A Database Analysis of Potentially Inappropriate Drug Use in an Elderly Medicaid Population

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We conducted a cross-sectional retrospective review of 1996 Kentucky Medicaid Pharmacy claims data to examine the prevalence of potentially inappropriate drug use in 64,832 Medicaid recipients aged 65 years and older who received a prescription. Twenty-seven percent of patients received at least one potentially inappropriate agent. Prevalence was higher for nursing home residents (33%) than for community dwellers (24%). Amitriptyline (7.6%), propoxyphene (6.5%), doxepin (4.0%), and indomethacin (2.3%) were the most prescribed potentially inappropriate agents. Education programs and interventions aimed at optimizing the prescribing and dispensing of the most appropriate drugs are needed.
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Inappropriate prescribing in the elderly is a widespread problem that has received much attention in recent years.[1–4] Avoidable adverse drug reactions (ADRs) are the most serious consequence of inappropriate prescribing.[5] Less serious ADRs that frequently are unrecognized may lead to prescriptions for additional agents and decreased quality of life.[2, 6] More serious ADRs may result in unnecessary hospitalizations and increased morbidity and mortality.[4] A recent meta-analysis estimated that 1.5 million, or 4.7%, of all hospital admissions were due to ADRs.[7] Studies limited to elderly persons found frequency rates as high as 17%.[8, 9] Prescribers and pharmacists both have a duty to patients to minimize the risk of ADRs. Theoretically, this could be done by reducing the number of inappropriate prescriptions.

Defining appropriateness can be somewhat problematic. In 1991, explicit criteria (Beers) were developed to determine potentially inappropriate drug use.[10] A consensus was reached among experts on statements derived from the literature. The criteria were designed to apply factors such as prescription claims data, in the absence of clinical information, to evaluate the appropriateness of prescribing to elderly (≥ 65 yrs) nursing home patients. They describe agents that should be avoided entirely in the elderly and other drugs whose dose, frequency of administration, or duration of use should not exceed certain limits.

To determine the use of potentially inappropriate drugs in community-dwelling elderly, the criteria were modified (Stuck) to include only agents that should be avoided entirely.[3] Investigators used the Beers or Stuck criteria to evaluate the prevalence of this problem in nursing home residents and in community-dwelling elderly (Table 1).[2–4, 6, 11–17]

The Beers criteria applied to nursing home patients; however, most studies were in community dwellers and used the Stuck criteria. Therefore, in 1997 the Beers criteria were updated to make them more applicable to the general elderly population. The updated criteria

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Table 1. Summary of Major Findings from Previous Studies

Criteria	Study Population	Recipients of Potentially Inappropriate Agents (%)	Most Prevalent Potentially Inappropriate Agents
Stuck[6]	6171 community dwellers	23.5	Dipyridamole Propoxyphene Amitriptyline
Stuck[3]	414 community dwellers	14.0	Benzodiazepines[a] Dipyridamole Amitriptyline
Beers[2]	1106 nursing home residents	40.3	Iron supplements Benzodiazepines[a] Dipyridamole
Beers[11, b]	21,884 nursing home residents	12.0	Dipyridamole Amitriptyline Methyldopa
Stuck[4]	9182 community dwellers	17.5	Propoxyphene Dipyridamole Amitriptyline
Stuck[12]	8713 community dwellers	5.0[c]	Propoxyphene Amitriptyline Dipyridamole
Beers[13]	1045 board and care home residents	24.1	Propoxyphene Benzodiazepines[a] Dipyridamole
Stuck[14]	85,111 nursing home residents	19.6	Dipyridamole Amitriptyline Diazepam
Stuck[15]	19,932 nursing home residents	48.8	Not reported
Stuck[16]	4202 community dwellers	2.9[d]	Diazepam Propoxyphene Dipyridamole
Stuck[17]	48,593 elderly Medicaid recipients	25.0	Propoxyphene Amitriptyline Diazepam

[a]Long-acting benzodiazepines: chlordiazepoxide, diazepam, and flurazepam.
[b]Excluded anxiolytics, major tranquilizers, and as needed agents.
[c]Number of office-based visits that involved a potentially inappropriate drugs.
[d]Number of hospital outpatient visits that involved a potentially inappropriate drug.

also reflect new drugs and the availability of additional information regarding the effects of older agents in the elderly.[18]

The limitations and subjectivity of the Beers criteria are discussed extensively elsewhere.[19–21] Like all tests, they have limited sensitivity and specificity and sometimes identify appropriate prescribing as inappropriate. In addition, it is important to note that using the criteria to evaluate prescription claims data more accurately gauges drug use (physician prescribing, patient requirement for the prescription, pharmacist review and dispensing) rather than solely physician prescribing. Even with these limitations the criteria are a useful screen to assess for an overabundance of potentially inappropriate prescribing or drug use in a given population. This study used the updated criteria.[18]

Methods

Data were extracted from a database containing over 10 million paid pharmacy claims for approximately 530,000 Kentucky Medicaid recipients in 1996. The data extract contained all claims for patients who were 65 years of age and older at the time the prescriptions were dispensed. The unit of analysis for calculating prevalence was the individual recipient who received a potentially inappropriate drug. Prevalence was calculated based on the total

number of unduplicated recipients who received any prescription compounds during the year. Community dwellers were defined as individuals who did not reside in a nursing home at the time a prescription was dispensed.

We applied the updated Beers criteria[18] to evaluate the data. Although practitioners should not be held to standards that did not exist at the time an agent was prescribed, we were interested in obtaining a baseline evaluation of the use of all drugs deemed potentially inappropriate.

The claims extract that we received contained the quantity of drug dispensed, but no other information was provided on how it was prescribed. Therefore, we could not determine the total daily dose, frequency of administration, or duration of use. Lorazepam, oxazepam, alprazolam, temazepam, zolpidem, triazolam, and iron supplements are considered potentially inappropriate only if they exceed a certain daily dose, frequency of administration, or duration of use. Since we were unable to determine these data, the compounds were not included in the analysis. Antihistamines also were not included. Most are obtained over the counter, and Kentucky Medicaid does not provide reimbursement. Thus, over-the-counter drugs are not in the database.

Drugs in the database were identified by their generic product code sequence number (First DataBank, San Bruno, CA). A specific generic product code sequence number is assigned to all products that have the same active ingredients and dosage form, regardless of manufacturer. For example, all diazepam 5-mg tablets have the same generic product code sequence number.

Statistical Analysis

We performed χ^2 tests for homogeneity to determine the relationship between use of potentially inappropriate drugs and patient demographics. Student's *t* tests were used to evaluate differences in the average number of prescriptions/patient/month between individuals who received a potentially inappropriate agent and those who did not; *t* tests also were used to evaluate differences in the average number of prescriptions/patient/month between nursing home residents and community dwellers.

Unconditional logistic regression analysis was performed to obtain odds ratios [ORs] and 95% confidence intervals [CIs] associated with potentially inappropriate drug use. Results are presented for a full main effects model. Dummy variables were used to model the effects of categoric variables. We created a dichotomous variable for age based on results of a study that found patients 85 years of age and older infrequently were prescribed potentially inappropriate drugs.[2] The number of different physicians that an individual saw in the year was categorized as fewer than 3, 3–5, 6–9, and 10 or more. The number of prescriptions that an individual received was categorized as 36 or fewer, 37–60, 61–119, and more than 120. These categories correspond to 3 or fewer, 4–5, 6–10, and more than 10 prescriptions/month.

All data manipulations and statistical analyses were performed with SAS software (version 6.12, SAS Institute, Cary, NC). A p value less than 0.05 was considered statistically significant.

Results

We found that 27% of elderly Medicaid recipients received a potentially inappropriate drug (Table 2). When analyzed separately, this came to nearly one-third (33.2%) of the nursing home residents and one-fourth (24.4%) of community dwellers.

The most frequently prescribed potentially inappropriate agents were amitriptyline (7.6%), propoxyphene (6.5%), doxepin (4.0%), and indomethacin (2.3%). Amitriptyline was taken most often by the total population of elderly individuals and separately for community dwellers. Nursing home residents took propoxyphene more frequently.

Most of these elderly Kentucky Medicaid recipients were white women (Table 3). Individuals who received a potentially inappropriate drug also were likely to be white women. Compared with community dwellers, nursing home residents received on average almost twice as many prescriptions/patient/month ($p<0.05$). This finding was consistent regardless of whether patients received a potentially inappropriate agent. Individuals who received such compounds had on average nearly two additional prescriptions/month compared with those who did not.

The relationship between use of potentially inappropriate drugs and various demographic risk factors for the logistic regression model is shown in Table 4. African-American race (OR 0.84, 95% CI 0.78–0.90) and age 85 years and older (OR 0.88, 95% CI 0.84–0.93) were independently associated with a decreased risk.

Table 2. Individuals Who Received a Potentially Inappropriate Agent

Drug	Number of Individuals	Total Population (%) (n=64,832)	Nursing Home Residents (%) (n=20,573)	Community Dwellers (%) (n=44,259)
Antidepressants				
Amitriptyline[a]	4953	7.64	4.87	8.93
Doxepin[b]	2578	3.98	2.64	4.60
Analgesics				
Propoxyphene[a]	4227	6.52	16.39	1.93
Pentazocine[a]	129	0.20	0.41	0.10
Meperidine[b]	39	0.06	0.16	0.02
Nonsteroidal antiinflammatory drug				
Indomethacin	1489	2.30	0.83	2.98
Platelet inhibitors				
Ticlopidine[b]	1155	1.78	1.71	1.81
Dipyridamole	602	0.93	2.51	0.19
Sedative or hypnotic agents				
Diazepam	1059	1.63	3.28	0.87
Chlordiazepoxide[a]	282	0.44	0.90	0.22
Flurazepam	94	0.15	0.34	0.06
Meprobamate	39	0.06	0.13	0.03
Barbiturates[c]	5	0.01	0.02	0.01
Antihypertensives				
Methyldopa[a]	844	1.30	0.78	1.54
Reserpine[a]	688	1.06	0.26	1.44
Muscle relaxants				
Methocarbamol	815	1.26	0.38	1.66
Cyclobenzaprine	275	0.42	0.78	0.26
Chlorzoxazone[b]	101	0.16	0.31	0.08
Carisoprodol[a]	83	0.13	0.24	0.08
Metaxalone[b]	39	0.06	0.15	0.02
Antispasmodics				
Oxybutynin	748	1.15	2.50	0.53
Dicyclomine	406	0.63	1.11	0.40
Hyoscyamine	318	0.49	0.99	0.26
Belladonna	41	0.06	0.19	0.00
Propantheline	34	0.05	0.10	0.03
Oral hypoglycemic				
Chlorpropamide	314	0.48	0.13	0.65
Cerebral vasodilators				
Ergoloid mesylates[b]	173	0.27	0.58	0.12
Cyclandelate	3	0.01	0.02	0.00
Antiarrhythmic				
Disopyramide[b]	112	0.17	0.17	0.18
Antiemetic				
Trimethobenzamide	11	0.02	0.05	0.00
Totals	17,620[d]	27.2	33.2	24.4

[a]Includes all combination products.
[b]Drug deemed potentially inappropriate by updated criteria (not addressed in original criteria).
[c]All barbiturates except phenobarbital.
[d]Column does not sum to total; 5% of individuals received more than one potentially inappropriate agent.

As the number of physicians and prescriptions increased, the probability of receiving such an agent increased. White race and female gender (OR 1.21, 95% CI 1.16–1.27), which were significant in χ^2 analysis, were independently associated with an increased risk.

Discussion

We found a high rate of potentially inappropriate drug use in an elderly Medicaid population. Over 27% of patients received at least one such agent during the year. The rate

Table 3. Patient Demographics and Use of Potentially Inappropriate Prescription Drugs

Patient Demographics	Received (n=17,620)	Did Not Receive (n=47,212)	p Value
Women (%)	77.4	72.7	0.001
White (%)	82.7	79.1	0.001
Age 85 and older (%)	23.7	23.6	0.824
Average no. of prescriptions/ patient/month			
Nursing home patients	9.4	6.5	0.0001
Community dwellers	4.9	3.0	0.0001
All patients	6.6	4.0	0.0001

was higher in nursing home residents than in community dwellers.

Nursing home residents received on average nearly twice as many prescriptions/month as community dwellers, but this does not necessarily indicate inappropriateness or poor quality of care. Indeed, the utilization of numerous drugs may be not only appropriate but necessary for nursing home residents.[22] However, the probability of an adverse drug reaction is higher with increased number of drugs,[4] and the regression analysis suggests that the probability of a potentially inappropriate agent is higher as the number of compounds taken increases. This finding is in agreement with other studies[3, 11, 13] and implies that the increased prevalence of potentially inappropriate drug use among nursing home residents is due to the fact that these individuals take more drugs overall.

The increased prevalence of potentially inappropriate prescribing among nursing home residents can be attributed to other factors. Many agents included in the criteria are old. Perhaps nursing home residents often are cared for by older physicians who developed prescribing habits when these drugs were being heavily promoted.[23] Other studies suggest that physicians who were older, graduated from medical school before 1965, had small nursing home practices, and consulted psychiatrists less frequently when prescribing psychoactive drugs frequently wrote potentially inappropriate prescriptions for nursing home residents.[24]

The percentage of nursing home residents who received prescriptions for propoxyphene increased 8-fold compared with community dwellers. The influence of a drug formulary and inefficiency in the prior-authorization process likely affected prescribing of propoxyphene for community dwellers. Propoxyphene is not

Table 4. Relationship between Use of a Potentially Inappropriate Drug and Risk Factors

Variable	Parameter Estimate	Adjusted OR	Lower 95% CI	Upper 95% CI
Age category				
65–84 yrs		1.00		
> 85 yrs	-0.13[a]	0.88	0.84	0.93
Race				
White		1.00		
African-American	-0.18[a]	0.84	0.78	0.90
Other	-0.33	0.72	0.45	1.11
Residency status				
Community dweller		1.00		
Nursing home resident	0.12[a]	1.13	1.07	1.18
Gender				
Men		1.00		
Women	0.19[a]	1.21	1.16	1.27
Number of physicians				
0–2		1.00		
3–5	0.34[a]	1.41	1.35	1.48
6–10	0.64[a]	1.90	1.74	2.07
> 10	0.75[a]	2.12	1.53	2.94
Number of prescriptions				
0–36		1.00		
37–60	0.64[a]	1.89	1.79	2.00
61–120	0.98[a]	2.67	2.54	2.81
> 120	1.61[a]	5.01	4.69	5.35

[a]$p<0.05$.

covered under Kentucky's Medicaid drug formulary; however, this formulary applies only to outpatient prescriptions. Thus, for nursing home residents, physicians are free to prescribe any drug they consider necessary. For community dwellers, pharmacists must receive authorization before dispensing propoxyphene or any nonformulary drug. The hassle associated with obtaining authorization for propoxyphene may have led physicians to prescribe alternative formulary agents, such as acetaminophen with codeine.

In most studies that used the Beers or Stuck criteria, propoxyphene, long-acting benzodiazepines, dipyridamole, and amitriptyline were the most common potentially inappropriate drugs prescribed.[2–4, 6, 11–14, 16, 17] In addition to propoxyphene and amitriptyline, we found doxepin, a drug not addressed in the original criteria, to be among the most commonly prescribed, but not dipyridamole. This is most likely because dipyridamole is not included in Kentucky's outpatient drug formulary.

Our findings are in agreement with a study that found patients aged 85 years and older were unlikely to receive potentially inappropriate drugs.[2] Our findings for at-risk populations—women and individuals who receive a large number of prescriptions—are similar to results of others.[2, 3, 6, 11, 13, 15] However, it is difficult to compare our results with those studies. Prevalence estimates differ in diverse populations depending on demographics. Other differences, such as criteria, study design, and study duration also may contribute to variances in prevalence. Furthermore, without significance testing or confidence intervals it is difficult to know if these variances are meaningful.

Our findings are consistent with results from most other studies that found, in general, a larger proportion of nursing home residents received potentially inappropriate drugs (20–49%)[2, 14, 15] compared with the community-dwelling elderly (14–24%).[3, 4, 6] However, one group found similar prevalence rates between nursing home residents and community dwellers in the elderly Maryland Medicaid population.[17]

In addition to unknown differences in demographics between Maryland and Kentucky Medicaid populations, methodologic differences in the studies could be responsible for the contrasting results. In both studies the denominator for calculating prevalence was the number of recipients who received any prescription drug. The other investigators included only individuals who were enrolled continuously in Medicaid during the study year, whereas our analysis included all individuals who received a prescription during the year.

In both studies prevalence should have been calculated based on the total number of Medicaid-eligible elderly individuals. This would have included individuals who did not take prescription drugs and resulted in a true prevalence estimate for the at-risk population. We did not have access to eligibility files; thus we could not calculate prevalence based on the total number of eligible recipients. It is not clear why the earlier study calculated prevalence based on the number of individuals who received any drug.

Differences in eligibility requirements and demographics between state Medicaid populations limit the ability to generalize our results to other Medicaid populations. In addition, our results may not reflect the prevalence of potentially inappropriate drug use in elderly, non-Medicaid populations. Medicaid is the primary payer source for more than 75% of the Kentucky nursing home residents.[25] The results of this study likely provide a stable estimate of the prevalence of potentially inappropriate drug use among all nursing home residents.

Limitations to using claims data for research purposes are described in the literature.[26–31] Specifically in this study, claims data did not contain prescriptions for over-the-counter and nonformulary agents that patients pay for out of pocket, or for prescriptions that were written but never dispensed.[26, 32] Therefore, our results actually measure dispensing rather than prescribing practices.[32] Given this limitation the prevalence of potentially inappropriate prescribing may be underestimated.

In addition to missing data on certain agents, pharmacy claims data can not accurately evaluate patient compliance, intensity of use, or clinical events.[17, 26] While adherence to therapeutic regimens and intensity of use are important and affect the probability that an individual will experience an ADR, we were more concerned with obtaining a baseline evaluation of how often potentially inappropriate drugs were taken.

The appropriateness of an agent that is prescribed to, or taken by, an individual cannot be determined without adequate clinical information and patient history. In addition, without measuring outcomes, the Beers criteria cannot determine whether adverse outcomes

have occurred, only that they are likely to occur. Detailed evaluations that are necessary to determine the appropriateness of an agent or whether an adverse outcome has occurred are not practical when evaluating the quality of prescribing or drug use in a large population. The extensive labor requirements associated with patient chart reviews and other necessary evaluations are cost prohibitive. The value of the Beers criteria is that they allow one to use readily available claims data to evaluate quickly and inexpensively the potential inappropriateness of prescribing or drug use in a given population. If high prevalence rates are found, more detailed investigations can be conducted.

Possible interventions to decrease the use of potentially inappropriate drugs include the following: removing these agents from the formulary, continuing medical education or in-service programs to warn practitioners of the potential risk, and more prospective drug use reviews (DURs) by pharmacists.[33] Some suggested face-to-face educational interventions or "academic detailing" directed at physicians and education programs for nursing staffs to improve prescribing and drug use in nursing homes.[5]

An on-line, prospective, DUR was effective in reducing inappropriate prescribing and improved the quality of care that elderly patients received from a large mail-order, pharmacy benefit manager.[34] Pharmacists who were trained in geriatrics and communication theory received a computer alert when a potentially inappropriate agent was requested. In subsequent telephone calls pharmacists were successful in convincing physicians to change to safer alternatives in 24% of cases.

The Omnibus Budget Reconciliation Act of 1990[35] required all states to implement a DUR program for their Medicaid populations. Based on the success of the DUR intervention described above, states should consider adopting similar interventions. This study provides baseline data that can be used as a reference point to evaluate the effectiveness of a DUR to reduce potentially inappropriate prescribing and use.

Conclusion

This study documents the high rate of inappropriate drug use in the elderly Kentucky Medicaid population, especially among nursing home residents. Results of studies such as this provide a mechanism to evaluate the quality of prescribing and dispensing and to alert physicians and pharmacists that closer scrutiny of prescriptions for such agents is necessary.[18] Further study is necessary to examine physician and pharmacist characteristics associated with potentially inappropriate prescribing and dispensing. The results of this study demonstrate the need for DUR interventions and education programs aimed at optimizing the prescribing and dispensing of compounds to elderly individuals.

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