

Clinical Investigation

Prevalence of and Factors Associated with Potentially Inappropriate Prescribing in Long-Term Care Facilities

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Background: The authors studied the prevalence and predictors of potentially inappropriate prescribing of common medications in the long-term care setting, using the pharmacy database as the primary source of information.

Methods: The Shoppers Drug Mart prescription database for 12,424 elderly residents in 169 long-term care facilities in Ontario was modified by assigning unique confidential identifiers to individual residents, physicians, and facilities, and by adding additional descriptors of physicians and facilities obtained from other sources. 4 types of potentially inappropriate prescribing were evaluated in this study: 1) daily or as needed prescription of any long half-life benzodiazepine; 2) daily use of a potent anticholinergic medication prescribed concurrently with a neuroleptic medication; 3) prescription of a tricyclic antidepressant with active metabolites (amitriptyline, doxepin, imipramine); 4) daily use of a traditional non-steroidal anti-inflammatory (NSAID) medication for more than 3 months without gastric protection. Linear regression techniques were carried out to determine predictors of potentially inappropriate prescribing.

Results: 13.6% of residents received at least 1 of the 4 potentially inappropriate medications examined in this study. 2.7% received long half-life benzodiazepines, 1.8% received anticholinergic medications for neuroleptic side-effects, 7.1% received tricyclic antidepressants with active metabolites (7.1%), while 3.9% received NSAIDs without cytoprotection. In univariable analysis, potentially inappropriate prescribing was less common in older residents ($P=.002$), for those with fewer daily medications ($P=.004$), in smaller facilities ($P=.017$), within the catchment area of a regional geriatric program ($P=.012$), with female physicians ($P=.036$), and with physicians with College of Family Physicians of Canada (CFPC) certification ($P=.002$). In mul-

tivariable analysis, the associations with resident age ($P=.003$), number of daily medications ($P<.001$), and physician CFPC certification ($P=.013$) remained significant.

Conclusions: Potentially inappropriate prescribing in long-term care facilities in Ontario is common. Pharmacy databases represent a valuable tool for assessing medication use in long-term care facilities.

Key words: Long-term care, elderly, common medications, inappropriate prescribing

INTRODUCTION

The majority of nursing home residents are elderly, and most have several medical conditions requiring pharmacologic therapy. The average nursing home resident is prescribed more than 8 medications concurrently, and is hence at high risk for drug-drug interactions.^{1,2} Gurwitz et al³ have recently documented a 30% annual incidence rate for adverse drug events in residents in long-term care settings in the United States; the majority of these adverse drug events involved commonly prescribed medications, and were felt to be predictable and preventable. Lazarou et al⁴ have similarly suggested that fatal adverse drug events represented the fourth leading cause of death in the United States in 1994, and that the vast majority of these fatalities occurred in the elderly with the use of commonly prescribed medications, such as sedatives, antidepressants, NSAIDs, narcotics, cardiovascular and hypoglycemic medications.

Consensus statements regarding the appropriate

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use of commonly prescribed medications in the elderly have recently been developed in both the United States and Canada.^{5,6} Simple methods for applying these prescribing guidelines in academic acute care and long-term care settings in Canada have recently been published.^{7,8} As well, Davidson et al⁹ have described several physician factors associated with potentially inappropriate prescribing in community dwelling elderly patients in New Brunswick. The prevalence of, and factors associated with, potentially inappropriate prescribing in non-academic long-term care facilities cannot be derived from these studies.

We investigated the prevalence of potentially inappropriate prescribing in non-academic long-term care facilities in Ontario, and physician, facility, and resident characteristics that may be associated with potentially inappropriate prescribing. Additionally, this study was undertaken to determine the feasibility of using the pharmacy database of the long-term care facilities as the primary source of information for such a study.

METHODS

This study was undertaken as part of a larger research collaboration (entitled *Improving Medication Use in the Elderly*) involving Shoppers Drug Mart Canada, the Southwestern Ontario Regional Geriatric Program and the University of Western Ontario Department of Geriatric Medicine. The study design was approved by the University of Western Ontario research ethics review board. The Shoppers Drug Mart database (extraction November 1998) serving 169 long-term care facilities in Ontario was modified to become a statistical database. To preserve confidentiality, unique identifiers were assigned to individual residents, physicians and facilities. The 169 long-term care facilities included 80 nursing homes (non-profit facilities providing 2 to 4 hours a day of skilled nursing care), 68 retirement homes (for-profit facilities providing meals in a dining-room, medication administration, and generally less than 1 hour a day of skilled nursing care), and 21 homes for the aged (non-profit facilities that provide both nursing home and retirement home levels of care). Resident information available included name, age, sex and prescribed medications (name, frequency, dosage and route of administration), the prescribing physician, and the name, size (number of beds)

and type (nursing home, retirement home, or home for the aged) of the long-term care facility. Information describing physicians and facilities were contained in separate files. The 1998 Canadian Medical Directory was used to determine physicians' graduation year, College of Family Physicians of Canada certification and sex. The Ontario Medical Association Section on Geriatrics provided a list of all Ontario physicians who identified geriatrics as their primary or secondary section in 1998. Long-term care facilities provided the name of their medical director (house physician). Maps provided by the Regional Geriatric Programs of Ontario of their catchment areas were used to determine whether particular long-term care facilities were located within the catchment area of a regional geriatric program. Shoppers Drug Mart provided the number of hours per month for the previous 3 months of in-person pharmacist consultation for each facility regarding medication issues. The blinded data was transferred to the University of Western Ontario Division of Geriatric Medicine for analysis.

The investigators reviewed two consensus papers^{5,6} and agreed upon four examples of potentially inappropriate prescribing that could be assessed within the study design. Many examples of potentially inappropriate prescribing in the elderly are diagnosis specific, such as the prescription of a systemic beta-adrenergic antagonist to a patient with a history of asthma; such examples could not be assessed in the current study, given the lack of clinical data in the database.

Three of the potentially inappropriate prescriptions identified were: regular or as needed prescription of any long half-life benzodiazepine, regular use of potent anticholinergic medications concurrently with regular neuroleptic drugs, and the regular prescription of tricyclic antidepressants with active metabolites. All of the above examples were noted in the McLeod et al⁵ guidelines for prescribing in the elderly. For the purposes of this study, chlordiazepoxide, clorazepate, diazepam, flurazepam, and nitrazepam were considered long half-life benzodiazepines, benzotropine and trihexyphenidyl were considered potent anticholinergics, and amitriptyline, doxepin, trimipramine, amoxapine and imipramine were considered tricyclic antidepressants with active metabolites. The fourth example of potentially inappropriate prescribing chosen was the regular use of NSAIDs for

more than 3 months without gastric protection, which was defined as the concurrent use of misoprostol. Use of the NSAID for >3 months was documented by review of the pharmacy administration database for 3 months prior to the extraction date. Acetylsalicylic acid (ASA), enteric-coated or plain, was treated as a NSAID only if the daily dose was >325 mg. At the time this study was undertaken, selective COX-2 inhibitors were not available in Ontario; similarly, there was no evidence at that time that H₂-receptor antagonists, such as ranitidine, or proton pump inhibitors, such as omeprazole, were effective in preventing NSAID-associated gastrointestinal bleeding. Several recent studies have documented both the higher risk for gastrointestinal bleeding with NSAID therapy in older patients, and the efficacy of cytoprotection with all of the above-mentioned agents.¹⁰⁻¹⁴

Analysis

Summary statistics were calculated at the resident, facility and physician level. The analysis was limited to residents ≥65 years old in retirement homes, nursing homes and homes for the aged (n=12,424). This analysis excluded four facilities that had combination bed types of either nursing home/home for the aged beds or nursing home/retirement home beds.

We were interested in making inferences at the

facility level. This is an appropriate level of analysis, because indicators of quality of care are often presented at the facility level, and this provides a manageable focus for interventions that may be used to improve prescribing practices or other aspects of care. To allow inferences at the facility level, adjustments for physician and resident characteristics were made by creating summary variables (averages in each facility) for both sets of characteristics. All analyses were then performed at the facility level,¹⁵ using a file containing the aggregated data. This type of analysis controls for any potential clustering effect, in which there may be greater similarity of prescribing patterns within facilities compared to prescribing patterns across facilities.

Univariable linear regression was used to identify factors associated with potentially inappropriate prescribing. Factors associated with potentially inappropriate prescribing at a significance level of $P < .05$ were forced into a multiple linear regression analysis model. The primary outcome for these analyses was the frequency of potentially inappropriate prescribing.

RESULTS

As shown in Table 1, residents were predominantly female, average age 84.2 years, and most resided in nursing homes. On average, residents were taking 6.3 daily medications and 2.8 as-needed med-

Table 1. Resident characteristics*

| | Total (n=12,424) | No potentially inappropriate prescriptions (n=10,734) | One or more potentially inappropriate prescription (n=1,690) |
|---------------------------------------|------------------------------|---|--|
| Age | 84.2 ± 7.6 (range 65-112) | 84.5 ± 7.5 (range 65-112) | 82.5 ± 7.8 (range 65-102) |
| Sex | 75.8% female | 77.4% female | 75.2% female |
| Facility Type | | | |
| nursing home | 56.3% | 57.2% | 50.7% |
| home for the aged | 21.6% | 21.1% | 24.8% |
| retirement home | 22.1% | 21.7% | 24.6% |
| Total no. of medications | 9.0 ± 4.8 (range 0-38) | 8.7 ± 4.7 (range 0-27) | 11.4 ± 4.9 (range 2-38) |
| No. of regular (daily) medications | 6.3 ± 3.6 (range 0-29) | 6.0 ± 3.6 (range 0-27) | 8.1 ± 3.7 (range 0-29) |
| No. of as-needed (prn) medications | 2.8 ± 2.3 (range 0-17) | 2.7 ± 2.2 (range 0-17) | 3.3 ± 2.4 (range 0-17) |

*Unless otherwise stated, numbers represent mean ± standard deviation.

ications for a total of nine medications. Table 2 demonstrates the heterogeneity of the facilities involved, especially with regards to number of beds, number of prescribing physicians, and the amount of pharmacist time consulting with facilities. Physician characteristics are described in Table 3.

Potentially inappropriate prescriptions were noted in 164 of the 169 facilities studied (97%). As shown in Table 4, 13.6% of all residents received at least one of the four potentially inappropriate prescriptions examined in this study, with 1.8% of all residents simultaneously receiving two, three or four potentially inappropriate prescriptions. Table 5 shows the frequency of potentially inappropriate prescriptions by type, and illustrates the four-fold variation in the likelihood of a resident receiving a tricyclic antidepressant with active metabolites (7.1%) versus a potent anticholinergic medication to reduce neuroleptic side-effects (1.8%).

Bivariable analysis (Table 6) reveals that potentially inappropriate prescribing within facilities was less common in older residents ($P=.002$), on fewer daily medications ($P=.004$), in smaller facilities ($P=.017$) within the catchment area of a regional geriatric program ($P=.012$), with female physicians ($P=.036$), and with physicians with College of Family Physicians of Canada (CFPC) certification ($P=.002$). A *post hoc* analysis revealed that potentially inappropriate prescribing was less common in nursing homes than in retirement homes or homes for the aged ($P=.047$). In multi-

Table 2. Facility characteristics (n=169)*

| | |
|--|------------------------------|
| Facility Type | |
| nursing home | 80 (47.3%) |
| retirement home | 68 (40.2%) |
| home for the aged | 21 (12.4%) |
| No. of beds | 83.3 ± 63.8 (range 3-360) |
| Facility is within a Regional Geriatric Program catchment area | 55.0 % |
| No. of prescribing physicians per facility | 12.8 ± 10.6 (range 1-51) |
| Number of minutes of pharmacist consultation per bed per facility per month (range 0.9-76.7) | 10.6 ± 11.1 |

*Unless otherwise stated, numbers represent mean ± standard deviation.

Table 3. Physician characteristics (n=1,489)*

| | |
|---|--|
| Sex | 80.7% male |
| Medical director (house physician) for the facility | 10.3% |
| CFPC Certification | 40.1% |
| Year of medical school graduation | 1975 ± 11.1 years (range 1940-1996) |
| Primary or secondary membership in Ontario Medical Association Geriatrics Section | 26.6% |

*Unless otherwise stated, numbers represent mean ± standard deviation.

variable analysis, the associations with resident age ($P=.003$), number of daily medications ($P<.001$), and physician CFPC certification ($P=.013$) remained statistically significant (Table 7).

DISCUSSION

There are several limitations to the current study. The current database provides information for the 25% of long-term care facilities in Ontario whose medications are provided through Shoppers Drug Mart. Although the distribution of facility type, resident sex and resident age in our study is similar to that of Ontario’s long-term care population as a whole (data not shown), our findings may not be generalizable to other long-term care facilities in Ontario. Hogan, Ebly and Fung have previously documented large regional variations in the use of potentially inappropriate medications in Canadian seniors;¹⁶ hence, our findings may not be general-

Table 4. Number of residents with potentially inappropriate prescriptions

| | |
|---|--------------------------------|
| | No. of Residents (n=12,424) |
| No potentially inappropriate prescription | 10,734 (86.4%) |
| 1 potentially inappropriate prescription | 1,475 (11.9%) |
| 2 potentially inappropriate prescriptions | 194 (1.6%) |
| 3 potentially inappropriate prescriptions | 20 (0.2%) |
| 4 potentially inappropriate prescriptions | 1 (0.0%) |
| 1 or more potentially inappropriate prescriptions | 1,690 (13.6%) |

Table 5. Potentially inappropriate prescriptions by type

| | No. of Residents (% of total) |
|--|----------------------------------|
| Daily or as-needed prescription of any long half-life benzodiazepine (chlordiazepoxide, clonazepam, diazepam, flurazepam, or nitrazepam) | 338 (2.7%) |
| Daily use of a potent anticholinergic medication prescribed concurrently with a neuroleptic medication | 222 (1.8%) |
| Daily use of a traditional non-steroidal anti-inflammatory medication for more than 3 months without gastric protection | 479 (3.9%) |
| Daily prescription of highly anticholinergic tricyclic antidepressant (amitriptyline, doxepin, trimipramine, imipramine) | 888 (7.1%) |

Table 6. Association of resident, facility and physician-related variables with potentially inappropriate prescribing – Univariable analysis

| Variable | St. Beta | P-value | Comment |
|---|----------|---------|---|
| Resident age | -.242 | .002 | Younger patients more likely to have potentially inappropriate prescriptions |
| Male vs female resident | -.027 | .732 | |
| Total no. of medications | .127 | .099 | |
| No. of regular meds | .223 | .004 | Potentially inappropriate prescriptions are more common in patients on a larger number of regularly administered medications |
| No. of prn medications | -.023 | .765 | |
| Facility in Regional Geriatric Program catchment area (vs not) | -.194 | .012 | Potentially inappropriate prescriptions are less common in areas where regional geriatric services are provided |
| No. of prescribing physicians per facility | .001 | .987 | |
| No. of beds per facility | -.183 | .017 | Potentially inappropriate prescriptions are more common in smaller facilities |
| Facility type (retirement home vs nursing home vs home for the aged)‡ | F = 3.11 | .047 | Potentially inappropriate prescriptions are less common in nursing homes than in retirement homes or homes for the aged |
| No. of minutes pharmacist consults per bed per month | -.022 | .817 | |
| Physician graduation year | -.050 | .521 | |
| House physician (vs not) | .039 | .618 | |
| CFPC certification (vs not) | -.236 | .002 | Potentially inappropriate prescriptions are less common if the physician is certified by the College of Family Physicians of Canada |
| Physician is member of Ontario Medical Association Section on Geriatrics (vs not) | -.093 | .231 | |
| Male physician (vs female) | .161 | .036 | Potentially inappropriate prescriptions are less common with female physicians |

‡ One-way Anova (*post hoc* test)

izable to other Canadian long-term care facilities, either. Additional studies of this type in other regions would be helpful in this regard.

The database used here does not contain clinical information for long-term care residents relating to medical diagnoses, current behavioural distur-

bance, the presence of depression, sleep disturbance, or pain. This may explain, in part, the small proportion of the variance in potentially inappropriate prescribing explained by the model. Such information is crucial for determining the appropriateness of both medications that have, as well as

Table 7. Multiple Linear Regression including variables significant at $P < .05$ in univariable analysis

| Variable | St. Beta | P-value |
|---|----------|---------|
| Resident age | -.226 | .003 |
| No. of regular medications | .273 | .000 |
| Facility in RGP catchment area (vs those not) | -.113 | .115 |
| No. of beds per facility | -.093 | .251 |
| CFPC certification (vs not certified) | -.184 | .013 |
| Male physician (vs female) | .123 | .098 |
| Retirement home (vs nursing home) | .088 | .266 |
| Home for aged (versus nursing home) | .113 | .143 |

$R^2 = .237$; Adjusted $R^2 = .199$, $P < .001$

those that have not been prescribed, eg. preventive therapy for osteoporosis. Recent medication changes were not assessed in the current study; it is possible that more appropriate alternatives (such as acetaminophen before NSAIDs for pain, or shorter-acting benzodiazepines before long-acting benzodiazepines) may have already been tried and found to be ineffective. Most importantly, the database used here was not linked to other databases such that the associations between drug therapy and resident outcomes could be determined. Proof that potentially inappropriate prescribing is associated with poor outcomes is scant, but does exist for anticholinergic and psychotropic medications.^{17,18} In contrast, there is ample evidence that physician prescribing behaviours can be favourably modified through education, pharmacist consultation, confidential feedback, or computerized utilization review, once a desired prescribing pattern has been identified.^{8,19-29}

It is difficult to compare the prevalence of potentially inappropriate prescribing found in the current study with previous studies in the long-term care setting, because we limited our study to four commonly prescribed classes of medications. Mort and Aparasu³⁰ recently found that the potentially inappropriate prescriptions assessed in our current study accounted for the majority of all potentially inappropriate prescriptions in an ambulatory elderly population. The prevalence of potentially inappropriate prescribing noted in our study (13.6%) is consistent with prevalence rates found (12-40%) in several recent studies in the long-term care setting.^{6,8,31,32}

The association noted between potentially inappropriate prescribing and number of daily medica-

tions is consistent with several previous studies.⁶⁻⁸ The inverse association between age and potentially inappropriate prescribing has not been noted previously, as other studies have found either no association between patient age and potentially inappropriate prescribing,⁸ or have found an increasing likelihood of potentially inappropriate prescribing with increasing patient age.³⁰ Given the large amount of variance in the multivariable model that is accounted for by resident age, this association warrants further investigation.

The association between CFPC certification of the prescribing physician and the lower likelihood of potentially inappropriate prescribing suggests that more extensive post-graduate training is associated with more appropriate prescribing. Davidson and Molloy⁹ found no association between patient mortality, morbidity and hip fractures and CFPC certification of the prescribing physician, but did find that CFPC certificants were likely to prescribe more medications for their elderly patients than primary care physicians without CFPC certification. CFPC certification only became available in 1969, and over 30% of the prescribing physicians included in the current study graduated prior to 1969. It is possible that the association between CFPC certification and potentially inappropriate prescribing is confounded by physician age, which certainly warrants further investigation.

Finally, this study demonstrates that it is quite feasible to use pharmacy databases as a major source of information for investigating medication use in the elderly. The advantages of a pharmacy database over many of the provincial drug benefit databases are the inclusion of all medications in the database (including simple analgesics such as acetaminophen, laxatives, and over-the-counter medications), and the ability to distinguish between regular and as-needed medications.³³ Electronic linkage of pharmacy databases to physician, hospital, and other health-care databases represents a powerful methodology for future outcomes-oriented research focused upon medication use in the elderly.³³

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