

Original Research

# Comparison of prescribing criteria in hospitalised Australian elderly

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## ABSTRACT\*

The Beers criteria (2003) and McLeod criteria (1997) have been applied internationally to quantify inappropriate prescribing in elderly populations. Similarly, guidelines have been published locally by the National Prescribing Service (NPS). Objective: This study aimed to adapt, evaluate and compare the utility of these three established criteria in measuring prescribing appropriateness in a sample of hospitalised elderly patients. Methods: Initial refinement of the criteria produced versions applicable to Australian practice. Inpatient records of 202 patients aged 65 years or older in six wards of the Princess Alexandra Hospital, Brisbane, Australia, were reviewed using the adapted criteria. 'Potentially inappropriate' prescribing was descriptively analysed using relevant denominators. Results: The adapted criteria collectively listed 70 'potentially inappropriate' medicines or drug groups and 116 'potentially inappropriate' prescribing practices. Patients (mean age 80.0; SD=8.3 years) were prescribed, a median of eight medicines (SD=4.0). At least one 'potentially inappropriate' medicine was identified in 110 (55%) patients. 'Potentially inappropriate' prescribing practices averaged 1.1 per patient (range 1-6). The adapted Beers criteria identified more 'potentially inappropriate' medicines/practices (44%, 101/232) than the McLeod criteria (41%) and NPS criteria (16%). Aspirin, benzodiazepines, beta-blockers and dipyridamole were most commonly identified. Conclusion: The Beers and McLeod criteria, developed internationally, required considerable modification for local prescribing. The three criteria differed in their focus and approaches, such that development and validation of national criteria, using the key features of these models, is recommended. There is potential to apply validated guidelines in clinical practice and review of prescribing, but only to supplement clinical judgement.

**Keywords:** Drug Utilization Review. Aged. Australia.

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## COMPARACIÓN DE LOS CRITERIOS DE PRESCRIPCIÓN EN ANCIANOS HOSPITALIZADOS EN AUSTRALIA

### RESUMEN

Los criterios de Beers (2003) y los criterios de McLeod (1997) han sido aplicados internacionalmente para cuantificar la prescripción inapropiada en las poblaciones de ancianos. Asimismo, el National Prescribing Service (NPS) ha publicado guías locales. Objetivo: Este estudio trató de adaptar, evaluar y comparar la utilidad de estos tres criterios establecidos para medir la prescripción inapropiada en una muestra de pacientes ancianos hospitalizados. Métodos: Un afinamiento inicial de los criterios produjo versiones aplicables a la práctica Australiana. Se recogieron los historiales de 202 pacientes hospitalizados de 65 o más años en seis servicios del Hospital Princess Alexandra de Brisbane, Australia y se utilizaron los criterios adaptados. Se analizó descriptivamente la prescripción 'potencialmente inapropiada' utilizando denominadores relevantes. Resultados: Los criterios adaptados incluían colectivamente 70 medicamentos o grupos 'potencialmente inapropiados' y 116 prácticas de prescripción 'potencialmente inapropiadas'. A los pacientes (edad media 80,0; DE=8,3 años) se les prescribió una media de ocho medicamentos (DE=4,0). Se identificó al menos un medicamento 'potencialmente inapropiado' en 110 (55%) pacientes. Las prácticas de prescripción 'potencialmente inapropiadas' promediaron 1,1 por paciente (rango 1-6). Los criterios de Beers adaptados identificaron más medicamentos/prácticas 'potencialmente inapropiadas' (44%, 101/232) que los de McLeod (41%) y NPS (16%). Los más comúnmente identificados fueron aspirina, benzodiacepinas, beta-bloqueantes y dipiridamol. Conclusión: Los criterios de Beers y McLeod, desarrollados internacionalmente, requieren una considerable modificación para la prescripción local. Los tres criterios diferían en su objetivo y abordajes, de modo que se recomienda el desarrollo y validación de criterios nacionales, utilizando los puntos clave de estos modelos. Existe la oportunidad de aplicar guías validadas en la práctica clínica y revisión de la prescripción, pero sólo para suplementar el juicio clínico.

**Palabras clave:** Revisión de uso de medicamentos. Ancianos. Australia.

## INTRODUCTION

The proportion of Australians aged 65 years and over is estimated to increase from 12% in 1999 to around 25% by 2051.<sup>1</sup> Older patients necessitate vigilance in prescribing due to their number of medical conditions and medications.<sup>2,3</sup> Internationally, 'inappropriate prescribing', a recognised problem in the elderly, has been modelled to quantify and reduce these issues.

Beers et al.<sup>4</sup> published criteria in the United States in 1991 to determine potentially inappropriate prescribing of medication. The revised version (2003)<sup>5</sup> categorises listed 48 medicines or drug classes that should generally be avoided in elderly patients. Despite acceptance and international application of the Beers criteria, continual updating and international tailoring are required.<sup>3,6,7</sup> The Beers criteria are explicit in nature, being derived from published reviews, expert opinions and consensus techniques without clinical judgement about the presenting patient.<sup>8</sup> Studies report 7.8%<sup>9</sup> to over 50%<sup>3,10</sup> of patients with at least one potentially inappropriate medication, dependent on research design (retrospective versus prospective reviews) and characteristics of the reference patients and setting (primary care, secondary care, continuing care).

The McLeod criteria,<sup>11</sup> a Canadian initiative, were developed following the Beers criteria 1991, based on risk-benefit ratios, drug-drug interactions and drug-disease interactions, and describing 38 prescribing practices (across four drug/disease groups: drugs to treat cardiovascular disease, psychotropic drugs, non-steroidal anti-inflammatory drugs, and other analgesics and miscellaneous drugs), again rated through expert consensus to produce a significance rating up to 4.00, as opposed to the 'high' and 'low' significance categories of the Beers criteria.

As with the Beers criteria, the McLeod criteria have been criticised for their limited applicability to geriatric clinical practice.<sup>3</sup> A revision, the Improved Prescribing in the Elderly Tool (IPET)<sup>3,12</sup> was trialled in Ireland and compared to the Beers criteria to quantify rates of inappropriate prescribing in hospitals. The Beers criteria demonstrated superior sensitivity via a more exhaustive list of drugs, despite some being considered obsolete or rarely used.<sup>13</sup>

Further international research has produced the START (Screening Tool to Alert doctors to Right Treatment) and STOPP (Screening Tool of Older Persons' Prescriptions) criteria.<sup>3,14</sup> While these criteria show promise, their international applicability has not been established.<sup>3</sup>

Several studies have merged the Beers and McLeod criteria to determine their combined and relative sensitivity.<sup>15-17</sup> Australian data applying both criteria are limited to analysis of Department of Veterans' Affairs pharmacy claims, in which 26

inappropriate medicines were identified.<sup>18</sup> The database excluded information about diagnosis, dosage and duration, requiring exclusion of some indicators of these criteria.

The only nationally-endorsed criteria specific to Australian prescribing exist in the National Prescribing Service (NPS) indicators for quality prescribing in Australian general practice, published in 2006.<sup>19</sup> These evidence-based criteria, designed for self-review of prescribing by general practitioners, describe quality prescribing via structure, process and outcome indicators, the process indicators detailing prescribing situations requiring caution in older patients. No published studies of their application have been located.

The Commonwealth Department of Veterans' Affairs produced a Therapeutic Brief No. 8 - Reducing Adverse Drug Events for your Veteran Patients for use by general practitioners. Although these guidelines were developed from both the Beers and McLeod criteria, details of their development are lacking, and the resulting criteria listed only four medication groups (long-acting benzodiazepines, anticholinergics, non-steroidal anti-inflammatories and a miscellaneous category) to guide patient management.<sup>2</sup>

Other developments have been reported following research in Victorian hospitals nearly 10 years ago, producing 19 prescribing indicators specific to hospitalised elderly.<sup>20,21</sup> These criteria demonstrated some potential, but they were not adopted more widely to gain national endorsement. More recently, researchers in Australia<sup>7</sup> have matched the most common reasons for treatment in the elderly with the most commonly prescribed medicines, incorporating precautions from the Australian Medicines Handbook.<sup>22</sup> This research produced locally-relevant criteria, although it rejected consensus methodology, and in deriving the list, equated most commonly prescribed medicines with 'most appropriate' prescribing.<sup>7</sup>

In summary, the Beers and McLeod criteria, with their limited applicability to Australian practice, appear to be the most established tools for measurement of prescribing to the elderly. The Australian equivalent in terms of scope and national endorsement is the NPS criteria, although alternatives have been reported for specific purposes. With the increasing elderly population in Australia, and the risks associated with multiple medicine use in this population, it is timely to investigate the utility of these models in the Australian context, recognising that prescribing criteria serve as a guide only and do not replace clinical judgement.

## METHODS

This study aimed to refine, apply and evaluate the utility of the Beers criteria 2003, the McLeod criteria 1997 and NPS criteria in a sample of hospitalised elderly patients in Australia. 'Utility' was defined as relevance of listed medications (or drug groups) to Australian prescribing and the interpretability of the criteria with respect to available patient records.

## Refinement of the Prescribing Criteria

The Beers, McLeod and NPS criteria were initially refined by one of the researchers (WP) by removing drugs unavailable in Australia.<sup>19,22</sup> This approach has been applied elsewhere.<sup>3,22,23</sup> Refinement of the Beers criteria resulted in retention of 57 medicines (63%). For the McLeod criteria, 33 of the 38 potentially inappropriate practices were determined relevant to Australian practice. The majority of the NPS criteria were worded as best-practice statements, rather than indicators of inappropriate medication prescribing; four of the 21 indicators of 'potentially inappropriate' prescribing were retained for this study. These related to prescribing of antibiotics for upper respiratory tract infections, prescribing of cephalexin for various conditions, prescribing of ACE inhibitors with diuretics and non-steroidal anti-inflammatory drugs (known as the 'triple whammy'), and long-term prescribing of benzodiazepines.

The merged criteria comprised:

- 70 medications or drug groups (13 medications were common to both the Beers and the McLeod criteria), and
- 116 'inappropriate' prescribing practices – medications or drug groups that should generally be avoided in the elderly or are considered inappropriate in particular conditions – 79 from the Beers criteria, 33 from the McLeod criteria and four from the NPS criteria.

The refined criteria were programmed into an Excel spreadsheet designed to also record patient codes, ward, medicines and medical conditions.

## Data Collection

This study was conducted in the Princess Alexandra Hospital (PAH), a 727-bed public hospital in Brisbane. Six wards containing a significant proportion of the hospital's elderly patients, and comprising three general medical wards (averaging two patient admissions per day per ward, total 80 beds) and three rehabilitation wards (averaging 0.5 patient admissions per day per ward, total 78 beds), were selected.

Ethical approval was obtained from the Health and Research Ethics Committee of the PAH prior to data collection. Informed consent of the patients was not required, due to their de-identification and lack of direct involvement.

Patients aged 65 years and older, on any regular prescribed medication, were included. Reason for admission did not affect their eligibility for inclusion. The target sample size was determined via initial data collection involving 70 patients, with statistical projection to determine differences between preliminary rates of 'inappropriate' prescribing (6.2% and 4.3%, the two closest proportions, at  $\alpha=0.5$  and 95% power). This approach indicated recording of 1478 medications, or 154 patients at 9.6 medications per patient. At the rate of data collection of one ward per day for data collection followed by six admissions per day, a total of 263 records could be collected over one month less

weekends (19 days). Losses due to inaccessibility, ineligibility, early discharge, and admission or discharge on non-research days were expected. Consequently, 19 data collection days were retained (March-April, 2007). The first three days comprised pilot testing, which identified minor improvements requiring limited retrospective supplementation of the pilot data. The data collection comprised 'snapshot' chart reviews by a single researcher (WP) of regular and 'as needed' medications, irrespective of the source, date or reason of the prescription. Patients who were either present or admitted during the data collection were included, and those who transferred between wards during the data collection were represented once only in the database, with their most current medications reviewed by the researcher.

## Analysis

Categorical or numerical significance ratings of the significance of inappropriateness were manually added to the database from literature describing the Beers, McLeod and NPS criteria. Prescribing of aspirin and benzodiazepines was assumed to be for continuing use. The Beers criteria considered aspirin as inappropriate at any dose in patients receiving anticoagulants, and at doses of at least 325mg as inappropriate in patients with a history of gastric ulceration. The McLeod criteria made no distinction regarding aspirin doses.

Analysis comprised descriptive comparison and critique of the three criteria to determine their respective 'utility', and prevalence data for prescribing appropriateness, according to the three criteria (using SPSS version 13.0). Denominators were the number of patients and the total number of prescribed medications.

## RESULTS

### Description of the Study Sample

During the study period, 296 patients were present in, or admitted to, the six wards. Eighty-seven were excluded due to age (<65 years), and seven patients' records were unavailable. The records of the 202 patients listed 1794 prescribed medications, a median of eight medications per patient (SD=4.0, maximum 22).

The mean age was 80.0 (SD=8.3) years (range 65-99 years). The dominant group was females aged 85-89 years (n=39). The three General Medical wards each contributed 37-45 patients to the study, while the three Rehabilitation wards each contributed 23-33 patients, reflecting the higher turnover of the General Medical wards. Some patients transferred between General Medical and Rehabilitation wards during the study.

### 'Inappropriate' Prescribing (per Patient)

The merged criteria identified 232 'potentially inappropriate' medications prescribed, averaging 1.1 potential issues per patient. The Beers criteria detected a mean of 0.5 potential cases of inappropriate prescribing per patient, compared to 0.47 using the McLeod criteria and 0.18 using the NPS criteria.

| Medicines/Drug Groups          | Identified Conditions           | Beers | McLeod | NPS |
|--------------------------------|---------------------------------|-------|--------|-----|
| Amiodarone                     |                                 | 7     | 0      | 0   |
| Amitriptyline                  |                                 | 2     | 0      | 0   |
| Anticholinergics               | Syncope/fall                    | 1     | 0      | 0   |
|                                | Cognitive impairment            | 3     | 0      | 0   |
|                                | Constipation                    | 1     | 0      | 0   |
|                                | Incontinence                    | 1     | 0      | 0   |
| Antipsychotics                 | Parkinsons                      | 1     | 0      | 0   |
| Aspirin                        | Receiving anticoagulants        | 36    | 0      | 0   |
| Aspirin                        | Hypertension                    | 0     | 47     | 0   |
| Antibiotics                    | Upper respiratory tract infect. | 0     | 0      | 3   |
| Benzodiazepines                |                                 | 0     | 0      | 26  |
| Beta-blockers                  | Angina and COPD                 | 0     | 1      | 0   |
|                                | Angina and heart failure        | 0     | 6      | 0   |
|                                | Hypertension and COPD           | 0     | 6      | 0   |
|                                | Hypertension and heart failure  | 0     | 13     | 0   |
| Calcium channel blockers       | Constipation                    | 4     | 0      | 0   |
|                                | Hypertension and heart failure  | 0     | 4      | 0   |
| Cephalexin                     |                                 | 0     | 0      | 1   |
| Clopidogrel                    | Receiving anticoagulants        | 5     | 0      | 0   |
| Diazepam                       |                                 | 5     | 0      | 0   |
| Digoxin >125mcg                |                                 | 1     | 0      | 0   |
| Dipyridamole                   | Receiving anticoagulants        | 2     | 0      | 0   |
|                                | Stroke                          | 0     | 13     | 0   |
| Doxepin                        |                                 | 2     | 0      | 0   |
| Imipramine                     | Arrhythmia                      | 2     | 0      | 0   |
| Methyldopa                     |                                 | 1     | 0      | 0   |
| Muscle relaxants               | Cognitive impairment            | 1     | 0      | 0   |
| Nifedipine                     |                                 | 4     | 0      | 0   |
| NSAIDs (non-aspirin)           | Hypertension                    | 0     | 2      | 0   |
| Oestrogen only                 |                                 | 2     | 0      | 0   |
| Oral steroid                   | Diabetes and COPD               | 0     | 1      | 0   |
| Oxazepam >60mg                 |                                 | 2     | 0      | 0   |
| Oxybutynin                     |                                 | 3     | 0      | 0   |
| Promethazine                   |                                 | 1     | 0      | 0   |
| Propranolol                    | COPD                            | 1     | 0      | 0   |
| Short-intermediate acting+fall | Syncope/Fall                    | 2     | 0      | 0   |
| SSRIs                          | SIADH/Hyponatraemia             | 4     | 0      | 0   |
| Tricyclic antidepressants      | Constipation                    | 1     | 0      | 0   |
|                                | Depression                      | 0     | 1      | 0   |
|                                | Syncope/Fall                    | 1     | 0      | 0   |
| Temazepam >15mg                |                                 | 5     | 0      | 0   |
| 'Triple Whammy'                |                                 | 0     | 0      | 7   |
| Total                          |                                 | 101   | 94     | 37  |

| Medication      | McLeod | Beers | NPS | Total |
|-----------------|--------|-------|-----|-------|
| Aspirin         | 47     | 36    | 0   | 83    |
| Benzodiazepines | 0      | 14    | 26  | 40    |
| Beta-blockers   | 26     | 0     | 0   | 26    |
| Dipyridamole    | 13     | 2     | 0   | 15    |

In total, 110 patients (55%) had been prescribed at least one 'potentially inappropriate' medication according to the amalgamated criteria, ranging from one to six instances per patient.

There was no significant difference in the proportions of patients with at least one 'inappropriate' medication detected by any of the three criteria between the Rehabilitation and Medical wards ( $p > 0.05$ ).

'Inappropriate' Prescribing (by Medicine and Drug Group)

Of the 232 potential issues detected (in 110 patients), 101 issues (44%) were identified by the

Beers criteria, 94 issues (41%) by the McLeod criteria and 37 issues (16%) by the NPS criteria (Table 1). There was no overlap in the components of the three criteria, and therefore each of the issues identified was discrete. The combined criteria identified the most common 'inappropriate' medications as aspirin and benzodiazepines (Table 2).

Of the 101 issues identified using the refined Beers criteria, 88 were classified as 'high' significance and 13 as 'low' significance issues. Thirty-six of the issues related to the prescription of aspirin in patients who concurrently received anticoagulant therapy ('high' significance). Of the 94 issues

detected using the McLeod criteria, the highest prevalence was again attributed to the prescribing of aspirin, which was classified with non-steroidal anti-inflammatory drugs, in patients with history of hypertension. The median significance rating (of a maximum of 4) was 3.35.

The NPS identified that prescribing in specific circumstances was with 'caution', rather than assigning significance. Benzodiazepines use in the elderly was the most common potential problem identified (26 of the 37 issues).

## DISCUSSION

### Discussion of the Method

Numerous trials of the Beers criteria and a combination of the Beers and McLeod criteria were hospital based.<sup>10,15,16,23-25</sup> Despite the mix of patients admitted to these wards, the findings from the selected wards in one hospital cannot be extrapolated to other wards in the hospital or the broader community. Future studies, however, are feasible to extend and validate this method. While our study reported a comparison of the Beers, McLeod and NPS criteria, amalgamation of the relevant features is the next logical step towards producing a set of criteria for use in Australian practice.

The preliminary data for 70 patients indicated a median of nine medicines per patient, whereas the final data from 202 records (including the pilot sample) identified a median of eight medicines per patient. Although the magnitude of this difference did not compromise the final sample size, the variability should be noted for future research.

Previous studies have reported the proportion of patients receiving at least one inappropriate drug prescription.<sup>9,10,15,23,24</sup> Our study presented 'potentially inappropriate' issues detected per patient and inappropriate issues detected by medicine or drug group. The two denominators provide alternative views of the prevalence and nature of potential inappropriate prescribing.

### Utility of the Refined Criteria

Utility was defined here as the relevance of the listed medications (or drug groups) to Australian prescribing and the interpretability of the criteria. Revision and numerous assumptions about the context of prescribing were required for all three criteria, and interestingly, there was limited commonality in the listed medicines (or drug groups). Although the majority of the constituent indicators was relevant to local practice and therefore retained, one recommendation from this study is to extend other local research to customise and validate a set of criteria for subsequent use in Australia.

Of the three criteria, the Beers criteria required the most refinement, due to the listing of specific medicines available in America but not in Australia. On this basis, it could be considered to have the lowest utility of the three criteria, but its sensitivity was superior, in detecting the highest proportion of

all potential prescribing issues and the greatest number of issues per patient. The incidence of inappropriate prescribing detected by the Beers criteria (44% of the identified issues) and McLeod criteria (41%) were somewhat higher than those of previous research (17% and 11%, respectively), in which only part one of the Beers criteria were included.<sup>17</sup>

The list of medication groups in the McLeod criteria is an advantage over the Beers and NPS criteria in terms of international applicability. The major limitation for application of the McLeod criteria was the need for patient-specific information concerning the indication, duration of prescription and co-morbidities. Difficulty in obtaining these data have been noted elsewhere.<sup>16,17</sup> An intermediate level of clinical knowledge was also required to associate prescribed medicines with the listed drug groups.

Although the NPS criteria were developed in Australia, the refined version only identified four indicators of prescribing appropriateness. The proportion of issues identified by the NPS criteria might not contribute significantly to the overall findings. However, the advantage of these criteria was their foundation in published literature. Amalgamation with the Beers and McLeod criteria is the obvious recommendation for further development.

In the absence of data about the intended duration of therapy, medications were conservatively assumed to be for continuing use, which may have over-represented the prescribing issues for patients taking benzodiazepines. Lack of information about the intended use of aspirin and co-morbidities may have resulted in over-estimation of the potential issues surrounding its use. By their nature, however, it may be assumed that these criteria offer an estimation of prescribing appropriateness, to be potentially overridden by clinical judgement.

The proportion of patients who received at least one inappropriate prescription in our study (55%) was consistent with two other studies citing 40% and 46% of patients, respectively, receiving at least one potentially inappropriate drug prescription.<sup>15,16</sup> However, a European study, in which the Beers and McLeod criteria were amalgamated, reported this figure at 20%.<sup>17</sup> International differences in prescribing practices and health care systems may invalidate such comparisons. We would expect our results to be similar to other hospitals in Australia, and higher than data reported from ambulatory studies due to the nature of the hospitalised study population. Newly-developed prescribing criteria, such as the STOPP/START criteria<sup>14</sup>, may also be integrated into Australian research in the same manner as the international criteria applied in this study.

The practices identified by these criteria as 'inappropriate' may indeed have been clinically sound, following unsuccessful alternatives or the consideration of risks in individuals, i.e. the use of implicit (patient-specific) criteria. These situations are largely undocumented and were unable to be embraced in this or similar studies.

## CONCLUSIONS

The intention of these prescribing criteria is to identify situations requiring consideration, rather than replace clinical judgement. Further customisation and application of criteria are recommended to produce validated guidelines for use in clinical practice and prescribing reviews in the care of elderly patients in Australia.

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## CONFLICT OF INTEREST

None declared.

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