ORIGINAL ARTICLE

Evaluation of the quality of drug therapy among elderly patients in nursing homes

A computerized pharmacy register analysis

ÅSA BERGMAN¹, JONNY OLSSON^{1,2,3}, ANDERS CARLSTEN^{1,5}, MARGDA WAERN⁴ & JOHAN FASTBOM^{2,3}

¹Apoteket AB, ²Swedish National Board of Health and Welfare, ³Ageing Research Centre, Neurotec, Karolinska Institute, ⁴Institute of Clinical Neuroscience, Sahlgrenska Academy at Gothenburg University, Sweden, and ⁵Institute of Social Medicine at Gothenburg University, Sweden

Abstract

Objective. To evaluate drug therapy quality among elderly nursing home residents. Secondary aims were to compare quality in young and old elderly and to determine whether number of prescribers affected quality of drug therapy. **Design.** A cross-sectional population-based register study. **Setting.** Nursing home residents in the Gothenburg area using the multi-dose system (e.g. patients who get their drugs machine dispensed into one unit for each dose occasion, a service offered by the National Corporation of Pharmacies). **Subjects.** All nursing home residents aged 65 years and older. **Main outcome measures.** The quality of drug therapy assessed using five quality indicators for the elderly recently introduced by the Swedish National Board of Health and Welfare; number of prescribed drugs per resident. **Results.** Over 70% of residents had one or more potentially inappropriate prescription. Younger nursing home residents (65–79 years) had significantly ($p < 0.001$) lower quality of drug therapy than older residents (80+). The average number of prescribing physicians per resident was high at almost four per resident. An increasing number of prescribers per resident was associated with a higher number of drugs prescribed and a lower quality of drug therapy. **Conclusion.** Computerized quality assurance systems can provide support for healthcare providers. Quality indicators should be modified to give maximum support for users.

Key Words: *Drugs, elderly, family practice, nursing home, prescribing, quality indicators*

Age-related physiological changes complicate drug therapy in older adults. In addition, the proportion of individuals with multiple diseases increases with age. Optimal medical therapy for several chronic diseases requires the use of multiple drugs, and accordingly drug treatment of the elderly is often extensive [1,2]. The number of drugs used and high age of patients are important risk factors for adverse drug effects [3] that may cause hospital admission [4–6]. This can have profound medical and safety consequences for the elderly and economic effects on the healthcare system [7,8].

In Sweden, quality indicators were developed from evidence in clinical literature in collaboration with experts [9,10]. The national drug registers in Sweden, operated by the National Corporation of

Extensive drug treatment combined with an increased risk of adverse drug effects among the elderly makes evaluation of the quality of drug treatment important.

- Using Swedish quality indicators, we found potentially inappropriate prescription in over 70% of nursing home residents.
- Further, an increased number of physicians per resident was associated with higher number of prescribed drugs and lower quality of drug therapy.
- A computerized pharmacy system can be a useful tool for providers of healthcare for the elderly.

Swedish Pharmacies (Apoteket AB), include information on prescribed drugs but these registers are not linked to medical records and their use is highly restricted. Information from the register called the ApoDos register includes all multi-dose users (e.g. patients who get their drugs machine dispensed into one unit for each dose occasion, a service offered by the National Corporation of Pharmacies) in Sweden.

The aim of this study was to evaluate the quality of drug therapy among elderly patients living in nursing homes, using quality indicators on data from the ApoDos register. Secondary aims were to compare quality in the young and old elderly and to determine whether number of prescribers affected quality of drug therapy.

Material and methods

Ethical approval

This study was approved by the Ethics Committee of the Karolinska Institute, Stockholm.

Inclusion criteria

All multi-dose users aged 65 or above residing in nursing homes in the Gothenburg area in June 2003 were included in this cross-sectional study, a total of 7904 residents.

Prescribed drugs

Information on residents' year of birth, sex, housing, and data on all prescribed drugs were obtained from the Swedish national drug register for multi-dose users. Drugs were classified according to the World Health Organization's Anatomical Therapeutic Chemical (ATC) classification system [11]. Data analyses were performed using SPSS 12.0 for Windows (SPSS Inc. 1989–2003). Descriptive statistics were used for the prescription of drugs. A t-test and chi-squared test were used for significance regarding quality indicators and gender and age group differences. Regression analysis was used to examine the association between number of prescribers and quality of drug therapy (logistic regression; dependent variable: presence of any quality indicator; independent variables: number of prescribers, age, and gender) as well as number of prescribers and the number of drugs prescribed (linear regression; dependent variable: number of drugs; independent variables: number of prescribers, age, and gender).

Quality indicators

The Swedish National Board of Health and Welfare recently introduced quality indicators for evaluation

of drug therapy among the elderly [12]. They include both drug- and diagnosis-specific indicators. The diagnosis-specific criteria describe prevalence of rational, irrational, and inappropriate/hazardous treatment for 11 common diagnoses. The drug-specific indicators are developed from Beers's criteria (1997) [9] and include 25 indicators regarding drug types, drug regimen, daily dose, and combination of drugs, regardless of diagnosis. Five drug-specific indicators were used in this study (see Box 1).

Results

Demography

A total of 7904 nursing home residents, 5513 women and 2391 men, were included in the study. The average age was 85 years, with 21% defined as younger elderly patients (65–79 years of age) and 79% as older elderly patients (80+).

Prescribed drugs

The average number of drugs prescribed per person was 11.9, of which 9 were prescribed for regular use and 2.9 as needed. There was no sex difference (males 11.8, females 12.0, $p=0.07$) and there was no difference between age groups (11.9 in both, $p=0.96$). Some 65% of the residents were prescribed 10 or more drugs and 86% had at least one psychotropic prescription. The most commonly prescribed drugs were laxatives (70%), followed by analgesics/antipyretics (62%), hypnotic-sedatives (55%), and antidepressants (51%) (Table I).

Quality indicators

A total of 74% of residents had at least one problematic prescription. The proportion with potentially inappropriate prescriptions was higher in

Table I. Prevalence (%) of the 10 most frequently prescribed drug groups among nursing home residents. Both regular use and as-needed prescriptions are included ($n=7904$)

Category	ATC*	%
Laxatives	A06A	70.3
Analgesics and antipyretics	N02B	61.5
Hypnotic-sedatives	N05C	55.1
Antidepressants	N06A	51.0
Antithrombotic agents	B01A	49.5
Anxiolytics	N05B	45.6
High-ceiling diuretics	C03C	44.1
Skin protection, for topical use	D02A	34.8
Vitamin B12 and folic acid	B03B	33.5
Opioid analgesics	N02A	31.5

*Anatomical Therapeutic Chemical classification system according to the World Health Organization [11].

young nursing home residents (aged 65–79) than in their older counterparts according to all indicators (Table II).

Number of prescribers per resident

The average number of physicians prescribing drugs per resident was 3.9 (1–16, $SD \pm 2.1$). There was a positive association between number of prescribers and number of prescribed drugs (OR 1.40; 95% CI 1.36–1.45, Nagelkerke $R^2 = 0.29$) and between number of prescribers and lower quality of drug therapy (OR 1.42; 95% CI 1.38–1.47, Nagelkerke $R^2 = 0.11$). Assessment of the overall model fit in the logistic regression analysis, as shown by the

Nagelkerke R^2 value, shows that the variance is only partially explained by the model.

Discussion

Principal findings

We found potentially inappropriate prescription in over 70% of residents and reduced quality of prescription according to indicators [13]. There were a high number of prescribers per resident, which was associated with polypharmacy and lower quality of drug therapy.

Limitations of the study

This study has some important limitations. Lack of information in the drug register regarding diagnosis, evaluation, and treatment period and the cross-sectional study design providing only point prevalences precluded the use of many of the quality indicators. Also, we lack information on indications for the different drug treatments. Therefore, we cannot exclude the fact that there might be a rationale behind some of the “inappropriate” treatments found. Findings regarding nursing home residents cannot be generalized to the elderly population as a whole. The selection of individuals with multi-dose prescriptions living in nursing homes most probably results in a higher than average morbidity. However, the vast majority of residents in nursing homes in the study area use the multi-dose system.

Prescribed drugs

The number of drugs prescribed per nursing home resident in this study was even greater than that (8–9) reported in a nationwide study in 1998 [13]. The proportion of patients with 10 or more prescribed drugs was higher as well (40% in 1998 and nearly 65% in the current study). With the availability of new treatments and national guidelines for several conditions recommending multiple drug therapy this development is not surprising. However, it emphasizes the increasing need for knowledge and guidelines regarding treatments with multiple drugs in patients with multiple diagnoses.

When comparing the most frequently prescribed drug, the frequency of prescription of antithrombotic agents, analgesics/antipyretics and antidepressants shows the greatest increase. However, these drugs have also been shown to be among the drugs most commonly implicated in adverse effects and hospital admissions [8]. For example, the prescription of antithrombotic agents has increased more than four-fold since 1995 [14]. This is probably due to the

Table II. Proportion of residents prescribed long-acting benzodiazepines and anticholinergic drugs, with drug duplications, three or more psychotropic drugs, and potential drug/drug interactions: n (65–79) = 1660, n (80+) = 6244

			Pearson's chi-square, two-tailed
			(%)
Long-acting benzodiazepines	Total	15.5	p < 0.001
	65–79 years	22.3	
	80+	14.0	
Anticholinergic drugs	Total	19.7	p < 0.001
	65–79 years	26.3	
	80+	17.9	
Drug duplication	Total	19.7	p < 0.001
	65–79 years	24.0	
	80+	18.5	
Drug/drug interaction category C	Total	45.2	p < 0.015
	65–79 years	47.8	
	80+	44.5	
Drug/drug interaction category D	Total	12.1	p < 0.013
	65–79 years	13.8	
	80+	11.6	
Three or more psychotropic drugs	Total	38.6	p < 0.001
	65–79 years	42.6	
	80+	37.5	
Any of the above	Total	73.8	p < 0.001
	65–79 years	78.9	
	80+	72.4	

Box 1. Drug-specific quality indicators introduced by the Swedish National Board of Health and Welfare and used in the present study

<p>Quality indicators for evaluation of the quality of drug therapy among the elderly, extracted and translated from the quality indicators proposed by the Swedish National Board of Health and Welfare [10]</p> <p><i>Proportion of individuals taking long-acting benzodiazepines:</i> Includes diazepam, flunitrazepam, and nitrazepam</p> <p><i>Proportion of individuals taking anticholinergic drugs:</i> Drugs with potent anticholinergic properties (antihistamines, urinary and gastrointestinal antispasmodics, cyclic antidepressants, low potency antipsychotics, anticholinergic anti-Parkinsonian drugs, antiarrhythmics class Ia, anticholinergic antiemetics)</p> <p><i>Proportion of individuals with drug duplications:</i> Regular use of two or more drugs within the same ATC group that could be considered unnecessary or associated with increased risk (drugs for peptic ulcer, iron preparations, calcium, potassium, high-ceiling diuretics, low-ceiling diuretics, thiazides, potassium-sparing agents, beta-blockers, calcium channel blockers, agents acting on the rennin-angiotensin system, cardiac glycosides, propulsives, oestrogens, NSAID, opioid analgesics, corticosteroids for systemic use, anticholinergic anti-Parkinsonian drugs, antipsychotics, anxiolytics, hypnotic-sedatives, antidepressants, antihistamines for systemic use, benzodiazepines, paracetamol).</p> <p><i>Proportion of individuals taking three and more psychotropic drugs:</i> (includes antipsychotics, anxiolytics, hypnotic-sedatives, and antidepressants)</p> <p><i>Proportion of individuals with potential drug/drug interactions, category C or D:</i> Drug–drug interaction category C or D according to the Swedish classification system described in the annual publication of Pharmaceutical Specialities in Sweden (FASS) [17] Category C (1–4): Drug–drug interaction that could lead to a changed effect or adverse events but which can be managed with individual dosage Category D (1–4): Drug combinations that should be avoided (category D) The degree of documentation is classified in groups 1–4</p>
<p>Note: The lower the proportion of each indicator, the better the quality of drug therapy.</p>

long-term benefits of the prophylactic use of low-dose aspirin. However, this treatment also increases the risk of gastrointestinal bleeding, especially among the elderly.

Neither the benefits nor the risks of treatment or non-treatment is described using the present indicators. The use of a benefit:risk ratio as well as a distinction between different types of drugs such as a TCA:SSRI ratio would further improve the indicators and better describe the complexity of treating elderly patients.

Quality indicators

The quality of drug therapy was better among older than younger elderly patients. This is consistent with previous findings showing that adverse drug reaction as a cause of hospital admission is most common among patients aged 65–83 years [8]. As age is a risk factor for adverse drug events, this could reflect a reduced need for treatment with age due to a healthy survivor effect.

The high frequency of potential drug/drug interactions in the section of the population using the

most drugs is hardly surprising but is of concern. Drug/drug interactions have been reported to be responsible for 15–20% of the adverse drug effects causing hospital admissions [8]. The drug/drug interaction system used in Sweden at present [14] does not always distinguish between interactions with or without clinical relevance and a clear differentiation would give a better measurement of quality and hence provide a better tool for improving therapy.

According to the indicators there has been a decrease in quality of drug use in the elderly, mostly due to the use of psychotropic drugs. The overall use of three or more psychotropic drugs has increased from 12% [14] to 39%. The most frequent drug duplications were with antidepressants followed by hypnotic-sedatives, antipsychotics, and anxiolytics, i.e. psychotropic drugs. The frequency of prescription of long-acting benzodiazepines has, however, decreased from 46% in 2000 [15] to 30% of all hypnotic-sedatives. Nevertheless, the total use of hypnotic-sedatives remains high at 55% due to the prescription of zopiclone. Furthermore, one-fifth of patients were prescribed anticholinergic drugs

compared with 13% in 1998 [14]. Psychotropic drugs are commonly implicated in adverse effects and hospital admissions among the elderly [8], and the combination of several of these drugs further increases the risks [3], making this development alarming. However, it should also be taken into account that, for example, a combination of two antidepressants may sometimes be necessary. Furthermore, the increase in prescription is represented by high-potency and atypical antipsychotics, SSRI and zopiclone – drugs less likely to cause adverse drug events compared with the previously used low-potency antipsychotics, heterocyclic antidepressants, and long-acting benzodiazepines, all of which have decreased in prescription – in compliance with national guidelines.

Despite the fact that the current study utilized only 5 of the 25 drug-specific indicators, potentially inappropriate prescription was observed in over 70% of residents. The indicators are primarily meant to be used for quality measurement on a population level and might not apply when used on individuals. Therefore they can never replace a clinical evaluation. But they can support the evaluation and indicate the probability of good quality.

Number of prescribers

The present study shows that a higher number of prescribers is associated with a higher number of prescribed drugs and a lower quality of prescription. Our analyses do not give any information regarding the casual relationship between these factors. Results are consistent with earlier findings showing that a higher number of physicians is a risk factor for inappropriate drug combinations [16] and that a lack of practitioner continuity and lack of routines for evaluation may contribute to polypharmacy [17–19]. Continuity between practitioner and patient may be hard to achieve but is of importance. This problem might partly be compensated by introducing a computerized support system to healthcare providers.

Conclusion

Drug use is extensive in the elderly living in nursing homes and there is a need for a system, like the computerized system used in this study, for quality assurance. A drug register available to both healthcare personnel and for epidemiological studies, including information on diagnosis, drug history, doses, total treatment period, and evaluation, should be introduced. Since many conditions can successfully be treated without the use of drugs, this information should also be included in such a

register. Treatment of the elderly is complex and maximum support should be provided for healthcare providers. Quality indicators should be modified to give maximum support for users and to provide guidelines for the treatment of the elderly with multiple diseases and multiple drug therapy included.

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