

# Inappropriate Prescribing for Elderly Americans in a Large Outpatient Population

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**Background:** We sought to determine the extent of potentially inappropriate outpatient prescribing for elderly patients, as defined by the Beers revised list of drugs to be avoided in elderly populations.

**Methods:** We conducted a retrospective cohort study using the outpatient prescription claims database of a large, national pharmaceutical benefit manager. The cohort included 765 423 subjects 65 years or older, who were covered by a pharmaceutical benefit manager and filed 1 or more prescription drug claims during 1999. Main outcome measures were the proportion of subjects who filled a prescription for 1 or more drugs of concern and the proportion of subjects who filled prescriptions for 2 or more of the drugs.

**Results:** A total of 162 370 subjects (21%) filled a pre-

scription for 1 or more drugs of concern. Amitriptyline and doxepin accounted for 23% of all claims for Beers list drugs, and 51% of those claims were for drugs with the potential for severe adverse effects. More than 15% of subjects filled prescriptions for 2 drugs of concern, and 4% filled prescriptions for 3 or more of the drugs within the same year. The most commonly prescribed classes were psychotropic drugs and neuromuscular agents.

**Conclusions:** The common use of potentially inappropriate drugs should serve as a reminder to monitor their use closely. Pharmaceutical claims databases can be important tools for accomplishing this task, though clinical and laboratory data are needed to improve the sensitivity and specificity of patient-specific alerts.

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**P**ERSONS 65 YEARS OR OLDER make up less than 15% of the US population but account for nearly one third of prescription drug consumption.<sup>1</sup> Elderly persons are more likely to have more than 1 chronic disease or condition, further increasing the likelihood that they take several drugs concurrently.<sup>2</sup> Most prescription drugs, when dosed and taken appropriately, have considerable potential to reduce morbidity and mortality and improve functioning. The potential benefits must be weighed, how-

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ever, against the substantial risk of adverse effects that increases with age.<sup>3-5</sup> The increased risk reflects changes in metabolism and excretion that occur with aging and is compounded by the number of prescription drugs taken.<sup>6</sup>

Improving medication safety requires that potentially dangerous prescribing patterns be detected quickly. Online,

computerized systems that support pharmaceutical benefit manager (PBM) databases can provide that mechanism. Currently, elderly patients have limited access to PBM services, typically through retirement benefits and selected self-pay prescription insurance programs. Several researchers have suggested, however, that PBMs should be used to administer a Medicare prescription drug program, in the event that one is created.<sup>7,8</sup>

In 1991, Beers et al<sup>9</sup> published criteria for determining the appropriateness of medication use in nursing home residents. Although developed originally for use in an institutional setting, the criteria have since been applied in a variety of settings.<sup>10-16</sup> More recently, Beers<sup>17</sup> compiled an updated list of criteria defining medications that generally should be avoided in elderly patients, regardless of setting. Using a Delphi technique with a panel of 6 nationally recognized experts in gerontological therapeutics, Beers developed the revised criteria, naming 28 medications or classes of medications as inappropriate for use in elderly patients.

**Table 1. Subject Characteristics\***

Characteristic	All Subjects (N = 765 423)	Subjects With $\geq 1$ Claim for a Beers List <sup>17</sup> Drug (n = 162 370)
Age, mean $\pm$ SD, y	73.7 $\pm$ 6.5	73.8 $\pm$ 6.5
Female	446 161 (58.3)	106 632 (65.7)
Geographic region†		
Northeast	147 048 (19.2)	23 485 (14.5)
Midwest	173 550 (22.7)	34 002 (20.9)
South	245 396 (32.1)	61 353 (37.8)
West	121 355 (15.9)	25 003 (15.4)
Other	78 074 (10.2)	18 527 (11.4)

\*Values are number (percentage) unless otherwise indicated.

†Northeast region includes Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont. Midwest region includes Iowa, Indiana, Illinois, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. South region includes Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia. West region includes Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. Other indicates Puerto Rico, Virgin Islands, Guam, and not available.

Adverse outcomes of 14 of the 28 medications were deemed to be potentially severe. Severity was defined conceptually with respect to the likelihood of an adverse outcome occurring and the clinical significance of the outcome should it occur.<sup>17</sup> In addition, the panel identified 35 drugs or classes of drugs inappropriate for use in elderly persons with certain medical conditions.

Taking advantage of a large, national sample of prescription drug claims for commercially insured elderly patients, the objective of the present study was to document the extent of potentially inappropriate outpatient prescribing for elderly Americans using the Beers revised list of medications that generally should be avoided in elderly patients. In addition, we discuss how online, computerized systems may be used to further our understanding of the risks and benefits associated with the drugs.

## METHODS

### STUDY POPULATION AND DATA SOURCES

We accessed the outpatient prescription claims database of AdvancePCS (Irving, Tex, and Scottsdale, Ariz), the largest PBM in the United States. Health insurance carriers contract with AdvancePCS to manage their formularies and adjudicate their prescription drug claims. AdvancePCS maintains a computerized pharmacy system that records data on each prescription drug dispensed to its beneficiaries, whether through a retail or mail-order pharmacy. More than 98% of the prescription drug claims are submitted and processed electronically at the time the prescriptions are filled (A.W., personal observation, August 27, 2001).

The analysis was limited to subjects whose health plans or insurance carriers required AdvancePCS to track claims for individual beneficiaries. Subjects with the same identifier for multiple family members were excluded. Also excluded were subjects younger than 65 years as of January 1, 1999. The analysis data set included all prescription drug claims adjudicated

for 765 423 elderly subjects who were continuously enrolled during calendar year 1999 and who filed 1 or more prescription drug claims during that period. All claims relating to the same individual were linked using a unique beneficiary identifier (encrypted to ensure confidentiality for the present study). A total of 1171 health insurance carriers were represented in the data, covering all 50 states, as well as US territories.

The research team oversaw study design and data analysis, but to ensure subject confidentiality, individual-level data were analyzed in the research division of AdvancePCS (Scottsdale, Ariz), and only aggregate data in tabular form were provided to the research team. Subject-specific data were not released to the research team. The data analysis protocol was approved by the institutional review boards of Duke University Medical Center, Durham, NC, and Georgetown University Medical Center, Washington, DC. Under a single-project assurance, the institutional review board of Georgetown University Medical Center served as the institutional review board for AdvancePCS.

## DATA ANALYSIS

We based our analyses on the updated list of medications and medication classes deemed by Beers<sup>17</sup> to be inappropriate for use in elderly patients. Because the AdvancePCS prescription claims database does not routinely capture detailed information regarding daily dosage and coexisting medical conditions, we limited our analysis to the 18 medications or medication classes that the consensus panel recommended that physicians avoid at any dose or frequency in elderly patients. Micromedex and MEDLINEplus were used to determine the therapeutic category of each drug.

The primary outcome was the proportion of subjects who filled a prescription for 1 or more of the listed drugs during 1999. The secondary outcome was the proportion of subjects who filled prescriptions for 2 or more drugs on the list during 1999. To test for differences between all beneficiaries in the study population and those with claims for drugs on the Beers list, we used *t* tests for continuous variables and  $\chi^2$  or Fisher exact tests for categorical variables.

## RESULTS

Baseline characteristics of the study population are presented in **Table 1**. The mean  $\pm$  SD age was 73.7  $\pm$  6.5 years, and 58.3% of subjects were women. The population was geographically diverse, with representation from all 50 states, the District of Columbia, Puerto Rico, and 2 US territories.

Of the 765 423 subjects in the study population, 162 370 (21.2%) filled a prescription for 1 or more drugs of concern. Characteristics of these subjects are also given in Table 1. The mean  $\pm$  SD age was 73.8  $\pm$  6.5 years, and 65.7% of the subjects were women. Most subjects (80.3%) filled prescriptions for a single drug on the Beers list during the study period. However, more than 25 550 subjects (15.7%) filled prescriptions for 2 different drugs of concern, and 6 402 subjects (4.0%) filled prescriptions for 3 or more different Beers list drugs concurrently or within the same year.

The most commonly prescribed drugs on the Beers list are given in **Table 2** by drug name and severity of potential adverse effects. Of the 162 370 subjects with 1 or more claims for a Beers list drug, 31 598 (19.5%) filled a prescription for either amitriptyline or doxepin. Claims

for these antidepressants alone accounted for nearly one quarter (23%) of the total claims for Beers list drugs. Although slightly more than half (50.8%) of all claims for drugs on the revised Beers list were for drugs with the potential for severe adverse effects, fewer than half of the subjects who filled prescriptions for Beers list drugs did so for those drugs (44.2%), indicating that some of the claims for drugs with the potential for severe adverse effects represent additional prescriptions of Beers list drugs for individual patients.

Seven psychotropic drugs (amitriptyline, chlorthalidone, diazepam, doxepin, flurazepam, hydroxyzine, and meprobamate) and 5 neuromuscular agents (carisoprodol, chlorzoxazone, cyclobenzaprine, metaxalone, and methocarbamol) were included on the Beers list. More than 210 000 subjects (27.5% of the study population) filled a prescription for a psychotropic drug in 1999. Of those, more than 25 000 subjects (12.6%) filled a prescription for amitriptyline and 17 178 (8.2%) filled a prescription for diazepam. Nearly 40 000 subjects (5.1%) filled prescriptions for neuromuscular agents. Of those, 15 690 (14.1%) filled a prescription for cyclobenzaprine.

## COMMENT

The findings of this population-based study of 765 423 patients confirm that potentially inappropriate prescribing is common among elderly patients. In 1999, more than 1 in 5 elderly patients (21.2%) filled a prescription for a drug that should generally be avoided in elderly patients. In the same year, nearly 1 in 20 (4.2%) filled prescriptions for 2 or more of these drugs. Of the 162 370 subjects with 1 or more claims for a Beers list drug, 71 834 (44.2%) filled 1 or more prescriptions for a drug for which adverse outcomes are likely to be clinically severe when used in elderly patients. In addition, 26 536 (16.3%) filled 1 or more prescriptions for amitriptyline, an antidepressant documented to have substantial anticholinergic and sedative effects.<sup>17</sup>

These findings are highly consistent with a recent study using data from the 1996 Medical Expenditure Panel Survey (MEPS).<sup>18</sup> Using an analytic sample of 2455 community-dwelling individuals 65 years or older, Zhan et al<sup>18</sup> estimated that 21.3% of elderly Americans received 1 or more potentially inappropriate medications, as defined by the revised Beers criteria. In addition, our findings mirror earlier studies based on a more extensive set of criteria developed for institutional settings.<sup>9</sup> In a study of community-dwelling subjects 75 years or older, Stuck et al<sup>11</sup> reported that 14% of subjects were prescribed 1 or more inappropriate medications. Willcox et al,<sup>13</sup> using self-reported data from the 1987 National Medical Expenditure Survey (NMES), found that 23.5% of elderly subjects filled prescriptions for 1 or more of the Beers list drugs. Consistent with our findings, approximately 80% of those subjects received only 1 such drug, but 20% received 2 or more. It is noteworthy—and worrisome—that little reduction in inappropriate prescribing has occurred since 1987, when the NMES was conducted.

Our findings are also consistent with previous studies suggesting that a large portion of potentially inap-

**Table 2. Most Commonly Prescribed Drugs From the Beers List<sup>17</sup> by Severity of Potential Adverse Events and Generic Drug Name, 1999\***

Generic Drug Name	Beneficiaries† (n = 162 370)	Claims (n = 658 819)
<b>High severity</b>		
Amitriptyline	26 536 (16.3)	119 221 (18.1)
Diazepam	17 178 (10.6)	68 529 (10.4)
Dicyclomine	6848 (4.2)	26 109 (4.0)
Doxepin	5062 (3.1)	32 334 (4.9)
Chlorthalidone-clidinium	3956 (2.4)	14 854 (2.3)
Chlorthalidone	3440 (2.1)	16 340 (2.5)
Other	8814 (5.4)	57 220 (8.7)
<b>Total</b>	<b>71 834 (44.2)</b>	<b>334 607 (50.8)</b>
<b>Low severity</b>		
Cyclobenzaprine	15 690 (9.7)	38 378 (5.8)
Hydroxyzine	11 206 (6.9)	42 172 (6.4)
Oxybutynin	10 969 (6.8)	53 108 (8.1)
Promethazine	10 842 (6.7)	31 083 (4.7)
Indomethacin	10 577 (6.5)	31 975 (4.9)
Carisoprodol	5766 (3.6)	16 018 (2.4)
Other	25 486 (15.7)	111 478 (34.4)
<b>Total</b>	<b>90 536 (55.8)</b>	<b>324 212 (49.2)</b>

\*Values are number (percentage).

†Percentage of subjects with 1 or more claims for a drug from the Beers list.<sup>17</sup>

appropriate prescribing in the elderly involves psychotropic drugs. In our study, 41% of beneficiaries who filled a prescription for a drug on the Beers list did so for a psychotropic drug. In earlier studies, based on the more extensive criteria, between 23% and 51% of potentially inappropriate prescriptions involved psychotropic agents.<sup>10,14,15</sup>

Given the consistency of findings across data sets and time, why do these drugs continue to be prescribed for the elderly? First, the Beers criteria have never been validated in a research setting. While there is general agreement that these drugs pose risks when used in elderly patients,<sup>19-21</sup> there are legitimate concerns that explicit criteria may be too rigid and cannot take into account all factors that define individualized high-quality health care.<sup>22</sup> In the absence of evidence-based guidelines, it may be difficult to convey clear, concise messages to physicians and the public about the risks and benefits of specific drugs.<sup>23,24</sup> Second, the evidence base for appropriate prescribing in the elderly is relatively weak. Elderly patients often are excluded from randomized clinical trials that generate information about adverse effects associated with specific drugs.<sup>25</sup> Estimates of adverse effects typically are based on large observational studies in which unmeasured confounders are likely to be present. Third, elderly patients often have multiple chronic diseases<sup>26</sup> and, therefore, receive complex drug regimens.<sup>27,28</sup> Physicians may be reluctant to alter a regimen that “works” because there is no perception of harm.<sup>23</sup> Fourth, physicians may have evaluated the risks and benefits and believe a given drug to be the best choice for a given patient. In some circumstances, the use of a drug may be clinically justified if the benefits of the drug outweigh the risks to the patient. The lack of diagnostic data on the prescription claims in the present study makes it diffi-

cult to evaluate the appropriateness of individual prescriptions.

How can we reduce inappropriate prescribing in the elderly? First, we must improve the evidence base for appropriate prescribing by designing clinical trials that encourage enrollment of elderly patients. Although the US Food and Drug Administration published the *Guideline for the Study of Drugs Likely to be Used in the Elderly*<sup>29</sup> to encourage clinical research to be more representative of the treated population, evidence suggests that the elderly remain underrepresented.<sup>25</sup>

Second, we should use existing criteria to identify elderly patients at high risk for suboptimal prescribing and to prioritize further studies.<sup>18</sup> Pharmaceutical claims databases may be particularly useful in identifying patients with claims for drugs of concern. Then, with careful monitoring of these natural experiments over time, we could begin to quantify the hazards associated with the drugs. Results from these natural experiments could inform risk management programs and a priori hypotheses for controlled studies.

Third, we should encourage the use of systems and technologies that support optimal prescribing behavior—such as drug utilization review,<sup>30,31</sup> computerized physician order entry with decision support,<sup>32</sup> and palmtop reference guides.<sup>33</sup> It is important to note that these systems are only as good as the information on which they rely. To avoid unacceptably low sensitivity and specificity of patient-specific alerts, clinical and laboratory data must be combined with medical and pharmaceutical claims data.<sup>34</sup> While adding a limited subset of clinical information to pharmaceutical claims data moves us closer to a solution, even that may be impractical. The privacy provisions of the Health Insurance Portability and Accountability Act<sup>35</sup> create obstacles—both real and perceived—to open sharing of data across health care providers. In addition, the current focus in database architecture is to make existing data sets more transparent, not to enhance the data being collected.

Our analysis likely underestimates the occurrence of potentially inappropriate prescribing in the elderly population. First, because patients' clinical data and detailed dosage instructions are not available in this database, potentially inappropriate prescribing related to underlying disease and excessive dosage or duration could not be examined. Second, most beneficiaries of PBMs are insured commercially and tend, therefore, to have less chronic disease.<sup>36</sup> Third, if patients have alternative sources of prescription drug coverage, out-of-plan utilization would bias these results downward. Finally, at the time claims are filed, the PBM screens the claims using computer software. To the extent that this screening process results in changes to patients' therapeutic regimens, our findings may underestimate potentially inappropriate prescribing in populations not covered (and not monitored) by a PBM.

Our study has some limitations. To the extent that prescription drug insurance benefits tend to increase the use of prescription drugs, the results reported herein may overestimate potentially inappropriate prescribing for the uninsured. Similarly, certain drugs may be used at very low doses as last-resort treatments for the management

of pain (eg, amitriptyline) or urinary incontinence (eg, doxepin). Also, these data provide no direct insight into the outcomes associated with the use of prescription drugs. Moreover, we cannot be certain that the drugs prescribed and dispensed were actually consumed. Finally, and most importantly, there are no data on the reasons why certain prescription choices were made by a specific clinician for a specific patient. Without detailed clinical data, including indications, we cannot be certain that these prescribing patterns are suboptimal.

## CONCLUSIONS

Using a national sample of prescription drug claims for elderly patients enrolled with a PBM, we found that more than 1 in 5 patients filled a prescription for 1 or more drugs of concern during 1999. Of those, more than 15% filled prescriptions for 2 different drugs of concern and 4% filled prescriptions for 3 or more of such drugs. Psychotropic drugs alone accounted for more than 45% of the claims for drugs on the Beers list. Online, computerized systems that support PBM databases provide an important tool for identifying potentially dangerous prescribing patterns, but they require augmentation with clinical and laboratory data to strengthen the sensitivity and specificity of the alerts.

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