Introduction

Older subjects use a higher number of drugs than younger ones, to treat a higher number of conditions. Polypharmacy is frequent in this population, and this carries an increased risk of medication-related problems, including adverse drug reactions (ADR) and drug-drug interactions [1–5]. Susceptibility to suffer these problems increases with age for a number of reasons, including age-related changes in pharmacokinetics and pharmacodynamics, polypharmacy, comorbidity, disability, social aspects, and the exclusion of the oldest, frailest patients from drug research.

Drug prescription in older people is complex, which leads to the frequent prescription of potentially inappropriate (PI) drugs, in many cases with adverse health outcomes [6–8]. Inappropriate prescription of drugs in geriatric patients is considered a public health problem that reduces patient safety, increasing morbidity, mortality and the use of costs [9]. The direct costs of treating conditions related with the inappropriate use of drugs can be high [10–12]. Even mild ADR carry costs, as they increase the number of visits to general practitioners, the use of drugs to treat symptoms of unrecognized ADR, and the use of over-the-counter drugs. Improvement of drug prescription is one of the most efficient strategies in this group of complex patients [9]. Even an intervention that carries a modest reduction in inappropriate prescription can be cost-effective, especially if it is cheap, well designed, and easy to use.

A drug is considered appropriate when there is clear evidence that supports its uses in a given condition, is well tolerated by most patients, and is cost-effective. Moreover, appropriate prescription in older subjects should consider the individual life expectancy of each
patient, avoiding preventive therapies in those with expected short survival, and promoting the use of drugs with a good risk/benefit ratio [9]. A prescribed drug is potentially inappropriate when the risk of adverse effects is higher than the expected clinical benefit, especially when evidence exists about safer or more effective alternatives. PI prescription also includes the use of drugs with a higher frequency or a longer time than needed, the use of drugs with a high potential of drug-drug or drug-disease interaction, and duplicate class drugs. Conceptually, inappropriate prescription also includes not using potentially beneficial drugs that are clearly indicated for the treatment of a disease, when they are not prescribed in older patients for several reasons [13].

Several simple instruments have been developed in different countries, based on explicit criteria, to review drug treatments and detect PI prescriptions. Beers criteria have been widely used [14–16], and have found rates of PI prescription in older people ranging from 11% to 65% in different populations [17–27]. Beers criteria have some deficiencies that limit their use, including several drugs that are rarely prescribed nowadays, a lack of structure in the presentation of the criteria, and omission of several important and common IP instances [28]. The Screening Tool of Older Person’s potentially inappropriate Prescriptions / Screening Tool to Alert doctors to the Right, i.e. appropriate, indicated Treatment (STOPP-START) criteria have been published recently in Europe, and seem to be more sensitive than Beers criteria to detect inappropriate prescription [29,30].

The STOPP-START criteria have not yet been compared with Beers criteria across different health care settings. The aim of this study was to compare these two instruments to detect PI prescription in older subjects in three different settings: a hospital geriatric outpatient clinic, a primary care clinic, and an assisted nursing home.

2. Methods

A cross-sectional study was performed in subjects older than 69 years old in three health care settings in Madrid: a hospital geriatric assessment outpatient clinic (HC), a primary care (PC) clinic of the National Health Service, and an assisted private nursing home (NH).

Fifty subjects were randomly selected at a fixed date from the list of 330 subjects living in the NH, and 50 from the list of 1400 patients who came to the PC clinic to visit any of seven attending physicians in one week; 50 consecutive patients referred by their family doctors for a first geriatric assessment were studied in the HC (a total of 670 new patients are referred each year). Drugs currently used by subjects the day of randomization were reviewed in the two first settings, and drugs used at the first clinic visit, before geriatric assessment and management recommendations, were reviewed in the hospital clinic. For all subjects, a careful review of computerized medical records and prescription records was performed, and Beers criteria and STOPP-START criteria were applied to search for PI prescriptions by an independent observer not directly involved in medical care of the subject.

STOPP-START criteria is newly developed and validated a set of criteria. Briefly, STOPP comprises 65 indicators for potentially inappropriate prescribing including clinically important drug-drug and drug-disease interactions, therapeutic duplication and drugs that increase the risks of cognitive decline and falls. START incorporates 22 evidence-based indicators for prescribing omissions in older people. STOPP/START criteria are organised by physiological system for ease of use [29]. The Spanish version of these criteria was used for this study [30].

A descriptive analysis of results was performed for each criteria (Beers, STOPP y START), measuring the number of subjects in each care setting with IP identified with each of the instruments, and the number of inappropriateness criteria identified in each subject. The influence of age and gender was also assessed.

Comparison of two proportions were done using Fisher’s exact test using Statistics Online Computational Resource (SISA). Chi-square test was used for comparisons between the three groups. This was only done for global results of each group, as the sample is too small to compare each item of each instrument.

3. Results

Table 1 shows age, gender, and PI prescriptions detected by each instrument. Mean age increased with the complexity of the health setting, and the proportion of females increased with age, as expected. Pooling the 150 subjects from the three settings, STOPP criteria detected a higher number of PI prescriptions (70 subjects, 47%) than Beers criteria (34 subjects, 23%) (p < 0.001). Lack of appropriate prescriptions, not detected by Beers criteria, was present in 64 subjects (43%) using START criteria. STOPP criteria also detected a higher number of subjects with two or more PI prescriptions than Beers criteria (p = 0.003).

Inappropriateness tended to vary in different settings. Both STOPP (p = 0.22) and START (p = 0.022) criteria showed a better quality of prescription (lower number of PI prescriptions) in patients cared by their general practitioners (GP), compared with those sent by their GP for assessment to the geriatric clinic or with those living in nursing homes, although these differences were only significant for START. No differences between settings or tendencies were found using Beers criteria (p = 0.92). Both Beers (p = 0.047) and STOPP (p = 0.064) had a tendency to detect a higher number of PI prescriptions in females, with no significant differences between them.

When each criterion was analysed separately, 22 of the 69 Beers indicators (32%), 33 of the 65 STOPP indicators (51%), and 18 of the 22 START indicators (82%) were found in any setting. The profile of the indicators found varied in different settings (Tables 2–4). STOPP criteria that identified PI prescriptions in at least one subject in each setting were the use of benzodiazepines in fallers (4% in PC, 10% in HC, 12% in NH), and duplicate drug prescription (6% in PC, 8% in HC, 8% in NH). Two Beers indicators were found across all settings: use of amiodarone; and use of calcium channel blockers, anticholinergics, or tricyclic antidepressants in chronic constipation. Two START indicators were also found in the three settings: not using statin therapy with a documented history of coronary, cerebral or peripheral vascular disease; and not using statin therapy in diabetes mellitus with coexisting cardiovascular risk factors.

STOPP criteria found different patterns of PI prescription in different settings. In PC, the most frequent problems detected were the use of aspirin in subjects with no cardiovascular history (16%), and the use of vasodilator drugs with persistent postural hypotension (10%); while in the NH, the use of benzodiazepines in fallers (12%), and the use of neuroleptics as long-term hypnotics were most frequent (10%). In the HC, errors were more variable; the most frequent problem detected was the use of benzodiazepines in fallers.

START criteria also showed different patterns for prescription omissions. In the NH, the lack of use of statins; and aspirin, or clopidogrel in subjects with cardiovascular disease were most frequent (16% and 12% of subjects). In the HC, lack of use of statins in subjects with arteriosclerosis (12%), not using fibre supplements for diverticular disease (12%), and lack of use of antidepressants (10%) were frequent. In PC, many different indicators were found in small numbers of subjects.

The distribution of Beers criteria in different settings was singular. Only a few cases of each indicator were detected in HC and NH, while in PC inappropriateness in the use of some

potentially inappropriate drugs: doxazosine (10%), anticholinergics and antihistamines (10%), and alpha-blockers, anticholinergics, tricyclic antidepressants, and long-acting benzodiazepines in subjects with stress incontinence (8%).

4. Discussion

Inappropriate prescription is a common and serious global healthcare problem in older people, leading to increased risk of...
Table 3
Potentially inappropriate prescription, using START criteria, in different health care settings.

<table>
<thead>
<tr>
<th>START criteria detected in at least one setting</th>
<th>Primary care (n=50) n (%)</th>
<th>Geriatric clinic (n=50) n (%)</th>
<th>Nursing home (n=50) n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1. Warfarin in the presence of chronic atrial fibrillation</td>
<td>–</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>A2. Aspirin in the presence of chronic atrial fibrillation, where warfarin is contraindicated, but not aspirin</td>
<td>–</td>
<td>–</td>
<td>1 2</td>
</tr>
<tr>
<td>A3. Aspirin or clopidogrel with a documented history of coronary, cerebral or peripheral vascular disease in patients with sinus rhythm</td>
<td>3</td>
<td>6</td>
<td>–</td>
</tr>
<tr>
<td>A4. Antihypertensive therapy where systolic blood pressure consistently &gt;160 mmHg</td>
<td>–</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>A5. Statin therapy with a documented history of coronary, cerebral or peripheral vascular disease, where the patient’s functional status remains independent for activities of daily living and life expectancy is greater than 5 years</td>
<td>3</td>
<td>6 6</td>
<td>12</td>
</tr>
<tr>
<td>A6. Angiotensin Converting Enzyme (ACE) inhibitor with chronic heart failure.</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>A7. ACE inhibitor following acute myocardial infarction</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>A8. Beta-blocker with chronic stable angina</td>
<td>2</td>
<td>4</td>
<td>–</td>
</tr>
<tr>
<td>A9. β-blocker with chronic stable angina</td>
<td>2</td>
<td>4</td>
<td>–</td>
</tr>
<tr>
<td>B2. Regular inhaled corticosteroid for moderate-severe asthma or COPD, where predicted FEV1 &lt; 50%</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>C2. Antidepressant drug in the presence of moderate-severe depressive symptoms lasting at least three months</td>
<td>–</td>
<td>–</td>
<td>5 10</td>
</tr>
<tr>
<td>D1. Proton Pump Inhibitor with severe gastro-oesophageal acid reflux disease or peptic stricture requiring dilatation</td>
<td>–</td>
<td>–</td>
<td>4 8</td>
</tr>
<tr>
<td>D2. Fibre supplement for chronic, symptomatic diverticular disease with constipation</td>
<td>–</td>
<td>–</td>
<td>6 12</td>
</tr>
<tr>
<td>D3. Disease-modifying anti-rheumatic drug (DMARD) with active moderate-severe rheumatoid disease lasting &gt;12 weeks</td>
<td>–</td>
<td>–</td>
<td>4 8</td>
</tr>
<tr>
<td>E1. Calcium and Vitamin D supplement in patients with known osteoporosis</td>
<td>2</td>
<td>4</td>
<td>2 4</td>
</tr>
<tr>
<td>E2. Metformin with type 2 diabetes +/- metabolic syndrome</td>
<td>4</td>
<td>8</td>
<td>1 2</td>
</tr>
<tr>
<td>(in the absence of renal impairment)</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>F2. ACE inhibitor or Angiotensin Receptor Blocker (ARB) in diabetes with nephropathy</td>
<td>–</td>
<td>–</td>
<td>1 2</td>
</tr>
<tr>
<td>F3. Antihypertensive therapy in diabetes mellitus with coexisting major cardiovascular risk factors (hypertension, hypercholesterolaemia, smoking history)</td>
<td>2</td>
<td>4</td>
<td>1 2</td>
</tr>
<tr>
<td>F4. Statin therapy in diabetes mellitus if coexisting major cardiovascular risk factors present</td>
<td>4</td>
<td>8</td>
<td>3 6</td>
</tr>
</tbody>
</table>

ADR and adverse outcomes. Many instances of PI prescription are preventable; hence, good screening tools to detect PI prescription are needed for use in the routine clinical setting. STOPP-START criteria have been recently developed and compared with Beers criteria [29,31]. In this study, we have shown that each of these criteria may have varying performances when they are used in older people cared for in different health care settings.

In previous studies, rates of PI drug use using Beers criteria in the community ranged from 13 to 28%, with a slow decline in recent years [32–35]. In nursing home patients, rates of use of PI drugs range from 28 to 47% [36–38]. In older subjects living in the community submitted to a specialist for geriatric assessment data are sparse, but PI prescription can be as high as 45% [39]. Using Beers criteria, we found rates of 24% in primary care, 20% in the nursing home, and 26% in geriatric outpatients. STOPP criteria have been published only recently, and not many data are yet available, but a study of 1329 subjects in Irish primary care clinics found PI prescriptions in 17 to 24% of the subjects [32]. Our rates with STOPP criteria were 36% in primary care, 50% in the nursing home, and 54% in geriatric outpatients, which are generally higher than with Beers criteria. STOPP criteria have also shown to be more sensitive than Beers criteria in detecting PI prescription in hospital inpatients (35% vs 25%) [31].

Older people are cared in a broad range of health care settings, from the community to intensive care. PI drug use exists in all of them, but prevalence rates, prescription profiles, differences in adverse outcomes due to inappropriate prescription in different settings, and policy implications have been poorly studied. Some studies have suggested that in outpatient settings, some characteristics of physician’s practice may influence prescribing attitudes [40]. Our study has shown that this may in fact be true. We compared older subjects living in the community, cared for by their general practitioners, with similar subjects who were submitted by their GP for a comprehensive geriatric assessment, and with subjects who were living in a nursing home. The rates of detection of PI drugs with Beers criteria was similar in the three groups (20 to 24%), but rates varied significantly with the use of STOPP criteria: PI were identified in 36% in the community, and rates grew to 50–54% in the more complex geriatric patients who needed geriatric assessment and in those living in nursing homes. This is an expected finding, as PI prescription is linked with disability and adverse health outcomes [7,10], which may trigger the need of specialist assessment or nursing home care. Rates of subjects with two or more PI prescriptions, assessed with STOPP criteria, almost doubled in geriatric outpatients when compared with community living subjects. Surprisingly, the opposite was true with Beers criteria, which seems to be a problem linked with this instrument. Performance of START criteria to detect omissions of appropriate prescriptions paralleled that of STOPP criteria. The number of subjects who did not receive the right treatment was highest in geriatric outpatients, which could again be linked with impaired outcomes in untreated patients (i.e., those with heart failure not receiving ACE inhibitors).

The characteristics and profile of inappropriate prescriptions also varies between settings. An interesting finding, using Beers criteria, was the clustering of PI drugs in certain groups in primary care subjects, a phenomenon that did not happen in more complex settings. If confirmed, this could be relevant for designing interventions for improving prescription in different settings: interventions directed to change prescriptions of specific groups of drugs (i.e., anticholinergics, or antihistamines) may be more efficient in primary care, while more complex wider-broad interventions would have to be designed in nursing homes and geriatric clinics. STOPP criteria, however, were able to identify specific areas of clustering of PI drugs in nursing homes. The most complex patients, those sent to geriatric assessment clinics, are more diverse as they are chosen by their GP for assessment by a specialist team with expertise in drug problems, which seems to be a correct way to proceed. START criteria also showed different patterns for lack of appropriate prescriptions in different settings.
This finding, if confirmed, could again lead to tailor interventions both to patient needs and to organizational priorities. STOPP-START criteria seem to consistently outperform Beers criteria in all settings, in this and other studies [31,32]. Many reasons have been suspected [19,20,31], including the use by Beers criteria of drugs rarely used in Western Europe, the fact that the designation of certain drugs as inappropriate by Beers criteria is debatable, and the use of closed lists of drugs instead of groups (i.e., TCAs). STOPP criteria contain 33 instances of PI prescriptions not found in Beers’ criteria, most of which were identified in the present study, and highlight clinical situations where it is potentially inappropriate to prescribe some groups of drugs. START criteria detected many instances of potentially inappropriate omission of indicated prescription (from 30% in primary care to 56% in patients who need geriatric assessment). This is an important finding, as older instruments of PI prescription do not account to correctly interpret its findings. Sample size is small for outcomes in this population, if its not benefits of evidence-based treatments. None.

Our study has several limitations that should be taken into account to correctly interpret its findings. Sample size is small for the three settings and, although results for each care settings are consistent with other published reports, do not allow for solid statistical analysis of PI prescription intensity. Raters were different at each setting, which could increase variability, although inter-rater variability has been shown to be acceptable both for Beers and STOPP-START criteria [41]. The wording of some criteria in both instruments may lead to misinterpretation of some elements and again increase variability. The lack of other data concerning subject characteristics other than age, gender and some care setting preclude analysis of some factors that may influence PI prescription (physical and mental function, comorbidities, resource utilization. . .). Finally, this study was performed in a public health care setting, which has specific guidelines for prescription in older people [42] that aim not only to improve prescription, but also to reduce drug use and costs in this population.

Instruments to detect PI prescriptions in older patients, including Beers and STOPP-START criteria, though clearly not a substitute for clinical assessment and judgement, encourage clinicians to consider medications as a possible cause of adverse health outcomes in older people, and to systematically detect those problems when assessing older individuals. A wider use of systematic instruments across all health care settings may be a step to reduce such adverse outcomes in the future.

Conflict of interest

None.

References


