ORIGINAL ARTICLE

# Multidisciplinary medication review in nursing home residents: what are the most significant drug-related problems? The Bergen District Nursing Home (BEDNURS) study

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*Qual Saf Health Care* 2003;**12**:176–180

British Geriatric Society

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Accepted for publication 14 November 2002

**Aim:** Based on a multidisciplinary review of drug use in nursing home residents, this study aimed to identify the most frequent clinically relevant medication problems and to analyse them according to the drugs involved and types of problems.

**Methods:** Cross sectional study auditing drug use by 1354 residents in 23 nursing homes in Bergen, Norway. Data were collected in 1997. A physician/pharmacist panel performed a comprehensive medication review with regard to indications for drug use and active medical conditions. The drug related problems were subsequently classified according to the drugs involved and types of problems (indication, effectiveness, and safety issues).

**Results:** 2445 potential medication problems were identified in 1036 (76%) residents. Psychoactive drugs accounted for 38% of all problems; antipsychotics were the class most often involved. Multiple psychoactive drug use was considered particularly problematic. Potential medication problems were most frequently classified as risk of adverse drug reactions (26%), inappropriate drug choice for indication (20%), and underuse of beneficial treatment (13%).

**Conclusions:** Three of four nursing home residents had clinically relevant medication problems, most of which were accounted for by psychoactive drugs. The most frequent concerns were related to adverse drug reactions, drug choice, and probable undertreatment.

Elderly people benefit most from modern drug treatment but are at particular risk for drug induced morbidity. Nursing home residents usually suffer from multiple medical problems leading to long term drug treatment,[1–4] and multiple drug use combined with ageing related pharmacokinetic and pharmacodynamic changes increases the risk of adverse drug reactions.[4–6] Drug misadventures are major reasons for admissions to hospital and death in the elderly.[6–10] Drug related hospital admissions are often caused by well known and preventable side effects.[11 12]

Several indicators for appropriate prescribing for the elderly aimed at quality improvement have been published, but none is considered to be a gold standard.[13–15] Consensus panels in the US and Canada have compiled lists of drugs considered to be inherently inappropriate for elderly people.[16–18] Studies using these explicit criteria have revealed significant use of inappropriate drug regimens among nursing home residents.[19–21] A major limitation in using these methods is that clinically relevant problems often relate to why and how a drug is used, not to the drug itself.[22] Whereas explicit criteria are useful for evaluating specific medications, these relatively rigid tools do not address individual patients. In contrast, comprehensive assessments such as the "medication appropriateness index"[23] and the "pharmaceutical care" concept for drug utilisation review, published by US pharmacist researchers,[24] are more patient specific and address the complexity of entire drug regimens of individual patients. These methods include an assessment of indication and effectiveness issues and can reveal clinically significant problems such as undertreatment and unnecessary drug use.[15 22]

Studies indicate that drug reviews conducted by clinical pharmacists are valuable for the identification of prescription alterations needed for nursing home residents.[25 26] Although a pharmaceutical perspective is important, relevant medical specialities are essential for assessing clinical aspects such as diagnoses and treatment outcome. The main advantage of panel assessment for drug regimens is the comprehensive nature of the evaluation. Multidisciplinary team interventions conducted on elderly patients have been found to be effective in detecting and resolving psychoactive drug problems[27] and in preventing readmissions of patients with heart failure.[28]

Based on a multidisciplinary drug utilisation review in nursing home residents, this study aimed to identify the most frequent clinically relevant medication problems and to analyse them according to the drugs involved and the types of problems encountered.

## METHODS

### Study population

Norwegian nursing homes provide care for both physically disabled and psychogeriatric residents, most of whom suffer from mental impairment.[29] In 1997 a cross sectional study auditing drug use in nursing homes was conducted in Bergen, the second largest town in Norway (population 230 000). Twenty three institutions (86% of the total Bergen nursing home population) participated in the study. All the 39

**Box 1 Issues addressed by medication review panel**

- Indication for drug use
- Dosage
- Duration of treatment
- Drug safety profile
- Potential drug-drug interactions
- Potential drug-disease interactions
- Therapeutic or pharmacological duplication
- Probable undertreatment

physicians supervising these institutions, usually part time general practitioners, were invited and agreed to participate. Data collection was completed for 1552 residents. Residents were excluded if they were admitted for respite care (n=146), were aged under 65 years (n=34), or if the data sets were incomplete (n=18), leaving 1354 subjects eligible for analysis.

### Data collection

Based on drug dispensary cards, nurses in charge recorded patients' age, sex, and currently used drugs (drug name, daily dose, schedule: standing medication or when required, duration: ⩾3 months or <3 months). For each resident the nursing home physicians subsequently provided diagnostic indication(s) for each drug and a list of active medical conditions. Drugs were coded according to the Anatomical Therapeutic Chemical (ATC) classification system.[30]

### Medication review

A four member physician/pharmacist panel (the three authors and a nursing home pharmacist) with long experience and interest in geriatric pharmacotherapy performed a comprehensive medication review. The drug regimens of individual patients were assessed with regard to diagnostic information. Issues addressed by the panel are listed in box 1.

All reviewers first independently assessed patients' drug profiles. Case notes concerning clinical and pharmacological issues were subsequently discussed in the panel until agreement was obtained on potential problems. Judgement concerning inappropriate prescribing was based on the panellists' professional expertise with respect to drug treatment response (adverse drug reactions, treatment failure), available prescribing guidelines,[31–33] and evidence from the literature. The panel aimed to identify problems considered to be of clinical relevance for the patients (drug regimen with known ability negatively to influence quality of life, morbidity, or mortality) rather than to detect all possible medication problems. A list of significant medication problems was compiled and updated continuously during the review process, and served as a template against which drug use was assessed. One single problem could involve several drugs, and one single prescription might cause several problems.

### Feedback

Each patient's medication problems were subsequently reported to the nursing home physicians, including specific suggestions for treatment alterations. In addition, more general recommendations concerning significant problems commonly identified in the study population were provided (table 1). However, follow up of possible changes in utilisation patterns after this intervention was not performed.

### Analysis of medication problems

All potential medication problems identified were subsequently classified in broad categories with regard to indication, effectiveness, and safety issues according to the "pharmaceutical care" concept for appropriate prescribing.[24] The categories were slightly modified by establishing an additional category ("need for diagnostic test") to confirm the diagnosis or indication for a drug (box 2). The inter-rater reliability of classifying identified problems into problem categories was tested in a random sample of 30 cases which were coded independently by two of the reviewers. The observed reliability of 83% in terms of kappa statistics ($\kappa$=0.62) was considered good.[34]

**Table 1** The Bergen District Nursing Home (BEDNURS) study: prevalent medication problems identified by a multidisciplinary expert panel and reported to nursing home physicians according to description of problem, clinical implications, and suggestion for treatment alterations

| Potential medication problems | Clinical implications | Suggestion for treatment alterations |
|---|---|---|
| Cardiovascular system | | |
| Diuretic monotherapy for heart failure | Suboptimal treatment | Consider ACE inhibitor |
| Verapamil or diltiazem in heart failure | Aggravation of heart failure | Stop drug |
| Non-selective beta-blocker (e.g. eye drops) in heart failure, asthma | Bradycardia; bronchospasm | Consider selective beta-blocker |
| Concurrent use of ACE inhibitor, potassium supplement, or potassium sparing diuretic | Hyperkalaemia | Check serum potassium |
| Concurrent use of diuretic or antihypertensive and NSAID | Fluid retention, reduced antihypertensive effect | Consider plain analgesic, e.g. paracetamol |
| Central nervous system | | |
| Concurrent use of multiple psychoactive drugs | Increased effect | Revise indication and regimen |
| Amitryptiline, doxepine | Strongly anticholinergic, excessive sedation | Consider SSRI |
| Long term use of antipsychotics for non-psychotic indications | Limited efficacy, cognitive deterioration, extrapyramidal and anticholinergic side effects | Stop drug |
| Concurrent use of antiparkinsonian agents and phenothiazine antipsychotics | Treatment of avoidable ADR | Revise regimen |
| Long acting benzodiazepines | Excessive sedation, cognitive deterioration | Stop drug |
| Benzodiazepine anxiolytic and benzodiazepine hypnotic concurrently | Pharmacological duplication, excessive sedation | Stop (one) drug |
| Alimemazine, promethazine | Strong anticholinergic and extrapyramidal side effects | Stop drug |
| Propoxyphene, pentazocine | Cardiotoxic, nephrotoxic, confusion, hallucinations | Consider other opioid analgesic |
| Miscellaneous | | |
| NSAID (e.g. indomethacin) | Confusion, gastrointestinal side effects | Consider e.g. paracetamol |
| Iron supplement and NSAID or antithrombotics | Treatment of avoidable ADR | Reconsider regimen |
| Nutritional supplements for iron deficiency anaemia | Ineffective treatment | Consider iron supplement |
| Vitamin C monotherapy for cystitis prophylaxis | Ineffective treatment | Consider oestrogen, metenamin |

ACE=angiotensin converting enzyme; NSAID=non-steroidal anti-inflammatory drugs;SSRI=selective serotonin re-uptake inhibitor; ADR=adverse drug reaction.

**Box 2 Problem categories employed by the panel**

**Indication**
- Need for additional drug: undertreatment for diagnosis
- Need for diagnostic test: unclear or not confirmed indication; need for review
- Unnecessary treatment: no appropriate medical indication; therapeutic or pharmacological duplication; drugs used for the treatment of avoidable adverse drug reactions

**Effectiveness**
- Choice of drug: drug not indicated for condition; more effective drug available; contraindication present
- Dosage too low

**Safety**
- Risk for single drug adverse drug reactions: unfavourable safety profile
- Drug-drug interaction
- Dosage too high; excessive treatment duration

### Statistical analyses
The analyses comprised Student's *t* test, $\chi^2$ test for trend, and Spearman's rank correlation. p values of $\leq 0.05$ were considered statistically significant.

## RESULTS
### Population characteristics
The mean (SD) age of the 1354 nursing home residents was 85.2 (6.8) years (range 65–111). Women accounted for 77% of all residents and were in general older than the men (mean age 85.9 and 82.8 years respectively, $p<0.001$). Based on the listed diagnoses, the residents had an average of 3.1 active medical conditions.

### Medication review
In total the residents used 7419 drug items: 6809 ATC classified drugs and 610 nutritional supplements. The mean (SD) number of ATC drugs used per resident was 5.0 (2.6), range 0–19. Only 17 (1.2 %) residents did not use any drugs.

The panel identified 2445 drug related problems in 1036 nursing home residents. The physician panellists generally placed more emphasis on drugs with known ability to cause clinical adverse outcomes, while the pharmacist more often provided remarks concerning pharmacokinetic issues such as drug-drug interactions requiring dose adjustment.

The median number of medication problems per resident was 1 (range 0–10), but this figure varied considerably between different nursing homes (from 1 (range 0–3) to 3 (range 0–6)). In total, 589 (44%) residents used at least one drug judged to be inappropriate by the panel. Identified numbers of problems were associated with numbers of drugs used per resident ($r=0.14$, $p<0.001$) but were not associated with numbers of main diagnoses ($r=0.01$, $p=0.66$), patients' age ($r=-0.03$, $p=0.25$), or sex ($t=-0.11$, $p=0.91$).

Drug treatment considered generally problematic by the panel, clinical implications, and suggested treatment alterations are listed in table 1.

### Analysis of medication problems
Ten drug classes (therapeutic groups) accounted for about 75% of all identified problems (table 2). Antipsychotic drugs were the single group contributing most frequently to overall medication problems, and every second antipsychotic prescription was considered to represent an inappropriate choice of drug.

While safety issues accounted for 47% of all identified problems, every second problem was related to indication (28%) and effectiveness (25%) issues (table 3).

## DISCUSSION
### Main findings
A multidisciplinary review of medication was found to be a useful method for identifying potential clinically relevant drug problems in nursing home residents. Psychoactive drugs, particularly antipsychotics, accounted for most problems. Concerns were most commonly related to risk for adverse drug reactions, inappropriate drug choice, and probable undertreatment.

### Limitations of the study
The high participation rate of the invited nursing homes and almost complete data sets from each institution contributed to the internal validity of this study. Similar administration and admission policies throughout the country make us believe that the participating institutions in the Bergen district are comparable to Norwegian nursing homes in general.

On the other hand, the panel assessment of drug regimens relies on implicit clinical judgement which may reduce the external validity. The medication review addressed issues judged to be clinically relevant rather than all possible

**Table 2** The Bergen District Nursing Home (BEDNURS) study: the 10 drug classes (ATC therapeutic groups) most commonly involved in potential medication problems as identified by a multidisciplinary expert panel according to number and percentage of all drugs accounting for potential problems, and the three possible problems most frequently related to these drugs

| Drugs accounting for potential problems | | | Problem categories most frequently related to the drugs | | | | | |
|---|---|---|---|---|---|---|---|---|
| Therapeutic group | n | % | No. 1 problem | n | No. 2 problem | n | No. 3 problem | n |
| Antipsychotics | 406 | 15.0 | Choice of drug | 208 | Drug-drug interaction | 139 | Risk for ADR | 51 |
| ACE inhibitors | 336 | 12.5 | Need for additional drug | 284 | Dosage too low | 31 | Drug-drug interaction | 20 |
| Anxiolytics | 270 | 10.0 | Dosage too high | 101 | Risk for ADR | 78 | Drug-drug interaction | 59 |
| Antidepressants | 237 | 8.8 | Drug-drug interaction | 98 | Risk for ADR | 76 | Unnecessary drug | 31 |
| Loop diuretics | 187 | 6.9 | Choice of drug | 66 | Dosage too low | 52 | Dosage too high | 27 |
| Minerals | 128 | 4.7 | Need for additional test | 103 | Dosage too low | 14 | Drug-drug interaction | 9 |
| Hypnotics | 123 | 4.6 | Dosage too high | 50 | Risk for ADR | 54 | Unnecessary drug | 20 |
| Opioid analgesics | 122 | 4.5 | Risk for ADR | 100 | Drug-drug interaction | 19 | Dosage too low | 2 |
| NSAIDs | 105 | 3.9 | Risk for ADR | 62 | Drug-drug interaction | 43 | | |
| Antihistamines | 96 | 3.6 | Risk for ADR | 66 | Unnecessary drug | 22 | Wrong drug | 6 |
| Sum | 2010 | 74.5 | | | | | | |
| Others | 688 | 25.5 | | | | | | |
| Total | 2698 | 100 | | | | | | |

Note that one single problem may address several prescriptions, and that one single prescription may account for several problems.
ADR=adverse drug reaction; NSAID=non-steroidal anti-inflammatory drug.

**Table 3** The Bergen District Nursing Home (BEDNURS) study: potential medication problems (n=2445) identified by a multidisciplinary expert panel according to principal problem categories and the three drugs (therapeutic groups) most commonly involved.

| Assessment | | Drugs (therapeutic groups) most commonly involved in the problems listed | | | | | |
|---|---|---|---|---|---|---|---|
| Potential problem | n | No.1 drug | n | No.2 drug | n | No.3 drug | n |
| *Indication* | | | | | | | |
| Need for additional drug | 327 | ACE inhibitors | 284 | Antithrombotics | 19 | Vitamins (D vitamin) | 6 |
| Need for diagnostic test | 203 | Minerals (e.g. potassium)* | 103 | Anti-anaemia (iron)* | 53 | Anti-gout* | 17 |
| Unnecessary drug therapy | 159 | Antidepressants | 31 | Anxiolytics* | 31 | Antihistamines* | 23 |
| *Effectiveness* | | | | | | | |
| Choice of drug | 492 | Antipsychotics† | 208 | Loop-diuretics | 66 | Vitamins (C vitamin) | 53 |
| Dosage too low | 117 | Loop diuretics | 52 | ACE-inhibitors | 31 | Minerals (e.g. calcium) | 14 |
| *Safety* | | | | | | | |
| Dosage too high | 244 | Anxiolytics* | 101 | Hypnotics* | 50 | Systemic corticosteroids* | 38 |
| Risk of adverse drug reaction | 637 | Opioid analgesics | 100 | Anxiolytics‡ | 78 | Antidepressants | 76 |
| Drug-drug interaction | 266 | Antipsychotics§ | 139 | Antidepressants§ | 98 | Anxiolytics§ | 59 |
| Total | 2445 (100%) | | | | | | |

*Long term treatment.
†Prescribed for non-psychotic diagnosis/symptoms.
‡Long acting compounds.
§Drug-drug interactions most commonly with other psychoactive drugs.

problems; the validity of the methodology therefore relies on the issues examined. The inter-rater reliability of classifying identified problems into problem categories was considered good even if the studied sample was small.

The diagnoses recorded by the physicians probably reflect everyday practice in nursing homes. However, we were not able to assess the validity and completeness of the indications and co-morbid conditions. As a result we may, for example, have underestimated underuse of probably beneficial treatment.

Another limitation is that the medication problems identified were potential problems because health outcomes in terms of morbidity or mortality have not been studied here. The identified problems were fed back to the nursing home physicians but, unfortunately, we were not able to follow up the possible impact of this intervention.

### Implications and similar work

Although this study was performed in a nursing home setting, the identified medication problems may not be unique to nursing home residents but may be relevant for the frail elderly population in general.

We considered drugs known to cause delirium, cognitive deterioration, and excessive sedation, eventually leading to falls and fractures[35–38] to be generally problematic. Concerns were particularly related to the use of multiple psychoactive drugs and opioid analgesics which are associated with a greater risk for adverse drug reactions, exceeding the risks caused by the use of single drugs.[39] Studies indicate an extensive use of these drugs in nursing homes.[1 19 27 40–42] Our finding that psychoactive drugs, particularly antipsychotics, accounted for most identified problems underlines the fact that inappropriate drug use may both relate to quality (lack of recognised indication) and quantity (extensive treatment duration). For antipsychotics, major concerns relate to a limited efficacy for behavioural problems in demented subjects and the common and serious adverse drug reactions.[36 43] Multiple psychoactive drug use should cause particular concern because of frequent drug-drug interactions.[44]

The high prevalence of identified medication problems affecting most nursing home residents may to some extent reflect a lack of established standards for good prescribing practice in nursing homes. There are few treatment guidelines targeted towards geriatric patients and these are usually restricted to limited therapeutic problems or drugs.

In a recent US study a conservative estimate of the annual occurrence of overt adverse drug events per nursing home resident was 0.24, half of which were judged to be preventable.[12] The finding that one quarter of all identified problems were "risks for adverse drug reactions" underlines the great potential for quality improvement. Although the expert panel considered multiple drug regimens to be justified in a number of cases because of complex morbidity,[45] multiple drug use appeared to be a marker for inappropriate regimens in this vulnerable population. Polypharmacy—particularly when including drugs without an appropriate indication or multiple psychoactive drugs—is associated with increased morbidity and hospital admissions for adverse drug reactions in old people.[6 9 10]

On the other hand, underuse of probable beneficial drug treatment—particularly ACE inhibitors for heart failure—accounted for about one in eight of the problems identified. Others have also reported undertreatment of various chronic conditions in the elderly including cardiovascular disease, osteoporosis, pain, and depression.[46–48] In the difficult balance between benefits and risks caused by drug use in old age, inappropriate undertreatment should also be considered. We have explored problems related to psychoactive drug use and undertreatment of heart failure in nursing homes in more detail elsewhere.[41 49]

Most drug problems are probably created at the stage of drug ordination or monitoring. The responsibility for medication management in Norwegian nursing homes in general relies on part time employed physicians who may only visit the nursing home a few hours per week. They probably often prescribe based on information presented to them by the nurses in charge. This may contribute to different therapeutic cultures and explain some of the great variations in drug use observed between different nursing homes.[41] The high proportion of demented nursing home residents creates particular challenges for safe prescribing. Reduced verbal communication abilities represent major obstacles for the interpretation of clinical signs and symptoms related to drug treatment.

### Implications for improving the quality and safety of care

Multidisciplinary team assessment may be a valuable method for regular reviews of drug usage in the elderly. The list of most frequent problems could be used to trigger concerns about medication problems of frail elderly persons in various settings. Our findings have shown that there is significant potential for quality improvement in drug treatment in nursing homes. Lessons from this study have been fed back by the panellists to nursing home physicians during continuing medical education activities.

**Key messages**

- Clinically relevant medication problems were identified in three out of four elderly nursing home residents by a multidisciplinary team review.
- Psychoactive drugs, particularly antipsychotics, were the drugs most commonly considered problematic.
- Risk of adverse drug reactions, inappropriate drug choice, and probable undertreatment were the most significant drug related problems.

Various interventions to improve the quality of prescribing practice have been shown to be effective—for example, legislation, academic detailing, and multidisciplinary team interventions.[27 50–52] However, interventions directed towards potential problems still need to demonstrate effectiveness on "hard" health outcome data. Patient outcomes should therefore be addressed in future longitudinal studies.

## ACKNOWLEDGEMENTS

The authors gratefully acknowledge the collaboration with pharmacist Fernande Hodneland from the Pharmaceutical Advisory Service in the district, and would also like to thank physicians and nurses at the participating nursing homes for their help and enthusiasm in recording the data needed for this study.

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This project was supported by grants from the National Geriatric Program of Norway and the Norwegian National Health Association (Nasjonalforeningen for Folkehelsen).

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