Suboptimal medication-related quality of care preceding hospitalisation of older patients

Abstract

Objective: To examine the prevalence of suboptimal medication-related processes of care before the hospitalisation of older patients.

Design and setting: We conducted a retrospective cohort study using a clinical indicator set related to medication management that has been validated by an expert panel as consisting of suboptimal aspects of medication use that clinicians should be able to foresee and avoid. Australian Government Department of Veterans' Affairs administrative claims data between 1 July 2007 and 30 June 2012 were analysed according to these clinical indicators to assess medication-related processes of care preceding hospitalisation.

Participants: Veterans with one or more hospitalisations in Australia for a condition defined by the clinical indicator set.

Main outcome measure: Prevalence of suboptimal medication-related processes of care before hospitalisation as a proportion of all hospitalisations defined by diagnoses in the clinical indicator set.

Results: During the 5-year study period, there were 164 813 hospitalisations with primary diagnoses for conditions included in the clinical indicator set, encompassing 83 430 patients. The overall proportion of hospitalisations that were preceded by suboptimal medication-related processes of care was 25.2% (41 546 hospitalisations); 34.5% of patients (28 807 patients) had at least one hospitalisation and 10.4% (8640 patients) had two or more hospitalisations preceded by suboptimal medication-related processes of care. At least one in 10 hospitalisations for chronic heart failure, ischaemic stroke, asthma, gastrointestinal ulcer or bleeding, fracture, renal failure or nephropathy, hyperglycaemia or hypoglycaemia were preceded by suboptimal medication-related processes of care.

Conclusions: This study highlights conditions for which there are evidence–practice gaps in medication management in the older population. Routine prospective monitoring of these evidence-based, validated, medication-related clinical indicators provides a means for quality improvement in the management of common chronic conditions.

Chronic diseases are the leading cause of death and disability worldwide, and their prevalence is increasing, particularly in the older population.[1] In Australia, chronic diseases account for 70% of total health expenditure, costing $91.2 billion in the 2010–11 financial year.[2] Optimal management of chronic disease therefore has significant potential to reduce health care expenditure, as well as improve health outcomes for individuals.

In Australia, it is estimated that between 2% and 3% of all hospital admissions are medication related.[3] There were 9.3 million hospital separations in Australia during 2011–2012 at an average cost of $5204 per separation; this suggests that there are about 232 500 medication-related admissions per year at an annual cost of $1.2 billion.[4] Many of these hospitalisations could potentially be prevented by delivery of appropriate primary care.[3]

To facilitate the reduction of medication-related morbidity, clinical indicators have been developed that assess processes of care associated with medication use and ensuing adverse outcomes of hospitalisation.[5,6] These medication-related clinical indicator sets were originally developed more than 10 years ago by expert panels in the United States, United Kingdom and Canada, based on the principles that medication-related problems are recognisable, that the adverse outcomes are foreseeable, and that their causes and outcomes are identifiable and controllable. On the basis of these clinical indicators, it has been reported that between 3% and 20% of hospitalised patients had suboptimal care before admission, depending on the country and population studied.[7-9]

Clinical indicators have been widely adopted as a measure of health system performance and quality of care provided to patients, ranging from the acute care to primary care settings, across a number of disease states.[10] Use of clinical indicators to determine the appropriateness and timeliness of care for patients with chronic disease and associated medication use is a potentially underused measure for assessing health system performance. Such indicators may facilitate the identification of areas with potential for improving health care and health outcomes, as well as reducing the frequency of adverse events.

We have developed evidence-based medication-related indicators of suboptimal processes of care before hospitalisation that are specific to the Australian health care setting.[11] The indicators are based on Level III or greater evidence, and were validated by an expert panel as aspects of medication use that clinicians should be able to identify and resolve in primary care.[12] The aim of this study was to apply these medication-related clinical indicators to investigate the prevalence of suboptimal medication-related processes of care preceding hospitalisation of older patients.

Methods

Ethics approval for this study was obtained from the Human Research Ethics Committees of the University of South Australia (protocol number 0000025588) and the Department of

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doi: 10.5694/mja14.01479

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Data source

We analysed DVA administrative health claims data to determine the prevalence of clinical indicators of suboptimal medication-related processes of care before hospitalisation in a treatment population of about 300 000 veterans during the study period (1 July 2007 to 30 June 2012). The DVA claims database contains patient-specific demographic data, including date of birth, date of death, sex, level of entitlement and residential status, as well as details of all prescription medicines, medical and allied health services, and hospitalisations provided to veterans for which the DVA pays a subsidy. Medicines are coded in the dataset according to the World Health Organization anatomical and therapeutic chemical (ATC) classification[13] and the Pharmaceutical Benefits Schedule (PBS) item codes.[14] Services are coded according to the Medicare Benefits Schedule (MBS),[15] and hospitalisations are coded according to the World Health Organization International Classification of Diseases, 10th revision, Australian modification (ICD-10-AM).[16]

Prevalence of clinical indicators in the DVA database

Details of the development of the clinical indicators of suboptimal medication-related processes of care before hospitalisation have been published elsewhere.[11] As an example of an indicator where the outcome of interest is hospitalisation for acute coronary syndrome, the associated process of care is defined as the combination of "patient has coronary artery stent (in 1 year before admission)" and "no use of aspirin or clopidogrel (in 12 months before admission)".[11]

We reviewed the clinical indicators to identify those that were suitable for testing with the DVA administrative health claims data. As the DVA database is an administrative claims dataset, it contains records only for medicines and health services that attract a subsidy. Health care activities that do not have an individual funding item number, such as blood pressure measurement, are not recorded in the administrative claims database. Although the use of health services (such as testing for glycated haemoglobin [HbA_{1c}] levels) can be determined from the claims data, the test results are not available. The criteria for appropriate use of health services as part of the process of care adopted by the indicators were based on practice recommendations in Australian evidence-based guidelines.[11] Some of the validated indicators included processes of care that could not be identified in the administrative claims database, and therefore had to be excluded from this analysis. A total of 21 of the 29 validated indicators included medication-related processes of care that could be identified in the claims database and were therefore included in this analysis. They were drawn from six disease groupings: cardiovascular disease, respiratory disease, gastrointestinal disease, osteoporosis or fracture, renal disease, and diabetes. Of these 21 indicators, 13 are based on Level I evidence.[11] Indicators that could not be included related to conditions that could not be accurately identified in the data: moderate to severe chronic obstructive pulmonary disease with frequent exacerbations, dyspepsia, and positive test results for *Helicobacter pylori*; influenza and pneumococcal vaccinations are not recorded in the database, nor are the doses of medicines used (corticosteroids) or the vitamin D or calcium levels.[11]

Data rules were developed for identifying each pattern of care and hospitalisation outcome for each indicator in the administrative claims dataset. These data rules included ICD-10-AM codes that identified each hospitalisation outcome, ATC or PBS item codes that identified medications, and MBS codes that identified testing procedures or claims related to the process of care. DVA administrative health claims between 1 July 2007 and 30 June 2012 were analysed to identify all hospitalisations with a primary diagnosis for the outcomes, and all MBS and PBS claims were analysed for patterns of care for the clinical indicator set.

We calculated the prevalence of hospitalisations with suboptimal medication-related processes of care before hospitalisation, as defined by the clinical indicator set. The prevalence was defined as the proportion of individuals with both the pattern of care and the associated hospitalisation divided by the total number of hospitalisations for that indicator. Demographic data were obtained for patients at study entry. All analyses were undertaken with SAS for Windows, v9.4 (SAS Institute).

Results

There were 164 813 hospitalisations for the conditions included in the clinical indicator set over the 5-year study period, encompassing 83 430 patients. The median age of the study population was 81 years (interquartile range, 78–84 years); 54.5% were men, and 6.9% resided in an aged care facility at the time of admission (Box 1).

Box 2 contains the final list of clinical indicators included in the study and the prevalence of suboptimal medication-related processes of care preceding hospitalisation. More than one-third (34.5%) of the study population had at least one hospitalisation and 10.4% had two or more hospitalisations involving suboptimal medication-related processes of care before admission (Box 1). The overall proportion of hospitalisations that were preceded by suboptimal medication-related processes of care was 25.2% (41 546 hospitalisations). The most common hospitalisations were for cardiovascular disease (including acute coronary syndromes and heart failure), fracture and gastrointestinal conditions. Fracture and congestive heart failure (CHF) caused the highest numbers of hospitalisations that were preceded by suboptimal medication-related processes of care (Box 2). Of the fracture hospitalisations, 85.4% were for patients aged 65 years or older

1 Demographics of the study population: hospitalisation for diagnoses in the medication-related clinical indicator set (n = 83 430)

Age, median (interquartile range)	81 years (78–84 years)
Sex, *n* (%)	
Male	45 456 (54.5%)
Female	37 974 (45.5%)
Location of residence, *n* (%)	
Residential aged care facility	5725 (6.9%)
Community	77 705 (93.1%)
Hospitalisations with suboptimal processes of care before admission, *n* (%)	
0	54 623 (65.5%)
1	20 167 (24.2%)
≥ 2	8640 (10.4%)

who had been dispensed a falls-risk medicine before admission; 19.7% and 17.2% of fracture hospitalisations were for men and women, respectively, who had a history of fracture or osteoporosis but had not received a medicine for osteoporosis. There were 4744 CHF admissions (17.1%) of patients with a history of CHF who had not been dispensed an angiotensin-converting enzyme inhibitor (ACEI) or an angiotensin receptor blocker (ARB) in the 3 months before admission. More than one in 10 admissions for gastrointestinal bleeding or ulcer were associated with long-term use of non-steroidal anti-inflammatory drugs (NSAIDs). About one in 10 admissions for renal failure occurred in patients with a history of diabetes who had not received a renal function test in the year before admission and were not dispensed an ACEI or ARB (Box 2).

Although there were more than 33 363 hospitalisations for acute coronary syndromes during the study period, less than 2% involved individuals with a history of myocardial infarction or who had received cardiac stents and had not been dispensed acute coronary syndrome medicines recommended by the guidelines. Similarly, although there were more than 17 149 hospitalisations for gastrointestinal bleeding, ulcer or gastritis during the study period, less than 1% involved patients with a previous history of gastrointestinal bleeding or ulcer who had been dispensed an NSAID without a concurrent gastroprotective agent (Box 2). There were 1751 admissions for hyperglycaemia or hypoglycaemia; only 209 of these patients (11.9%) were prescribed insulin and had not received an HbA_{1c} test in the 6 months before admission.

Discussion

This is the first study to examine suboptimal medication-related processes of care before hospitalisation. We applied newly developed evidence-based clinical indicators specific to the Australian health care setting and found that 25.2% of hospitalisations for conditions identified in the clinical indicator set were preceded by suboptimal medication-related processes of care. Of the 28 807 patients in the study who had hospitalisations preceded by suboptimal medication-related processes of care, 30% (8640 patients) had multiple such hospital admissions. At least one in 10 hospitalisations for CHF, ischaemic stroke, asthma, gastrointestinal ulcer or bleeding, fracture, renal failure or nephropathy, hyperglycaemia or hypoglycaemia were preceded by suboptimal medication-related processes of care that clinicians should be able to identify and avoid. The frequency of falls-risk medicine use before hospitalisation for a fracture was particularly high (85.4%), highlighting the need to review appropriate prescribing of these medications for older people, who may be particularly vulnerable to their adverse effects.

A recent Australian study (CareTrack) examined the provision of appropriate health care. The investigation was based on medical records from health care practices (primary and secondary care) and hospitals, and it found that 43% of Australian patients had not received appropriate care.[17] The CareTrack study examined process indicators only, and these were not linked to outcome measures, such as hospitalisation. The indicators included in the study were either consensus or evidence-based in nature, and were related to individual patient data. Gaps in the provision of appropriate care for specific conditions were identified (including for diabetes, osteoporosis, asthma and stroke), consistent with the results of our study.

Many of the conditions for which suboptimal processes of care were identified by our study fall within National Health Priority Areas for Australia or are associated with a high disease burden in Australia.[18] This highlights the potential suitability of the medication-related indicators for monitoring appropriate provision of health care in Australia.

Other studies have highlighted the suitability of clinical indicators as quality indicators for monitoring health system performance and assessing the quality of patient care.[5,7,10] Our study showed that administrative health databases can be used to investigate suboptimal medication-related processes of care before hospitalisation through the application of clinical indicators, and to assess the appropriateness of health care in current clinical practice. Routine prospective monitoring of trends in suboptimal processes of care associated with medicine use, and the use of the indicators in administrative health datasets or as data-mining tools in primary care, could provide a valuable tool for monitoring and improving health system performance. Primary care interventions, such as patient-

2 Prevalence of hospitalisations after suboptimal processes of care as defined by the medication-related clinical indicator set

No.	Hospitalisation outcome	Process of care (preceding hospitalisation)	Total hospitalisations (TH)	Hospitalisations after suboptimal care [% TH, 95% CI]
Cardiovascular disease indicators				
1	Acute coronary syndrome	1) History of myocardial infarction (in 2 years before admission) 2) Not on aspirin, β-blocker, ACEI or ARB and statin (in 3 months before admission)	33 363	567 [1.69%, 1.56%–1.84%]
2	Acute coronary syndrome	1) Patient has coronary artery stent (in 1 year before admission) 2) No use of aspirin or clopidogrel (in 12 months before admission)	33 363	640 [1.91%, 1.75%–2.05%]
3	CHF	1) History of CHF (in 2 years before admission) 2) Not on an ACEI or ARB (in 3 months before admission)	27 828	4744 [17.05%, 16.66%–17.54%]
4	CHF or heart block	1) History of CHF and heart block or advanced bradycardia (in 2 years before admission) 2) Use of digoxin (in 6 months before admission)	31 039	195 [0.63%, 0.54%–0.72%]
5	Ischaemic stroke	1) History of chronic atrial fibrillation or ischaemic stroke (in 2 years before admission) 2) No use of warfarin or aspirin (in 3 months before admission)	6637	677 [10.20%, 9.47%–10.93%]
Respiratory disease indicators				
6	Asthma	1) History of asthma 2) Use of short-acting β-agonist more than three times per week 3) No use of inhaled corticosteroids	1335	214 [16.03%, 14.13%–18.07%]
7	Asthma	1) History of asthma 2) Use of long-acting β-agonist 3) No use of inhaled corticosteroids	1335	10 [0.75%, 0.32%–1.28%]
Gastrointestinal disease indicators				
8	Gastrointestinal bleed, perforation or ulcer or gastritis	1) History of gastrointestinal ulcer or bleeding 2) NSAID use for at least 1 month 3) No use of gastroprotective agent (eg, proton pump inhibitor)	17 149	107 [0.62%, 0.48%–0.72%]
9	Chronic constipation or impaction	1) Regular use of a strong opioid analgesic (fentanyl, oxycodone, morphine) 2) No concurrent use of a laxative	6780	604 [8.91%, 8.22%–9.58%]
10	Gastrointestinal ulcer or bleed	1) Patient with osteoarthritis 2) Dispensed long-term NSAID therapy (including cyclooxygenase-2 inhibitors)	17 125	2166 [12.65%, 12.20%–13.20%]
Osteoporosis or fracture indicators				
11	Fracture	1) Female patient 2) History of osteoporosis or fracture 3) No use of hormone replacement therapy, bisphosphonate, teriparatide, selective oestrogen receptor modulators or strontium	20 213	3467 [17.15%, 16.68%–17.72%]

(*continued*)

2 Continued

No.	Hospitalisation outcome	Process of care (preceding hospitalisation)	Total hospitalisations (TH)	Hospitalisations after suboptimal care [% TH, 95% CI]
12	Fracture	1) Male patient 2) History of osteoporosis or fracture 3) No use of bisphosphonate or teriparatide	12 231	2406 [19.67%, 18.98%–20.38%]
13	Fracture	1) Patient aged 65 years or older 2) Use of a falls-risk medicine[6,7,24] (eg, long-acting hypnotic or anxiolytic, tricyclic antidepressant)	31 486	26 892 [85.41%, 85.01%–85.79%]
Renal disease indicators				
14	Renal failure or nephropathy	1) History of diabetes 2) Microalbuminuria and plasma creatinine not monitored in previous 12 months 3) Patient not on ACEI or ARB	7335	665 [9.07%, 8.44%–9.76%]
15	Renal failure	1) NSAID use for > 3 months 2) Serum creatinine not monitored in the previous 12 months	7113	102 [1.43%, 1.13%–1.67%]
Diabetes indicators				
16	Hyperglycaemia	1) Use of an oral hypoglycaemic agent 2) HbA_{1c} level not monitored in previous 6 months	223	42 [18.83%, 13.67%–23.93%]
17	Hypoglycaemia	1) Use of a long-acting oral hypoglycaemic agent (glibenclamide or glimepiride) 2) HbA_{1c} level not monitored in the previous 6 months	1528	67 [4.38%, 3.37%–5.43%]
18	Hyperglycaemia or hypoglycaemia	1) Use of insulin 2) HbA_{1c} level not monitored in the previous 6 months	1751	209 [11.94%, 10.38%–13.42%]
19	Hyperglycaemia or hypoglycaemia	1) Use of insulin or oral hypoglycaemic medicines 2) Use of medicines that may alter blood glucose concentration 3) HbA_{1c} level not monitored in the previous 6 months	1751	103 [5.88%, 4.80%–7.01%]
20	Hypoglycaemia	1) Use of glibenclamide or glimepiride 2) Renal function not monitored in the previous year	1528	42 [2.75%, 1.97%–3.63%]
21	Cardiovascular disease	1) History of diabetes 2) Not on lipid-lowering drug	67 177	2541 [3.78%, 3.66%–3.94%]

ACEI = angiotensin-converting enzyme inhibitor; ARB = angiotensin receptor blocker; CHF = congestive heart failure; HbA_{1c} = glycated haemoglobin; NSAID = non-steroidal anti-inflammatory drug. ◆

specific feedback to medical practitioners, could focus on improving processes of care that have known and significant risks for patient outcomes and health care expenditure.

The suboptimal processes of care associated with the medication-related indicators applied in our study were validated by an expert panel as problems that clinicians should be able to recognise as suboptimal, with adverse outcomes that are foreseeable, and which could be identified and controlled. Collaborative home medicines reviews that involve the patient, the pharmacist and the general practitioner have been shown to increase the identification and resolution of medication-related problems,[19] and to reduce hospitalisation of patients with heart failure[20] and those taking warfarin.[21] The suboptimal care processes leading to hospitalisation outcomes in our study are the types of problems that could be identified and potentially resolved with a medication review (eg, reviewing the use of laxatives by chronic users of opioids or of falls-risk medications). Future research could be conducted to confirm whether such reviews are effective in reducing the incidence of suboptimal medication-related processes of care.

A limitation of our study is that we did not assess whether implementation of appropriate care processes would have avoided hospitalisation. It may be that hospitalisations would still have occurred even if the appropriate pattern of care had been implemented. Of interest for future studies would be an examination of the occurrence and effect on hospital admissions of the care processes defined by the indicator set. In addition, there may be a subset of patients in the study population for whom certain medications are contraindicated, possibly related to comorbid conditions that we were not able to identify. An additional limitation was the inability to distinguish between individuals with diastolic and systolic heart failure on the basis of the available data; we acknowledge that the evidence base for the efficacy of ACEIs and ARBs in reducing long-term morbidity and mortality in those with diastolic heart failure is currently lacking.[22] Furthermore, we were unable to assess the use of over-the-counter medicines.

Our study analysed DVA administrative data, which cover an older population of patients with a median age of 81 years. However, our results are probably applicable to other older Australians. Age-specific comparisons of DVA Gold Card holders (those eligible for all health services subsidised by the DVA) without service-related disability with the wider Australian population have found similar rates of GP visits, filling of prescriptions, and hospitalisations per year.[23]

Although differences in the definitions of clinical indicators may limit their applicability to other population groups, the indicators we used are based on high-level evidence for common chronic conditions and are linked to patient outcomes. More than 60% of the indicators examined were based on Level I evidence, which, where applicable, included clinical studies of those aged 75 years or older (eg, the use of anti-osteoporosis medicines to reduce the incidence of fractures).[11]

In summary, this study highlights conditions associated with suboptimal medication-related processes of care in the primary care setting. The patterns of care on which the indicators are based incorporate high-level evidence and are therefore likely to be applicable internationally. Failure to implement appropriate patterns of care suggests that an opportunity to improve health care outcomes is being missed. Routine prospective monitoring of the prevalence of suboptimal processes of care and adverse outcomes in the Australian health care system by means of these clinical indicators may provide a method for assessing the appropriateness of care for common chronic conditions and identifying evidence–practice gaps in primary care. The results could be used to inform and focus the development of interventions and efforts to improve the quality of health care delivery, potentially reducing morbidity and health care costs.

Acknowledgements: This research was funded by the BUPA Health Foundation. We thank the expert clinical panel and the project advisory group for their time and expertise. We thank the Department of Veterans' Affairs for providing the administrative claims data used in this study.

Competing interests: No relevant disclosures. ■

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