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Potentially inappropriate medications prescribed for elderly patients through family physicians

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Abstract The elderly population is increasing throughout the globe, resulting in higher healthcare costs. Potential inappropriate medication (PIM) prescriptions are a major health problem affecting the elderly persons. Due to limited studies in PIM use in primary care and home healthcare in Saudi Arabia, we aim to examine the extent of PIM prescription for and use by elderly patients. This study was carried out with 798 elderly patients, arbitrarily selected from Prince Sultan Medical Military City through the patient register. The mean age of the patients were in the range of 75.2 ± 5.5; 37.8% were males and 62.2% were females. The elderly patients are affected majorly with diabetes (73.9%), hypertension (83.2%) and lipid abnormalities (73.8%). The maximum patients involved in this study were affected with lower hemoglobin levels i.e. 99.2%. Renal impairment was found in 64% and iron supplements were the most commonly used in 23.1%, followed by analgesics and opioids (17%). The 52.5% of participants were using one or more PIMs. Kidney was the only functions and had influence on prescribed decisions. This study indicates PIM is a concern in elderly patients attending clinics and home residents and commonly prescribed ones are atypical antipsychotics, iron overdose, benzodiazepines and opioids. Prescription of drug–drug interactions, cascades and inappropriate drug doses results in preventable adverse effects.

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1. Introduction

The elderly population is increasing globally, resulting in higher healthcare costs and demand for services (Klarin et al., 2005; Fick et al., 2001). The estimation of current statistics suggests that 2.9% of the affected elderly persons were more than 65 years of age in the Saudi population (WHO, 2011). One of the challenges in the provision of healthcare to elderly persons is inappropriate prescriptions, drug-related is inappropriate prescriptions and complications. The earlier
studies from the western population indicates 12% and 23% of
more than 65 years of age consumed at least 10 medications at
any given time, and five prescription drugs monthly (Kauffman
et al., 2002). One of the study from European population
showed that the older people in community-dwelling received
~2.8–5.0 drugs (Brekke et al., 2008). An earlier study in the
90s concluded the person who receives two, and seven
drugs experienced with 13%, 38% and 82% risk (Goldberg
et al., 1996). Duplicate use of drugs within the same class is
common and often unrecognised. The side effects of drugs
are leading to polypharmacy, coupled with continued prescrip-
tion of cascades (example; prescribing levodopa for parkinso-
nian symptoms resulting from neuroleptic drugs side effects)
(Col et al., 1990). Older individuals are at a higher risk of
developing drug-related adverse events because of age-related
changes and reduced organ reserve capacity (Byles et al.,
2003). Furthermore, age-related changes in drug pharmaco-
rinetics and pharmacodynamics and coexisting diverse under-
yling medical morbidities contribute towards serious adverse
drug interaction and toxicity (Handler et al., 2006). Polyphar-
macy, non-prescription drugs and inadequate treatment adher-
ence carry a substantially high risk for morbidity and
mortality. Hospital admission, functional impairment, falls,
cognitive decline, drug toxicity and poor quality of life are
common, due to inappropriate prescription of medication
(Williams, 2002; Chin et al., 1999; Buajordet et al., 2001). In
total, 5% of total hospitalisations are reportedly drug-
related; 17% thereof are of older adults (Lazarou et al., 1998).

Drug-related problems are common in primary care (Doshi
et al., 2005) and up to 35% of older patients attending outpa-
tient clinics develop preventable adverse drug interactions
(Mallet et al., 2007). Prescription of inappropriate medications
is an important preventable drug-related problem (Beijer and
de Blaey, 2002). A potentially inappropriate medication
(PIM) refers to prescription of drugs carrying risks outweigh-
ing the expected clinical benefits, especially when there is evi-
dence for an equally or more effective and safer alternative
medication (Spinewine et al., 2007; Chang and Chan, 2010).
There are few international evidence-based studies on a com-
prehensive clinical approach comprising appropriate drug pre-
scription for elderly people. Beers’ criteria, published in 1991
and updated in 2003 and 2012 (Beers et al., 1991; Fick and
Semla, 2012; Fick et al., 2003), are the most widely used tool
for appropriate prescription and monitoring of elderly persons
in ambulatory settings and long-term facilities. Recently,
Beers’ criteria updated PIMs to include up to 53 drugs in three
classes, which may carry negative outcomes and limited effec-
tiveness for elderly people. The criteria had been well described
and emphasised, to improve the care of older adults and
reduce exposure to PIMs (Fick and Semla, 2012). PIMs fall
under three major therapeutic classes, organs and systems,
namely: PIMs and classes to avoid in older adults, PIMs and
classes to avoid in older adults with certain diseases and syn-
dromes and medications to be used with caution in older
adults.

There is insufficient evidence regarding PIM use in primary
care and home healthcare in Saudi Arabia. One economic-
focused, cross-sectional study, conducted from 2002 to 2004,
at Riyadh Military Hospital, using outpatients’ pharmacy-
dispensary records, found that 43.6%, 18% and 38.4% of
patients took at least one, two and three or more PIMs, respec-
tively (Al-Omar et al., 2012). Since there are limited qualitative
and quantitative data locally on appropriate drug use among
elderly persons, in ambulatory settings and home healthcare,
the majority of prescriptions are by family physicians; improv-
ing the quality of family physicians’ prescriptions would
improve patients’ quality of life and minimise drug hazards.
Hence, we conducted this study, to identify and analyse the
medications taken by elderly persons consulting family physi-
cians at the Family and Community Medicine and the Home
Healthcare departments at Prince Sultan Military Medical
City, Riyadh, and to classify the dispensed drugs, based on
Beers’ criteria, as PIMs.

This study aimed to establish the extent of inappropriate
drug prescription for and use by elderly patients, by determin-
ing the proportion of; (1) ambulatory medical care visits by
elderly patients resulting in inappropriate drug prescription
(visit-level analysis), and (2) elderly, community-dwelling
recipients of inappropriate drugs (person-level analysis). Sec-
ondly, the study examined trends in these outcomes for recent
years and, thirdly, factors associated with a higher risk of inap-
propriate drug prescription/use.

2. Materials and methods

The target population was elderly patients, aged ≥65 years,
despite gender and ethnicity. Common medical co-
morbidities possibly influencing the number of medications
and pharmacokinetics, and the number of medications used
by the elderly, were recorded. Only Prince Sultan Medical Mil-
tary City (PSSMCC) items and non-over-the-counter (non-
OTC) medications were counted and registered for each
patient. Non-PMMSC items, OTC medication and herbal sup-
plements were excluded from the analysis, as they were not
well recorded for each patient. We pooled and documented
laboratory results possibly indicating functional impairment
of common organs (renal function, liver function, uncontrolled
diabetes, etc.) and increasing the potential hazards of some
medications for each patient.

Data were collected from patients’ medical electronic and
non-electronic records, and from the main hospital laboratory
framework. Data were captured and managed on EXCEL.
Demographic data, a list of commonly used medications,
comorbidities, laboratory data sheets and prescribed medica-
tion multiplicity were prepared and used by investigators.

All registered elderly patients who visited family medicine
chronic disease clinics (CDCs) and those involved in the Home
Health Care (HHC) programme were included in this study;
institutionalised patients were excluded. 798n patients were
randomly selected through the patient registry programme,
from the data registries at Wazarat Family Medicine Center
and Home Health clinics. We excluded patients attending
other hospitals, with multiple medication prescriptions.

2.1. Statistical analysis

Data were analysed using an SPSS software programme (ver-
sion 20). Both descriptive and analytic statistics were applied.
Percentages, mean and standard deviation were used for
descriptive statistics. For analytical statistics, Chi squared test
was applied for categorical data, and Student’s t test and
ANOVA were applied for numerical data. Statistical signifi-
cance was considered at p < 0.05. The intended sample size
was 400 participants. We used Beers’ criteria due to their wide use in clinical practice; they are the best-known criteria for identifying PIM use among the elderly (Nagendra Vishwas et al., 2012). Evidence-based methodology enabled the development of the AGS 2012 Updated Beers’ Criteria, to help healthcare providers improve medication safety in older adults. To determine the number of PIMs, we applied the latest criteria by Beers et al., published in 2012, and a review of scientific literature. Apart from explaining the drugs and doses to be avoided among elderly persons, to prevent adverse effects, these criteria evaluate the severity of potential adverse effects. We did not record treatment duration and indication of any inappropriate prescribed drugs, due to difficulties with data documentation.

3. Results

The study participants were elderly, as defined by the World Health Organisation (WHO). The mean age was 75 years; with SD (75.2 ± 5.5) with no significant differences between CDC and HHC patients after using chi-square test. Female patients made up 62.2% of the sample. Table 1 and Fig. 1 depict common chronic diseases among elderly participants. The majority of patients were diabetic (73.9%), hypertensive (83.2%) and with lipid profile abnormalities (73.8%). Almost all participants had haemoglobin abnormalities (99.2%), with no significant difference between CDC and HHCS patients. About 64% had some renal impairment.

Table 2 and Fig. 2 depict the medication groups used by the patients. Iron supplements were the most commonly used (23.1%), followed by analgesics and opioids (17%). Different types of antipsychotics were used by 7.6% of the participants. Some patients were using two types of analgesic drugs (2%); few (0.1%) were using three types. Some patients (1%) were using two kinds of antipsychotics simultaneously.

Almost 52.5% of participants were using one or more PIMs as in Table 3. At least 17.3% were using two; the majority were using <4. One patient was using 10 PIMs simultaneously and another using 12.

Antispasmodics and muscle relaxants, tolterodine and chlorpheniramine, were frequently prescribed to 13 and 11 HHC patients respectively while two CDC patients were found to take tolterodine. Risperidone was one of the atypical antipsychotic medications prescribed to 39 HHC patients, and quetiapine to 29. Only one CDC patient was taking quetiapine. Other commonly prescribed medications were iron supplements (ferrous sulphate for 184 patients), oral muscle relaxants for 40 patients, hypoglycaemic (glibenclamide) for 49, diclofenac for 42 and tizanidine for 40. The most common PIM was a high dose of ferrous sulphate, in about 33% of the participants compared to the rest of the group (p < 0.001). There was no statistical difference between the two patient groups.

| Table 1 | Age, sex and medical history of homecare and CDC patients. |
|---------|---------------------------------|
| Total (n = 798) | Homecare (n = 663) | CDC (n = 135) | \( \chi^2 \) test | p-Value |
| Age | | | | | |
| Mean ± SD | 75.2 ± 5.5 | 75.8 ± 5.4 | 72.2 ± 5.0 | t = 7.067 | < 0.001* |
| Median (Q1–Q3) | 75 (71–79) | 76 (72–80) | 72 (68–76) | |
| Gender | | | | | |
| Male | 302 | 37.8 | 238 | 35.9 | 64 | 47.4 | 6.317 | 0.012* |
| Female | 496 | 62.2 | 425 | 64.1 | 71 | 52.6 | |
| Disorders | | | | | |
| Diabetes type 2 (DM2) | 590 | 73.9 | 458 | 69.1 | 132 | 97.8 | 47.933 | < 0.001* |
| Hypertension (HTN) | 664 | 83.2 | 552 | 83.3 | 112 | 83.0 | 0.007 | 0.933 |
| Dyslipidaemia | 589 | 73.8 | 467 | 70.4 | 122 | 90.4 | 23.053 | < 0.001* |
| Ischaemic heart disease (IHD) | 136 | 17.0 | 121 | 18.3 | 15 | 11.1 | 4.044 | 0.044* |
| Congestive heart failure (CHF) | 31 | 3.9 | 22 | 3.3 | 9 | 6.7 | 3.368 | 0.066 |
| Dementia | 50 | 6.3 | 49 | 7.4 | 1 | 0.7 | 8.445 | 0.004* |
| Parkinson’s disease | 37 | 4.6 | 36 | 5.4 | 1 | 0.7 | 5.578 | 0.018* |
| Seizure disorders | 37 | 4.6 | 37 | 5.6 | 0 | 0.0 | 7.900 | 0.005* |
| Psychiatric diseases | 193 | 24.2 | 188 | 28.4 | 5 | 3.7 | 37.175 | < 0.001* |
| Renal function test abnormality | 511 | 64.0 | 417 | 62.9 | 94 | 80.3 | 13.397 | < 0.001* |
| Liver function test abnormality | 5 | 0.6 | 3 | 0.2 | 2 | 1.5 | Fisher | 0.200 |
| Haemoglobin (Hb) abnormality | 792 | 99.2 | 657 | 99.1 | 135 | 100.0 | 1.231 | 0.267 |

* Statistically significant at p < 0.05.
groups regarding the use of paracetamol combinations (see Table 4).

As in Table 5, and based on Mann–Whitney U test results, liver function had no significant influence on prescription decisions. Only kidney function profile had some influence. Twelve PIMs were prescribed to patients, without adjustment of their renal impairment profile. Analgesics and opioids were the most common PIMs for patients with renal insufficiency. There was a statistically significant difference regarding prescription of iron supplements, between patients with normal kidney function and those with renal impairment.

### Table 2 Frequency of use of PIMs by medication group (n = 798).

| Medication Group                        | Frequency | Percentage |
|-----------------------------------------|-----------|------------|
| Anticholinergics/muscle relaxants/antispasmodics | 1         | 39         |
| Antipsychotics                          | 1         | 61         | 7.6        |
| 2                                       | 8         | 1          |
| Antiepileptics                          | 1         | 0          | 0.0        |
| Sedative-hypnotics                      | 1         | 6          | 0.8        |
| Antihypertensives                       | 1         | 12         | 1.5        |
| Antidepressants                         | 1         | 17         | 2.1        |
| Skeletal muscle relaxants               | 1         | 43         | 5.4        |
| Anti-infectives                         | 1         | 2          | 0.3        |
| Oral hypoglycaemics                     | 1         | 49         | 6.1        |
| Analgesics and opioids                  | 1         | 119        | 14.9       |
| 2                                       | 16        | 2          |
| 3                                       | 1         | 0.1        |
| Platelet aggregation inhibitors         | 1         | 4          | 0.5        |
| Antiarrhythmics                         | 1         | 7          | 0.9        |
| Iron supplements                        | 1         | 184        | 23.1       |

### Table 3 Total number of PIMs among participants (n = 798).

| Total No. of medications | Frequency | Percentage |
|--------------------------|-----------|------------|
| 0                        | 379       | 47.5       |
| 1                        | 103       | 12.9       |
| 2                        | 138       | 17.3       |
| 3                        | 54        | 6.8        |
| 4                        | 69        | 8.6        |
| 5                        | 23        | 2.9        |
| 6                        | 17        | 2.1        |
| 7                        | 3         | 0.4        |
| 8                        | 9         | 1.1        |
| 9                        | 1         | 0.1        |
| 10                       | 1         | 0.1        |
| 12                       | 1         | 0.1        |

4. Discussion

Optimal drug therapy is essential in caring for elderly persons; worldwide, elderly patients use medication. A safe prescription method for elderly persons must include the decision as to whether a drug is indicated, choosing the best drug, determining a dose and schedule appropriate for the patient’s physiologic status, monitoring for effectiveness and toxicity, educating the patient about expected side effects, and indications for seeking consultation. Polypharmacy and inappropriate...
ately prescribed drugs cause many adverse events and, sometimes, are life threatening. Side effects are serious consequences of inappropriate prescriptions. In our study, 52.5% of the 798 elderly, CDC and homecare patients were on P1 PIMs, as per Beers’ criteria. One to two and five or more PIMs were prescribed to approximately 30% and 6.8% of the participants, respectively. We found less prevalence of PIMs among elderly persons in this context in Saudi Arabia, than in some Western countries (Hepler and Segal, 2003; Qato et al., 2008; Herings et al., 1995; Ay et al., 2005; Rajska-Neumann and Wieczorowska-Tobis, 2007).

The most common PIM was a high dose of ferrous sulphate (>325 mg/day) among about 33% of the participants. This is due to the high prevalence of iron deficiency anaemia among the elderly. High dose of iron supplement may precipitate constipation, which in turn may induce abdominal pain, loss of appetite, frequent falls and social isolation. High iron doses were prescribed to 23% of surveyed patients, for no clear reason. This is problematic and predisposes participants to serious side effects. Analgesics and opioids were the second most prescribed medications, with ≥1 type thereof taken by approximately 17%. According to previous studies, elderly

| Table 4 | Comparison of homecare and CDC patients’ medication use. |
|---------|---------------------------------------------------------|
|         | HHC (n = 663)                                      | CDC (n = 135)  | \( \chi^2 \) test | \( p \)-Value |
| Anticholinergic muscle relaxants |                     |                     |                     |               |
| Oxybutynin       | 8          | 1.2       | 0          | 0.0          | Fisher  0.364 |
| Tolterodine      | 13         | 2.0       | 0          | 0.0          | Fisher  0.141 |
| Chlorpheniramine | 11         | 1.7       | 0          | 0.0          | Fisher  0.227 |
| Hydroxyzine      | 2          | 0.3       | 0          | 0.0          | Fisher  1.000 |
| Hyoscyamine      | 1          | 0.2       | 0          | 0.0          | Fisher  1.000 |
| Scopolamine      | 2          | 0.3       | 2          | 1.5          | Fisher  0.135 |
| Antipsychotics   |                     |                     |                     |               |
| Quetiapine       | 29         | 4.4       | 1          | 0.7          | 4.092  0.043* |
| Haloperidol      | 5          | 0.8       | 0          | 0.0          | Fisher  0.596 |
| Olanzapine       | 3          | 0.5       | 0          | 0.0          | Fisher  1.000 |
| Risperidone      | 39         | 5.9       | 0          | 0.0          | 8.349  0.004* |
| Sedative-hypnotics |                   |                     |                     |               |
| Diazepam         | 3          | 0.5       | 0          | 0.0          | Fisher  1.000 |
| Lorazepam        | 3          | 0.5       | 0          | 0.0          | Fisher  1.000 |
| Antihypertensives: |                   |                     |                     |               |
| Methylpap        | 1          | 0.2       | 1          | 0.7          | Fisher  0.310 |
| Spironolactone > 25 mg | 9   | 1.4       | 1          | 0.7          | Fisher  1.000 |
| Antidepressants  |                     |                     |                     |               |
| Fluoxetine       | 4          | 0.6       | 0          | 0.0          | Fisher  1.000 |
| Clomipramine     | 1          | 0.2       | 0          | 0.0          | Fisher  1.000 |
| Amitriptyline    | 11         | 1.7       | 1          | 0.7          | Fisher  0.702 |
| Skeletal muscle relaxants |     |                     |                     |               |
| Tizanidine       | 38         | 5.7       | 2          | 1.5          | 4.255  0.039* |
| Baclofen         | 3          | 0.5       | 0          | 0.0          | Fisher  1.000 |
| Anti-infectives  |                     |                     |                     |               |
| Nitrofurantoin   | 2          | 0.3       | 0          | 0.0          | Fisher  1.000 |
| Oral hypoglycaemics |                 |                     |                     |               |
| Glibenclamide    | 42         | 6.3       | 7          | 5.2          | 0.257  0.612 |
| Analgesics and opioids |             |                     |                     |               |
| Ibuprofen        | 10         | 1.5       | 2          | 1.5          | Fisher  1.000 |
| Diclofenac       | 36         | 5.4       | 6          | 4.4          | 0.218  0.640 |
| Paracetamol combination | 80   | 12.1      | 18         | 13.3         | 0.167  0.683 |
| Decongestant     | 2          | 0.3       | 0          | 0.0          | Fisher  1.000 |
| Platelet aggregation inhibitors |     |                     |                     |               |
| Dipyridamole     | 4          | 0.6       | 0          | 0.0          | Fisher  1.000 |
| Antiarrhythmics  |                     |                     |                     |               |
| Digoxin > 125 mcg | 7          | 1.1       | 0          | 0.0          | Fisher  0.609 |
| Iron supplements |                       |                     |                     |               |
| Ferrous sulphate > 325 mg | 175 | 26.4      | 9          | 6.7          | 24.607 <0.001* |

* Statistically significant at \( p < 0.05 \).
Table 5  Comparison of the number of PIM groups used, based on renal function tests (RFT).

|                           | Normal Renal Function Test (n = 269) | Abnormal Renal Function Test (n = 511) | Mann–Whitney (z) | p        |
|---------------------------|--------------------------------------|----------------------------------------|------------------|----------|
|                           | Mean | SD | Min | Max | Median | Q1   | Q3   | Mean | SD | Min | Max | Median | Q1 | Q3   | z    | p        |
| Anticholinergics/muscle relaxants/antispasmodics | 0.1  | 0.2 | 0   | 1   | 0      | 0    | 0    | 0.0  | 0.2 | 0   | 1   | 0      | 0  | 0    | -1.226 | 0.220   |
| Antipsychotics            | 0.1  | 0.4 | 0   | 2   | 0      | 0    | 0    | 0.1  | 0.3 | 0   | 2   | 0      | 0  | 0    | -1.680 | 0.093   |
| Sedative-hypnotics        | 0.0  | 0.1 | 0   | 1   | 0      | 0    | 0    | 0.0  | 0.1 | 0   | 1   | 0      | 0  | 0    | -0.802 | 0.423   |
| Antihypertensives         | 0.0  | 0.1 | 0   | 1   | 0      | 0    | 0    | 0.0  | 0.1 | 0   | 1   | 0      | 0  | 0    | -0.527 | 0.598   |
| Antidepressants           | 0.0  | 0.1 | 0   | 1   | 0      | 0    | 0    | 0.0  | 0.1 | 0   | 1   | 0      | 0  | 0    | -0.071 | 0.944   |
| Skeletal muscle relaxants | 0.1  | 0.2 | 0   | 1   | 0      | 0    | 0    | 0.1  | 0.2 | 0   | 1   | 0      | 0  | 0    | -0.056 | 0.955   |
| Anti-infectives           | 0.0  | 0.0 | 0   | 0   | 0      | 0    | 0    | 0.0  | 0.0 | 0   | 0   | 0      | 0  | 0    | -1.027 | 0.305   |
| Oral hypoglycaemics       | 0.0  | 0.2 | 0   | 1   | 0      | 0    | 0    | 0.1  | 0.3 | 0   | 1   | 0      | 0  | 0    | -1.520 | 0.129   |
| Analgesics and opioids    | 0.2  | 0.5 | 0   | 2   | 0      | 0    | 0    | 0.2  | 0.5 | 0   | 3   | 0      | 0  | 0    | -1.139 | 0.255   |
| Platelet aggregation–inhibitors | 0.0  | 0.1 | 0   | 1   | 0      | 0    | 0    | 0.0  | 0.0 | 0   | 1   | 0      | 0  | 0    | -1.708 | 0.088   |
| Antiarrhythmics           | 0.0  | 0.1 | 0   | 1   | 0      | 0    | 0    | 0.0  | 0.1 | 0   | 1   | 0      | 0  | 0    | -1.266 | 0.206   |
| Iron supplements          | 0.4  | 0.5 | 0   | 1   | 0      | 0    | 1    | 0.2  | 0.4 | 0   | 1   | 0      | 0  | 0    | -6.909 | <0.001 *|
| Total No. medications     | 1.7  | 2.0 | 0   | 10  | 1      | 0    | 3    | 1.3  | 1.8 | 0   | 12  | 0      | 0  | 2    | -3.209 | 0.001 *|

* Statistically significant at p < 0.05.
patients require more analgesic prescriptions than do non-clinical adult populations (Pitkala et al., 2002). This could be because elderly persons experience multiple medical problems and pain, due to chronic diseases like osteoarthritis, muscular pain, headaches and joint pains. Sometimes, a physician may not have sufficient skills to care for elderly patients or time to scrutinise patient history and physical examination, to determine the exact medical problem.

In this study, antipsychotic medications were the third most commonly prescribed drugs (8.6%). Despite the strong recommendation against prescription of antipsychotics to older patients, unless necessary, more than 69 patients received ≥1 thereof. Antipsychotic medications reportedly predispose elderly patients to falls, fractures, sleep problems and driving problems (AGSP, 2009). Scientific geriatric organisations warn physicians against prescribing antipsychotic drugs to elderly persons for periods exceeding four weeks, to avoid serious side effects. The United States Food and Drug Administration (FDA) cautions against prescription of antipsychotics to elderly persons, due to the increased risk of cardiovascular mortality resulting from chronic use (Qato et al., 2008). Aspirin and clopidogrel were the least prescribed medications. The potential, serious side effects on the elderly include gastrointestinal upset, gastric bleeding and bleeding disorders. The most common PIMs in our study were antipsychotics, tricyclic antidepressants, anticholinergics/muscle relaxants/antispasmodics, antiepileptics, sedative-hypnotics, antihyper- tensive, skeletal muscle relaxants, anti-infectives, oral hypoglycaemics, analgesics and opioids, platelet aggregation-inhibitors, antiarrhythmics, and iron supplements.

The possibility of an ADE should always be considered when evaluating elderly patients; any new symptom should be considered drug-related, until proven otherwise. Pharmacokinetic changes lead to increased plasma drug concentrations, and pharmacodynamic changes to increased drug sensitivity in older adults (Avorn et al., 1989). Various criteria have been introduced for identifying medications to avoid prescribing, or to prescribe cautiously, in older adults. Compliance with these is suboptimal. Clinicians could address this by avoiding overly prescribing inappropriate drug therapies. ADEs result in four times as many hospitalisations in elderly patients as in younger adults (AGSP, 2009). Prescription of cascades, drug–drug interactions and inappropriate drug doses result in preventable ADEs. Prescription of PIMs, as shown in this study, is a concern for elderly patients attending outpatient clinics and home residents; atypical antipsychotics, iron overdose, benzodiazepines and opioids are most commonly prescribed inappropriately. A step-wise approach towards prescriptions for older adults should include periodic review of current drug therapy; discontinuation of unnecessary medications; consideration of non-pharmacologic alternative strategies; consideration of safer, alternative medications; and prescription of the lowest possible effective dose and necessary beneficial medications only.

References

American Geriatrics Society Panel on Pharmacological Management of Persistent Pain in Older Persons, 2009. Pharmacological management of persistent pain in older persons. J. Am. Geriatr. Soc. 57, 1331–1346.

Al-Omar, H.A., Al-Sultan, M.S., Abu-Auda, H.S., 2012. Prescribing of potentially inappropriate medications among the elderly population in an ambulatory care setting in a Saudi military hospital: trend and cost. Geriatr. Gerontol. Int. 13, 616–621. http://dx.doi.org/10.1111/j.1447-0594.2012.00951.x.

Avorn, J., Dreyer, P., Connelly, K., Soumerai, S.B., 1989. Use of psychoactive medication and the quality of care in rest homes. Findings and policy implications of a statewide study. N. Engl. J. Med. 320, 227–232.

Ay, P., Akici, A., Harmanc, H., 2005. Drug utilization and potentially inappropriate drug use in elderly residents of a community in Istanbul, Turkey. Int. J. Clin. Pharmaco. Ther. 43, 195–202.

Beers, M.H., Ouslander, J.G., Rolinghier, I., Reuben, D.B., Brooks, J., Beck, J.C., 1991. Explicit criteria for determining inappropriate medication use in nursing home residents: UCLA Division of Geriatric Medicine. Arch. Intern. Med. 151, 1825–1832.

Beijer, H.J., de Blaeij, C.J., 2002. Hospitalisations caused by adverse drug reactions (ADR): a meta-analysis of observational studies. Pharm. World Sci. 24 (2), 46–54.

Brekke, M., Rognstad, S., Straand, J., Furu, K., Gjelstad, S., Bjørner, T., et al, 2008. Pharmacologically inappropriate prescriptions for elderly patients in general practice: how common? baseline data from The Prescription Peer Academic Detailing (Rx-PAD) study. Scand. J. Prim. Health Care 26, 80–85.

Buajordet, I., Ebbesen, J., Eriksen, J., Brors, O., Hilberg, T., 2001. Fatal adverse drug events: the paradox of drug treatment. J. Intern. Med. 250, 327–341.

Byles, J.E., Heinze, R., Nair, B.K., Parkinson, L., 2003. Medication use among older Australian veterans and war widows. Intern. Med. J. 33, 388–392.

Chang, C.B., Chan, D.C., 2010. Comparison of published explicit criteria for potentially inappropriate medications in older adults. Drugs Aging 27, 947–957.

Chin, M.H., Wang, L.C., Jin, L., Mulliken, R., Walter, J., Hayley, D. C., et al, 1999. Appropriateness of medication selection for older persons in an urban academic emergency department. Acad. Emerg. Med. 6, 1223–1242.

Col, N., Fanale, J.E., Kronholm, P., 1990. The role of medication noncompliance and adverse drug reactions in hospitalizations of the elderly. Arch. Intern. Med. 150, 841–845.

Doshi, J.A., Shaffer, T., Briesacher, B.A., 2005. National estimates of medication use in nursing homes: findings from the 1997 medicare current beneficiary survey and the 1996 medical expenditure survey. J. Am. Geriatr. Soc. 53 (3), 438–443.

Fick, D.M., Semla, T.P., 2012. American Geriatrics Society Updated Beers Criteria for potentially inappropriate medication use in older adults. J. Am. Geriatr. Soc. 10, 1532–5415.

Fick, D.M., Waller, J.L., Maclean, J.R., Heuvel, R.V., Tadlock, J.G., Gottlieb, M., et al, 2001. Potentially inappropriate medication use in a Medicare managed care population: association with higher costs and utilization. J. Manag. Care Pharm. 7, 407–413.

Fick, D.M., Cooper, J.W., Wade, W.E., Waller, J.L., Maclean, J.R., Beers, M.H., 2003. Updating the Beers criteria for potentially inappropriate medication use in older adults: results of a US consensus panel of experts. Arch. Intern. Med. 163, 2716–2724.

Goldberg, R.M., Mabee, J., Chan, L., Wong, S., 1996. Drug-drug and drug-disease interactions in the ED: analysis of a high-risk population. Am. J. Emerg. Med. 14, 447–450.

Handler, S.M., Wright, R.M., Ruby, C.R., Hanlon, J.T., 2006. Epidemiology of medication-related adverse events in nursing homes. Am. J. Geriatr. Pharmacother. 4, 264–272.

Hepler, C.D., Segal, R., 2003. Preventing Medication Errors and Improving Drug Therapy Outcomes: A Management Systems Approach. CRC Press, Boca Raton, FL, p. 520 (ISBN: 0-8493-1576-X).

Herings, R.M., Stricker, B.H., de Boer, A., Bakker, A., Sturmans, F., 1995. Benzodiazepines and the risk of falling leading to femur
Inappropriate medications prescribed for elderly patients

fractures. Dosage more important than elimination half-life. Arch. Intern. Med. 155, 1801–1807.
Kaufman, D.W., Kelly, J.P., Rosenberg, L., Anderson, T.E., Mitchell, A.A., 2002. Recent patterns of medication use in the ambulatory adult population of the United States: the Slone Survey. EDJAMA 287 (3), 337–344.
Klarin, I., Wimo, A., Fastbom, J., 2005. The association of inappropriate drug use with hospitalization and mortality: a population-based study of the very old. Drugs Aging 22, 69–82.
Lazarou, J., Pomeranz, B.H., Corey, P.N., 1998. Incidence of adverse drug reactions in hospitalized patients: a meta-analysis of prospective studies. JAMA 279, 1200–1205.
Mallet, L., Spinewine, A., Huang, A., 2007. The challenge of managing drug interactions in elderly people. Lancet 370, 185–191.
Nagendra Vishwas, H., Harugeri, A., Parthasarathi, G., Ramesh, M., 2012. Potentially inappropriate medication use in Indian elderly: comparison of Beers’ criteria and screening tool of older persons’ potentially inappropriate prescriptions. Geriatr. Gerontol. Int. 12 (3), 506–514.
Pitkala, K.H., Strandberg, T.E., Tilvis, R.S., 2002. Inappropriate drug prescribing in home-dwelling, elderly patients: a population-based survey. Arch. Intern. Med. 162, 1707–1712.
Qato, D.M., Alexander, G.C., Conti, R.M., Johnson, M., Schumm, P., Lindau, S.T., 2008. Use of prescription and over-the-counter medications and dietary supplements among older adults in the United States. JAMA 300, 2873–2878.
Rajaska-Neumann, A., Wieczorowska-Tobis, K., 2007. Polypharmacy and potential appropriateness of pharmacological treatment among community-dwelling elderly patients. Arch. Gerontol. Geriatr. 44, 303–309.
Spinewine, A., Swine, C., Dhillon, S., Lambert, P., Nachega, J.B., Wilmotte, L., et al, 2007. Effect of a collaborative approach on the quality of prescribing for geriatric inpatients: a randomized, controlled trial. J. Am. Geriatr. Soc. 55, 658–665.
Annual report of the regional director, country statistical profile, 2011. Geneva, World Health Organization; (updated 2011 May 16; cited 2015 Jul 8). Available from: http://www.who.int/about/en/.
Williams, C.M., 2002. Using medications appropriately in older adults. Am. Fam. Physician 66, 1917–1924.