Audits of medication use in Sydney nursing homes

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Abstract

Background: most nursing home residents take several different medications. Reports have shown considerable variation in the frequency and types of prescriptions between nursing homes and between countries.

Objective: to record the current pattern of medication use in Sydney nursing homes to allow comparison with patterns observed 5 and 10 years previously, and in other countries.

Methods: data were recorded from the medication cards and clinical files of all 3,054 residents in 50 nursing homes in the Central Sydney Health Area and were compared with data recorded in 1993 and 1998.

Results: the mean number of medications prescribed per resident in 2003 was 6.84, while the mean number consumed regularly (rather than ‘as necessary’) was 5.42. These numbers were higher than 5 and 10 years previously, though there had been reductions in use of diuretics, anticonvulsants, hypnotics and anxiolytics. There had been increased prescription of antidepressants, anti-diabetes drugs, calcium and (among women) thyroid hormones. Prescription rates for laxatives, cardiovascular medication and analgesics remained high.

Conclusions: the pattern of medication prescription has changed. This may be attributable to improved education of clinicians and nursing home staff, involvement of pharmacists and altered or increased prevalence of medical and mental disorders in nursing homes.

Keywords: nursing homes, medication, drug prescription, drug utilisation, survey, longitudinal studies, aged, pharmaco-epidemiology

Introduction

Ageing is associated with increased use of medication. A recent Swedish study reported the mean number of drugs taken at age 79–80 years was 4.0 (men) and 4.7 (women) [1]. Nursing home residents are prescribed more drugs than older people living in their own homes [2], and half take at least one inappropriate medication [3]. Studies have demonstrated that pharmacist input helps reduce medication use in nursing homes [4, 5]. Guidelines for achieving better use of medicines in Australian aged care facilities were launched in March 1997 [6].

Data concerning medication use in nursing homes in Central Sydney have been collected during three surveys, at 5 year intervals. A major aim was to compare frequency of
use of various medications with that in other countries and across time. Reports concerning prescriptions of psychotropic medication in these nursing homes have been published [7, 8] or are in press [9].

Method

Approval for the study was given by the Central Sydney Health Service Ethics Committee.

Between May and December 2003, a research nurse (S.D.) gathered data from all 51 nursing homes in the catchment area of Central Sydney Area Health Service. She recorded demographic details and extracted data concerning medication prescriptions for all residents (whatever their age) in the nursing homes at the time of the survey. Australian nursing homes used standardised medication cards, with p.r.n. (‘pro re nata’ or ‘as required’) medications listed separately from medications prescribed for regular use. Staff signed their initials on the cards every time they administered a medication. S.D. checked whether medications had been given as prescribed during the previous 2 weeks, and if the prescription was p.r.n., she noted the frequency of use. If it was given at least once daily for the prescribed period, it was regarded as a ‘regular’ prescription. During data entry, drugs were coded, based on the anatomical, therapeutic and chemical (ATC) classification system recommended by the WHO [10]. One small nursing home released only limited information, and therefore, data from that facility were not included in the tabulation of results.

In 1993, in one sector (A) of the Central Sydney Area, there were 47 nursing homes, but by 1998 only 39 were still open and in 2003 there were only 25 nursing homes in that sector. The survey in 2003 included these 25 and also the 26 in the other sectors (B and C) of the area (Figure 1). Many residents in nursing homes in one sector had lived in another sector or area before admission. Few of those residents in nursing homes in 2003 were resident in 1993. Nevertheless, comparisons of observations from the three surveys were considered warranted. Because of financial constraints, medication data from only the first 20 nursing homes visited in the first survey were entered for analysis; ratings of cognitive function {Mini Mental State Examination (MMSE) [11]} were available for the majority.

Although the selection of the 20 was not truly random, there was no identified evidence of selection bias. Data from 37 nursing homes surveyed in 1998 were included; two other homes declined full involvement in the survey. The classification of medications used in 1993 and 1998 was the MIMS (MediMedia Australia) system, which corresponds largely to the WHO’s ATC system and is used widely in Australia by health professionals. In other respects, the methodology for collection of data on medication use was the same for the three surveys.

The SAS procedure (General Linear Models) was used to model the effects of age, sex and the number of beds in nursing homes. The F statistic was used to determine the significance of each parameter. Chi-squared tests were used to examine associations where appropriate.

Results

The numbers, gender distribution and mean age of residents included in the three surveys are summarised in Table 1.

The mean total number of medications per resident in the various nursing homes varied, in 2003, from 4.45 to 11.37 (mean 6.84, SD 3.73 and confidence limits 6.78–7.05), and was more than 7.0 in half the nursing homes. The median number per resident was 5. When it was found (very uncommonly) that a drug had been prescribed to be given regularly but had not been given at all during the 4 weeks, it was excluded from the subject’s list of prescribed medications. The mean number of medications given regularly (i.e. not including p.r.n., but including those where some doses had been refused or omitted) varied from 3.34 to 7.52 (mean 5.42). There was no significant correlation between nursing home size and mean numbers of medications per resident.

Table 2 summarises the percentages of residents in 2003 (n = 3,054) who were prescribed medication (p.r.n. and/or regular), classified according to the ATC system. Medications in selected sub-classes are shown. For example, class A in the system (alimentary tract and metabolism) has 16 sub-classes, nine of them consisting of medications relating to functions or disorders of the alimentary tract. Drugs used in diabetes comprise sub-class A10, vitamins are in sub-class A11 and mineral supplements in A12. The latter is further sub-classified into calcium salts, potassium salts and other mineral supplements. Class B (blood and blood-forming organs) includes antithrombotic agents, antihaeomorphagics and anti-anaemic preparations.

Similar details were obtained in the previous two surveys, and some of these are summarised below to demonstrate differences and similarities between the three sets of data. In 1993, we observed (by reading nursing and other notes) that laxatives and certain analgesics were quite commonly administered (nurse-initiated) to residents without their being written up on medication sheets, whereas in 1998 and 2003, any administration of medication was required to be recorded on charts with medication orders signed by a doctor.

In 1998, p.r.n. medication was prescribed for 1410 (72%) of the residents. In 2003, at least one medication was prescribed p.r.n. for 2,064 residents (67.6%), and only 958
were prescribed medication to be taken regularly without any p.r.n. Of 20,891 prescriptions on the medication cards of 3,054 residents, 20.8% were p.r.n. Sixty-five percent of prescriptions for analgesics, 46.8% of prescriptions for respiratory conditions (most commonly obstructive airways disease) and 46.2% of prescriptions for laxatives were p.r.n. (Table 2). Almost 40% of medications prescribed for skin conditions were for p.r.n. use, and 20% of topical and anti-inflammatory products prescribed for joint and muscular pain were p.r.n. Over 95% of prescriptions for most other types of medication were for regular rather than p.r.n. use.

Details of interest in relation to medications prescribed in nursing homes are highlighted below. Development of new drugs and differences between the classification systems used in 1993/8 (MIMS) and 2003 (ATC) mean that comparisons should be interpreted with caution.

**Alimentary system medication**

In 1998, 62% of the residents and, in 2003, 59.6% were prescribed laxatives. The likelihood of being prescribed laxatives was shown to vary significantly between nursing homes, but age was still significant ($F = 1.33$, $P<0.05$) even after controlling for individual nursing home and number of beds.

The percentages of residents prescribed anti-ulcer drugs were similar in 1998 and 2003. In 2003, 25.3% of males and 18.4% of females were taking proton pump inhibitors regularly (chi-square $18.7$, $P<0.001$), while 11.2% of the males and 11.9% of female residents were prescribed H$_2$ receptor antagonists.

**Cardiovascular medications**

All surveys showed that cardiovascular medications were prescribed significantly more often for females than males. However, after controlling for age (and the fact that the older the resident the greater the likelihood of having cardiac problems), this gender difference was not significant. The percentage of residents taking diuretics progressively declined over the 10 years, from 33.6 to 25.4%. In 2003, 82% of prescriptions for diuretics (not including those in combined formulations) were for high-ceiling diuretics such as frusemide. The range of non-diuretic agents for treating hypertension differed between the survey periods, which may help explain the increase from about 24% of males and 31% of females taking them in 1998 to 33% males and 36% females in 2003. Approximately 19.7% of residents were taking ACE inhibitors in 2003.

In 1993, a higher percentage of residents who had little or no cognitive impairment ($n = 107$) than of those who scored in the cognitively impaired range ($n = 823$) on the MMSE were prescribed cardiovascular medication (72 versus $60%$; chi-square $= 6.03$, $P<0.05$).

**Endocrine medications**

At each survey, one quarter of antidiabetic drug prescriptions were for insulin. Thyroid or antithyroid medications were given to 4% of residents in 1993, 6.4% in 1998 (2.4% of males and 8.3% of the females) and 7.3% in 2003. Approximately 6.6% of residents were given thyroid hormones in 2003, with a significant difference between males (2.4%) and females (8.7%). Gender remained significant even after controlling for age and size of nursing home ($F = 51.73$, $P<0.0001$).

The percentage of people for whom calcium (some with vitamin D) was prescribed increased from 3% in 1998 to 10.5% in 2003, with a significant gender difference both times (7.6% males, 11.9% females in 2003).
Platelet aggregation inhibitors (among them low-dose Aspirin) were given regularly to 29.6% of residents in 2003.

**Analgesics**

The prescription rate for analgesics (excluding low-dose Aspirin and non-steroidal anti-inflammatory drugs such as indomethacin and celecoxib) remained high over the 10 years. In 2003, regular morphine, codeine or other opioids were prescribed for 3.7% of the residents. Salicylates were prescribed for 3.7% on a regular basis and almost none p.r.n., but anilides (most commonly paracetamol) were prescribed regularly for 15% and p.r.n. for 27%.

**Anticonvulsants**

In 1998, 22% of male and 14.3% of female residents took anticonvulsants. In 2003, the corresponding figures were 17.4 and 10.4%, the gender difference being age associated ($F = 5.06, P<0.0001$).

**Psychotropic medication**

Prescription rates of psychotropic medications in 1993, 1998 and 2003 have been compared elsewhere [9]. Hypnotic, anxiolytic and neuroleptic drugs were used less in 2003 than 5 and 10 years previously in Sydney nursing homes, regular dosages being prescribed for only 11.3, 4.1 and 23.6%, respectively. Antidepressants were prescribed more, with 11.4% taking selective serotonin reuptake inhibitors, 4.2% venlafaxine or mirtazapine and 4.9% another antidepressant. The ratio of atypical to conventional neuroleptic use changed from 1:8 in 1998 to 2:1 in 2003.

**Ocular medication**

Most of the medications prescribed for sensory organ conditions were for eye conditions, given regularly. Half were to treat glaucoma, the prescription rate for women being significantly greater than that for men (10.9 versus 8.2%; chi-square 4.99, $P<0.05$).

**Discussion**

The latest survey provides a cross-sectional view of the recent pattern of use of medication in nursing homes in Central Sydney, allowing comparison with data from other countries and demonstrating change in certain aspects. With development of new drugs and with new findings concerning optimal treatments, it is unsurprising that the pattern has changed.

The increase between the first two surveys in the number of prescribed medications is partly attributable to under-recording of nurse-initiated medication in 1993. The

<table>
<thead>
<tr>
<th>Class of medication</th>
<th>Number of residents (%)</th>
<th>Number of prescriptions</th>
<th>Prescriptions written 'PRN' (%)</th>
<th>Females (%)</th>
<th>Males (%)</th>
<th>Significance of gender difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Alimentary tract and metabolism (includes vitamins, minerals)</td>
<td>2554 (83.6)</td>
<td>5909</td>
<td>33.0</td>
<td>83.4</td>
<td>83.9</td>
<td>NS</td>
</tr>
<tr>
<td>A02. Drugs for acid-related disorders</td>
<td>1029 (33.7)</td>
<td>1085</td>
<td>6.6</td>
<td>31.9</td>
<td>37.7</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>A06. Laxatives</td>
<td>1819 (59.6)</td>
<td>2379</td>
<td>46.2</td>
<td>61.3</td>
<td>56.4</td>
<td>NS</td>
</tr>
<tr>
<td>A10. Drugs for diabetes (insulins, hypoglycaemics)</td>
<td>338 (11.1)</td>
<td>452</td>
<td>1.8</td>
<td>10.8</td>
<td>11.6</td>
<td>NS</td>
</tr>
<tr>
<td>A11C. Vitamin D and analogues (e.g. calcitriol)</td>
<td>330 (10.8)</td>
<td>334</td>
<td>0</td>
<td>12.6</td>
<td>7.6</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>A12A. Calcium salts (some with Vitamin D)</td>
<td>320 (10.5)</td>
<td>324</td>
<td>0</td>
<td>11.8</td>
<td>7.6</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>B. Blood-related</td>
<td>1418 (46.4)</td>
<td>1832</td>
<td>0.4</td>
<td>46.7</td>
<td>45.8</td>
<td>NS</td>
</tr>
<tr>
<td>B01. Antithrombotic (including low-dose Aspirin)</td>
<td>975 (31.9)</td>
<td>985</td>
<td>0.1</td>
<td>32.1</td>
<td>32.5</td>
<td>NS</td>
</tr>
<tr>
<td>B03. Anticoagulant</td>
<td>664 (21.7)</td>
<td>791</td>
<td>0</td>
<td>26.3</td>
<td>24.6</td>
<td>NS</td>
</tr>
<tr>
<td>C. Cardiovascular</td>
<td>1667 (54.6)</td>
<td>3234</td>
<td>4.2</td>
<td>56.5</td>
<td>50.5</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>C01AA. Digitalis glycosides</td>
<td>305 (10.0)</td>
<td>308</td>
<td>0</td>
<td>11.3</td>
<td>7.9</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>C03. Diuretics</td>
<td>712 (23.3)</td>
<td>766</td>
<td>0.4</td>
<td>25.0</td>
<td>20.0</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>C09BA, C09DA. Diuretic plus antihypertensive</td>
<td>63 (2.1)</td>
<td>63</td>
<td>0</td>
<td>2.1</td>
<td>2.0</td>
<td>NS</td>
</tr>
<tr>
<td>C02, 07, 08, 09. Antihypertensives, β-blockers, etc.</td>
<td>1061 (34.7)</td>
<td>1341</td>
<td>0</td>
<td>35.8</td>
<td>32.9</td>
<td>NS</td>
</tr>
<tr>
<td>D. Dermatologicals</td>
<td>447 (14.6)</td>
<td>575</td>
<td>39.6</td>
<td>14.9</td>
<td>14.0</td>
<td>NS</td>
</tr>
<tr>
<td>G. Genitourinary and sex hormones</td>
<td>211 (6.9)</td>
<td>227</td>
<td>7.0</td>
<td>7.4</td>
<td>6.0</td>
<td>NS</td>
</tr>
<tr>
<td>H. Systemic hormones</td>
<td>344 (11.3)</td>
<td>380</td>
<td>4.6</td>
<td>13.7</td>
<td>6.3</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>H02AB. Glucocorticoids</td>
<td>107 (3.5)</td>
<td>113</td>
<td>0</td>
<td>3.9</td>
<td>2.8</td>
<td>NS</td>
</tr>
<tr>
<td>H03AA. Thyroid hormones</td>
<td>203 (6.6)</td>
<td>217</td>
<td>0</td>
<td>8.7</td>
<td>2.4</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>J. Systemic anti-infectives</td>
<td>425 (13.9)</td>
<td>534</td>
<td>0.7</td>
<td>14.3</td>
<td>12.7</td>
<td>NS</td>
</tr>
<tr>
<td>L. Antineoplastic and immunomodulating</td>
<td>149 (4.9)</td>
<td>153</td>
<td>0.7</td>
<td>4.1</td>
<td>6.4</td>
<td>NS</td>
</tr>
<tr>
<td>M. Musculoskeletal</td>
<td>557 (18.2)</td>
<td>658</td>
<td>11.4</td>
<td>18.5</td>
<td>17.6</td>
<td>NS</td>
</tr>
<tr>
<td>N. Nervous system</td>
<td>2584 (84.6)</td>
<td>5612</td>
<td>46.9</td>
<td>85.0</td>
<td>83.5</td>
<td>NS</td>
</tr>
<tr>
<td>N02. Analgesics</td>
<td>1942 (63.6)</td>
<td>2335</td>
<td>65.0</td>
<td>66.7</td>
<td>57.6</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>N03. Anti-epileptics</td>
<td>387 (12.7)</td>
<td>492</td>
<td>0.6</td>
<td>10.4</td>
<td>17.4</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>N04. Antiparkinson</td>
<td>224 (7.3)</td>
<td>301</td>
<td>1.8</td>
<td>6.7</td>
<td>8.7</td>
<td>NS</td>
</tr>
<tr>
<td>N05. 06. Psychotropic</td>
<td>1645 (53.9)</td>
<td>2473</td>
<td>21.5</td>
<td>53.1</td>
<td>55.1</td>
<td>NS</td>
</tr>
<tr>
<td>P. Antiparasitic (etc)</td>
<td>7 (0.2)</td>
<td>7</td>
<td>0</td>
<td>0.2</td>
<td>0.3</td>
<td>NS</td>
</tr>
<tr>
<td>R. Respiratory</td>
<td>530 (17.4)</td>
<td>955</td>
<td>46.6</td>
<td>16.7</td>
<td>18.6</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>S. Sensory organs</td>
<td>560 (18.3)</td>
<td>751</td>
<td>8.1</td>
<td>19.1</td>
<td>16.6</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>V. Various, others</td>
<td>107 (3.5)</td>
<td>109</td>
<td>3.5</td>
<td>4.2</td>
<td>2.9</td>
<td>NS</td>
</tr>
</tbody>
</table>
increase between 1998 and 2003 may partly be explained by the increased mean age (Table 1) and associated change in disability level of the resident population, but may also be partly attributable to increased use of multiple medications when treating cardiovascular illnesses and some other conditions. Recent reductions in prescription of psychotropic medication have been balanced by increases in use of certain other medications, including drugs for osteoporosis and thyroid disorders.

Comparisons must be interpreted with caution. Nursing homes closed and even in those where the survey was repeated the resident populations and staff changed over time. Half the nursing homes included in the 2003 survey had not been included previously. Despite this, comparisons (many not shown here) between results of the three surveys showed similarities that confirm the validity of the 2003 findings. Comparable findings from another Australian study in 1994 concerning the mean number of drugs taken by residents, and the percentages of various medications that were prescribed p.r.n., were reassuring [12]. Differences between these data and those reported from other countries will thus be of interest, especially when speculating on reasons for changes in frequency of use.

Prescription rates vary between countries and are affected by various factors. For example, in Bergen (Norway), the median number of drugs per resident was 4 [13], and in London, the mean number of regular medications was 5.1 [14]. Physicians in the United States were reported as prescribing an average of 7.2 drugs per resident [15]. Over 40% of prescriptions in the US nursing homes were for p.r.n. medication [16], whereas in the latest Sydney survey, 21% of nursing home prescriptions were p.r.n. The key determinant for whether residents are prescribed p.r.n. medication has been reported as the specific nursing home in which the resident lives [17]. Advice from pharmacists to nursing home staff and doctors has been shown to lead to reductions in medication use [5, 18]. Such advice was increasingly available in Sydney between 1993 and 2003, but data to explore this association were not obtained in this study.

‘Mentally intact’ residents have been shown to consume more drugs than those with cognitive impairment [13]. Residents with a diagnosis of dementia have been reported as less likely to receive cardiovascular medications [19], a finding replicated in our 1993 survey. They are also less likely to be given analgesic medication [20].

Several confounders should be considered when comparing patterns of use across time and in different nursing homes and different jurisdictions. Significant gender differences in medication use have been identified in the present study, but these need to be considered in relation to differences in the mean ages of male and female residents. To a large extent, age explains the higher use of cardiovascular medications in females. The 3.5-fold higher percentage use of thyroid medication among females shown in successive surveys was not an age effect and presumably is because females are more likely to have thyroid disorders.

Differences between countries may be attributable to differing admission policies, nursing home standards, involvement of specialists, availability of pharmacy advice, cost of drugs, quality improvement strategies, education of staff and various other factors. Noting differences with regard to patterns of use of different drugs and classes of medication and administrative practices will help provoke ideas on whether and how to seek change. Although the latest survey in Central Sydney did not show a drop in the mean number of drugs prescribed per resident, the involvement of pharmacists in reviewing medication use and improved education of staff may have contributed to changes in the way psychotropic medications and antihypertensive medications are prescribed in nursing homes.

Limitations of this study include that the nursing homes were all in a central part of a big city and that in 1998 and 2003 the residents themselves were not examined by research staff. Strengths include that the latest survey allows comparison with findings from two earlier surveys and that all nursing homes in the area were willing to provide access to medication cards and files.

Key points
- Audits of medication use in nursing homes reveal increasing prescription rates.
- Prescription rates vary considerably between nursing homes.
- Increased use may be attributable to increased use of multiple medications when treating cardiovascular disorders, as well as the increasing mean age and medical morbidity of residents.
- The classes of medication administered most commonly to Sydney nursing home residents in 2003 were laxatives, antithrombotic agents, analgesics and drugs for acid-related disorders.

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Conflict of interest

Professor Snowdon is a member of the Janssen-Cilag Australian Advisory Board on use of medication in treating people with dementia and has received funding for his attendance at meetings and has been an investigator in studies sponsored by Janssen-Cilag. He has also received financial support for involvement in or speaking at educational meetings from Eli Lilly, Lundbeck, Wyeth, Organon, GlaxoSmith Kline, Novartis, Pharmacia and other pharmaceutical companies.
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