the MRQOC indicators in this study has highlighted areas where improvement in MRQOC can be made for Australian aged care residents. MRQOC activities in this population should be targeted at monitoring and reducing exposure to antipsychotics and benzodiazepines, improving the use of preventative medications for cardiovascular disease and improving access to collaborative health

services. Results from this study are similar to those from other countries (UK, Canada, USA and Europe) indicating that suboptimal MRQOC has some common elements. Australian and international studies recommend the use of comprehensive geriatric assessment and medication review to improve MRQOC in aged care.

Funding

Ethics

This study was approved by the University of South Australia human research ethics committee (protocol number: 27439) and the Australian Government Department of Veterans' Affairs human research ethics committee (project number: E012/009).

References

1. World Health Organization. Multisectoral action for a life course approach to healthy ageing: draft global strategy and plan of action on ageing and health. *69th World Health Assembly*. A69/17. 2016. http://apps.who.int/gb/e/e_wha69.html

2. Productivity Commission. *Caring for Older Australians: Overview, Report no. 53, Final Inquiry Report*. Canberra: Australian Governmnet, 2011.

3. Chen Y, Briesacher BA, Field TS *et al*. Unexplained variation across US nursing homes in antipsychotic prescribing rates. *Arch Intern Med* 2010;**170**:89–95.

4. Milton JC, Hill-Smith I, Jackson SHD. Prescribing for older people. *Br Med J* 2008;**336**:606–9.

5. Wilson RN, Runciman WB, Gibberd RW *et al*. The quality in Australian health care study. *MJA* 1995;**163**:458–71.

6. Lau DT, Kasper JD, Potter DEB *et al*. Hospitalisation and death associated with potentially inappropriate medication prescriptions among elderly nursing home residents. *Arch Intern Med* 2005;**165**:68–74.

7. Roughead EE, Gilbert AL, Woodward MC. Medication use by Australian war veterans in residential aged-care facilities. *J Pharm Pract Res* 2008;**38**:14–8.

8. National Committee for Quality Assurance (NCQA). *Healthcare Effectiveness Data and Information Set*. USA: National Committee for Quality Assurance, 2013. www.ncqa.org.

9. National Institute for Health and Care Excellence (NICE). *Indicators Process Guide*. Manchester: NICE, 2014.

10. Hillen JB, Vitry A, Caughey GE. Evaluating medication-related quality of care in residential aged care: a systematic review. *SpringerPlus* 2015;**4**:220. [Internet].

11. Centres for Medicare and Medicaid Services. *MDS Quality Measure/indicator Report*. www.cms.gov.

12. Prescribing and Primary Care, Health and Social Care Information Centre. Quality and outcomes framework. Achievement, prevalence and exceptions data, 2012/13. *Technical Annex*. In: The Health and Social Care Information Centre, editor. United Kingdom 2013.

13. Belardi L, O'Keeffe D. Quality Indicators: more questions than answers. *Aust Ageing Agenda* 2016 January/February: 22–3.

14. Kalisch L, Pratt NL, Ramsay E *et al*. Multiple anticholinergic medication use and risk of hospital admission for confusion or dementia. *JAGS* 2014;**62**:1916–22.

15. WHO Collaborating Centre for Drug Statistic Methodology. *Index ATC With DDD 2015*. Oslo. www.whocc.no.

16. Australian Government. *Schedule of Pharmaceutical Benefits: Commonwealth of Australia*. www.pbs.gov.au.

17. World Health Organisation. *International Classification of Diseases, Australian Modification V10*. www.who.int/classification/icd/en.

18. Medicare Australia. *Medicare Benefits Schedule*. Department of Human Services, Australian Government. www.medicareaustralia.gov.au.

19. Quality Use of Medicines and Pharmacy Research Centre. University of South Australia. Veterans' MATES Program Canberra: Australian Government. Department of Veterans' Affairs. www.veteransmates.net.au

20. Slugget J, Caughey G, Ward M *et al*. Antithrombotic use following transient ischaemic attack or ischaemic stroke among older Australians with atrial fibrillation. *Intern Med J* 2014;**44**:1134–7.

21. Roughead E, Kalisch L, Ramsay E *et al*. Continuity of care: when do patients visit community healthcare providers after leaving hospital? *Intern Med J* 2011;**41**:662–7.

22. Australian Institute of Health and Welfare. METeOR. Metadata Online Registry. Age-standardised rate. 2016

23. Peterson AM, Nau DP, Cramer JA *et al*. A checklist for medication compliance and persistence studies using retrosepctive databases. *Value Health* 2007;**10**:3–12.

24. Shah SM, Carey IM, Harris T *et al*. Quality of chronic disease care for older people in care homes and the community in a primary care pay for performance system: retrospective study. *Br Med J* 2011;**342**:d912. www.bmj.com.uk.

25. Cherubini A, Corsonello A, Lattanzio F. Underprescribing of beneficial medicines in older people. *Drugs Ageing* 2012;**29**:463–75.

26. American Geriatrics Society 2015 Beers Criteria Update Expert Panel. American Geriatrics Society 2015 Updated Beers criteria for potentially inappropriate medication use in older adults. *JAGS* 2015;**63**:2227–46.

27. Bronskill SE, Rochon PA, Gill SS *et al*. The relationship between variations in antipsychotic prescribing across nursing homes and short term mortality. *Med Care* 2009;**47**:1000–8.

28. Chen Y, Briesacher BA, Field TS *et al*. Unexplained variation across US nursing homes in antipsychotic prescribing rates. *Arch Intern Med* 2010;**170**:89–95.

29. Office of Inspector General. Medicare atypical antipsychotic drug claims for elderly nursing home residents: Department of Health and Human Services. USA, 2011. Report no.: OEI-07-08-00150.

30. Elderman T. Has CMS's partnership with the nursing home industry really reduced the inappropriate use of antipsychtoic drugs by nursing home residents as much as CMS claims? *No. Centre for Medicare Advocacy*. Cited June 2016. www.medicareadvocacy.org [cited 2016 6th August].

31. Macfarlane S, O'Connor D. Managing behavioural and psychological symptoms in dementia. *Aust Prescr* 2016;**39**:123–5.

32. Kitamura T, Kitamura M, Hino S *et al*. Gender differences in clinical manifestations and outcomes among hospitalised patients with behavioural and psychological symptoms of dementia. *J Clin Psychiatry* 2012;**73**:1548–54.

33. Gilbert A, Quintrell LN, Owen N. Use of benzodiazepines among residents of aged-care accommodation. *Community Health Stud* 1988;**12**:394–9.

34. Azermai M, Elseviers M, Petrovic M *et al*. Geriatric drug utilisation of psychotropics in Belgian nursing homes. *Hum Psychopharmacol* 2011;**26**:12–20.

35. Australian Medicines Handbook. *AMH Aged Care Companion*. Adelaide, SA 5001: Australian Medicines Handbook, 2014.

36. Gindin J, Shochat T, chetrit A *et al*. Insomnia in long-term care facilities. A comparison of seven European countries and Israel: The Services and Health for elderly in Long TERm care Study. *JAGS* 2014;**62**:2033–39.

37. Australian and New Zealand Society for Geriatric Medicine. Position statement—sleep in the older person. *Australas J Ageing* 2015;**34**:203–12.

38. Roughead EE, Kalisch LM, Ramsay EN *et al*. Bridging evidence-practice gaps: improving use of medicines in elderly Australian veterans. *BMC Health Serv Res* 2013;**13**:514. [Internet].

39. Parker MH, Sanoski CA. Clinical pearls in using antiarrhythmic drugs in the outpatient setting. *J Pharm Pract* 2016;**29**:77–86.

40. Therapeutic Guidelines Limited. *eTG Complete. Palliative Care*. West Melbourne: Therapeutic Guidelines Ltd, 2017.

41. Australian Government. QUMPRC. Department of Veterans' Affairs. Veterans' MATES Therapetuic Brief. Topic 11. In: *Building a Comprehensive Care Cycle for Veterans With Diabetes*. Adelaide: UniSA, 2005.

42. Hillen JB, Vitry A, Caughey GE. Trends in general practitioner services to residents in aged care. *Aust J Prim Health* 2016;**22**:517–22.

43. Chen TF. Pharmacist-led home medicines review and residential medication management review: The Australian model. *Drugs Ageing* 2016;**33**:199–204.

44. Schneeweiss S, Avorn J. A review of uses of health care utilisation databases for epidemiologic research on therapeutics. *J Clin Epidemiol* 2005;**58**:323–37.

Appendix 1

Indicator description	Disease classification criteria (ICD-10AM/PBS codes)	Medication exposure criteria (ATC/PBS codes)
Medication appropriateness in the most prevalent conditions		
1. Use of a Beta-Blocker post myocardial infarct or in ischaemic heart disease	ICD-10AM: I20, I21, I22, I23, I24 and I25	ATC: C07AA, C07AB and C07AG
2. Use of a statin post myocardial infarct or in ischaemic heart disease	ICD-10AM: I20, I21, I22, I23, I24 and I25	ATC: C10AA, C10BX and C10BA
3. Angiotensin Converting Enzyme Inhibitor (ACEI) or Angiotensin-2 receptor blocker (A2RB) use in hypertension and/or congestive heart failure	Congestive heart failure: ICD-10AM: I500, I501, I509, I110, 130, I132 and/or PBS: 08255 L, 08256 M, 08257 N, 08258 P, 08604 W, 08606Y, 0881D, 08732 N, 08733 P, 08734Q, 08735 R, 9311 C, 9312D and 9316 H Hypertension: ICD-10AM I10, I11, I12, I13, I14 and I15	ATC: C09 and C10BX
4. Antiplatelet therapy post myocardial infarct or ischaemic heart disease (aspirin and clopidogrel not ticlopidine)	ICD-10AM: I20, I21, I22, I23, I24 and I25	ATC: B01AC or PBS: 9296 G
5. Antiplatelet therapy post stroke or in transient ischaemic attacks (aspirin, clopidogrel and dipyridamole not ticlopidine)	ICD-10AM: I63, G45.0, G45.1, G45.2, G45.8 and G45.9	ATC: B01AC and B01AC07 and/or PBS: 8382E
6. Medicines to avoid in patients with cardiovascular disease (NSAIDs)	Congestive heart failure: ICD-10AM: I500, I501, I509, I110, 130, I132 and/or PBS: 08255 L, 08256 M, 08257 N, 08258 P, 08604 W, 08606Y, 0881D, 08732 N, 08733 P, 08734Q, 08735 R, 9311 C, 9312D and 9316 H Hypertension: ICD-10AM I10, I11, I12, I13, I14 and I15	ATC: M01A
7. Medicines to avoid in history of dementia. 1. Medications with moderate to strong anticholinergic properties [14]	ICD-10AM: F00, F01, f02, F03, F05.1, G30 and G31.2 and/or ATC: N06D	ATC codes: A03AB05, A03BA01, C01BA03, G04BD04, N02CX01, N03AF01, N04AA01, N04AA02, N04AC01, N05AA01, N05AC01, N05AD01, N05AE04, N05AH04, N05AX08, N05AX13, N06AA02, N06AA04, N06AA09, N06AA10, N06AA12, N06AA16, N06AB05, R06AD02 and R06AX02
8. Medicines to avoid in history of dementia. 2. Statins	ICD-10AM: F00, F01, F02, F03, F05.1, G30 and G31.2 and/or ATC: N06D	ATC: C10AA, C10BX and C10BA
9. Medications to avoid in history of falls (sedating antihistamines, TCAs, MOAIs, SSRIs, benzodiazepines, antipsychotics and medications with moderate to strong anticholinergic properties)	ICD-10AM: R29.6, R26, R27, W00 and W19	ATC codes: A03AB05, A03BA01, C01BA03, G04BD04, N02CX01, N03AF01, N04AA01, N04AA02, N04AC01, N05AA01, N05AC01, N05AD01, N05AE04, N05AH04, N05AX08, N05AX13, N06AA02, N06AA04, N06AA09, N06AA10, N06AA12, N06AA16, N06AB05, R06AD02, R06AX02, N06AA, N06AX03, N06AB, N05BA, N05CD and N05A

Table continued

Appendix 1 Continued

Indicator description	Disease classification criteria (ICD-10AM/PBS codes)	Medication exposure criteria (ATC/PBS codes)
General medication appropriateness		
10. Avoid exposure to benzodiazepines		ATC codes: N05BA and N05CD and N03AE02
11. Avoid use of medications with moderate or strong anticholinergic properties [14]		ATC codes: A03AB05, A03BA01, C01BA03, G04BD04, N02CX01, N03AF01, N04AA01, N04AA02, N04AC01, N05AA01, N05AC01, N05AD01, N05AE04, N05AH04, N05AX08, N05AX13, N06AA02, N06AA04, N06AA09, N06AA10, N06AA12, N06AA16, N06AB05, R06AD02 and R06AX02
12. Avoid select anti-arrhythmics (disopyramide, flecainide, quinidine, procainamide and sotalol)		ATC codes: C01BA03, C01BC04 and C07AA07
13. Avoid select antidepressants (TCAs and MOAIs)		ATC codes: N06AA and N06AX03
14. Avoid typical and atypical antipsychotics		ATC codes: N05AA to N05AF, N05AH, N05Al and N05AX.
15. Avoid select antispasmodics and muscle relaxants (orphenadrine, baclofen, dantrolene, mebeverine, propantheline, atropine, hyoscyamine, belladonna and butyl scopolamine)		ATC codes: M03B, M03C, A03A and A03B
16. Avoid alpha blockers (prazosin and doxazosin)		ATC code: C02CA
17. Avoid centrally acting alpha agonists (methyldopa, reserpine and clonidine)		ATC code: C02A
18. Avoid shorter acting nifedipine products		ATC code: C08CA08PBS codes: 1694E and 1694 F
19. Duplication of therapeutic class (high-risk medications)		ATC code: as per MRQOC indicator
20. Concomitant use of warfarin and aspirin		ATC codes: B01AA and B01AC06PBS codes (4078 P, 8202Q, 4076 M, 4077 N, 1010E, 9296 G and 8382E)
21. 'Triple Whammy'—concomitant use of ACEI/A2RB, diuretic and NSAID		ATC codes: C90, C03 and M01A
Access to services		**Health service utilization exposure (MBS item numbers)**
22. Access to annual cycle of care service for diabetes		MBS item number: 2517–2526 and 2620–2635
23. Access to a medication review		MBS item number: 903