Outpatient Benzodiazepine Prescribing, Adverse Events, and Costs

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Abstract

Objectives: The objectives of this preliminary study were to identify a cohort of patients receiving outpatient prescriptions for a class of medications, benzodiazepines, that are known to increase the risk of adverse events, and to analyze the temporal association between outpatient benzodiazepine usage and inpatient and outpatient injury-related health care encounters for this cohort. **Methods:** As part of a larger research program on high-risk medications and patient injuries, we identified 17,558 patients receiving benzodiazepine outpatient prescriptions at one Veterans Health Administration (VHA) hospital system, with 9,304 individuals more than 59 years old. Adverse outcomes of interest, viz., inpatient or outpatient health care encounters coded as injuries while using benzodiazepines, were analyzed. Direct medical costs for inpatient stays and average costs for outpatient visits were obtained from cost extracts from the VHA Decision Support System. Modified Beers criteria (Zhan et al., JAMA 2001;286(22):2823–9) for potentially inappropriate medications in the elderly, irrespective of dose, were applied to three years of outpatient prescription data for the cohort of patients more than 59 years old. More than 1 million outpatient prescriptions were analyzed by Zhan's modified Beers inappropriateness categories, namely, always avoid, rarely appropriate, and some indications. **Results:** For the 17,558 patients receiving outpatient benzodiazepines, we identified 297 inpatient injury admissions and 2,977 outpatient injury encounters for 1,352 patients that occurred while using benzodiazepines at the time of the injury. Over $3 million dollars in direct medical costs were associated with these injuries. **Conclusions:** Pharmacy Benefit Management data linked with clinical administrative data can be used to identify evidence of adverse events (patient injuries) linked to potentially inappropriate prescribing patterns in elderly outpatients.

Introduction

Certain medications have been identified as risk factors for fall-related injuries, adverse drug events, motor vehicle accidents, and increased hospitalizations, all of which result in potentially preventable health care utilization and costs.[1–11] Older persons are particularly at risk for injuries associated with the use of certain medications, including antidepressants, antihypertensives, barbiturates, sedative hypnotics, anxiolytics, and combinations

of these medications.[12–20] Beers and other researchers have used explicit criteria developed by experts, including geriatricians, pharmacologists, and others, to identify potentially inappropriate drug prescribing for the elderly.[14, 18, 21] Zhan, using a modified Delphi method, further categorized Beers' 1997 list of drugs into appropriateness categories of "always avoid," "rarely appropriate," and "some indications," irrespective of dosage.[14, 18] The Zhan categorizations could be considered conservative, as they do not include the impact of drug dosage, drug-drug, or drug-disease interactions, which could expand the list. While another study[22] used some of these factors to develop other potentially inappropriate prescribing criteria, we used Zhan's more conservative approach for this preliminary study.

Benzodiazepines (BZDs) are generally acknowledged as a class of medications that are an independent risk factor for fall-related and other serious injuries in community dwelling elders.[9–11, 23–28] Two BZDs are on Zhan's list, and her expert panel considered long-acting BZD use by the elderly to be inappropriate, as have others.[27–29] Nevertheless, benzodiazepines continue to be disproportionately prescribed for older adults, and may be prescribed for long periods of time.[17, 28, 30] In our study population, BZDs were widely prescribed during the study period. Preliminary analyses of administrative datasets for the hospital found that as many as one in five outpatients received at least one prescription for a BZD during the study period.

There were four objectives of this study. The first was to identify BZD outpatient prescriptive patterns in a cohort of patients at one Veterans Health Administration (VHA) hospital system. The second was to analyze the temporal association between outpatient BZD usage and inpatient and outpatient injury-related health care encounters for this cohort. The third objective was to analyze the direct medical costs associated with those injury-related health care encounters. The fourth objective was to apply Zhan's modified Beers' criteria to those patients in the cohort who were 60 years of age or older to identify other potentially inappropriate outpatient medications they were receiving. The unique contribution of this preliminary study was a demonstration of the potential for enhancing patient safety by our methodology of linking outpatient drug usage of certain high-risk medications with actual adverse outcomes.

Materials and methods

Sources of data

A datamart was created using data extracted from the administrative datasets for a VHA hospital system, which included its medical center and associated outpatient hospitals and community-based outpatient clinics. VHA outpatient prescription data from the Pharmacy Benefit Management (PBM) system was extracted for three calendar years (1999–2001). The PBM database contained information on the strength of the drug, prescribed daily amount, fill date, quantity supplied, and a unique patient identifier. Using the PBM data, we

identified a cohort of all patients receiving outpatient BZD prescriptions to analyze their BZD usage for the 3-year period.

Using the patient identifier, the pharmacy data was combined with health care utilization data. The inpatient and outpatient health care encounter data were extracted from the centralized VHA National Patient Care Database, which included information on patient demographics and International Classification of Diseases-9th Revision-Clinical Modification (ICD-9-CM)-coded[31] diagnoses in different datasets. The VHA Decision Support System (DSS) cost extracts provided information on treatment costs. These extracts from administrative datasets were linked to the PBM data to create a master dataset for our analyses. There were 142,204 outpatient BZD prescriptions for 17,558 unique individuals. Over the same time period, there were over 1 million other prescriptions (non-BZDs) for those unique patients, which we could search for other potentially inappropriate prescriptions.

Injury identification

We identified a cohort of all patients receiving outpatient BZD prescriptions to analyze their BZD usage for the 3-year period. The cohort's inpatient and outpatient injury-related health care encounters were identified using the ICD-9-CM codes for injuries and poisonings (800–999).[31] The administrative datasets we used did not permit us to obtain the actual occurrence dates of the injuries. The administrative data has the dates of associated health care encounters for those injuries. Injuries were identified by ICD-9-CM injury codes for inpatient admissions and outpatient clinic visits.

Even though we defined an injury within the ICD-9-CM range of 800–999, injuries for certain types of codes were excluded from our analyses. The Clinical Classification Software (CCS) of the Agency for Healthcare Research and Quality (AHRQ) was used to aggregate the injury codes into homogenous diagnosis groups. The CCS categories 237 (complication of device, implant, or graft) and 238 (complications of surgical procedures or medical care) were excluded from our analyses because they are iatrogenic injuries and historically have not been included in injury studies (e.g., the Centers for Disease Control and Prevention's [CDC] E-coding matrix for injuries). The remainder of the CCS injury categories, accidental injuries and poisonings, were included in our analyses and are consistent with types of accidental injuries that have been related to BZD use.[32–34] Finally, CCS category 227 patients (spinal cord injuries) were also excluded from the analysis due to a coding anomaly. Consultations with clinicians and medical record coders suggested that almost all spinal cord injury patients in our dataset were being treated for followup care rather than for their original spinal cord injury.

The health care encounters coded for an injury may, or may not, reflect treatment for an incident injury. Treatment for an injury may include inpatient and outpatient phases, with multiple injury-coded health care encounters associated with an episode of care. The primary and secondary diagnosis fields in both inpatient and outpatient datasets were examined for injury codes. In order to

temporally associate an individual's outpatient BZD usage with health care encounters, we linked drug fill dates with injury-coded health care encounters. The resulting dataset of injury-coded encounters was compared with fill dates of BZDs and parsed down to only those encounters with an injury code for injuries that occurred while receiving BZDs.

Injury costs

Two different sources of data were used to identify costs associated with patient health care encounters coded for an injury. The direct costs of hospitalizations were obtained from the National Data Extract (NDE) of the DSS financial reporting datasets at the Austin Automation Center (AAC), a Federal data center with the Department of Veterans Affairs. The outpatient costs per visit were based on the facility's outpatient average costs per CCS category injury visit obtained from the AAC's CCS summaries for 2002.

Other potentially inappropriate medications

Our final objective in this study was to apply Zhan's modified Beers criteria to a subset of the cohort in a two-step manner. Using the 17,558 patients receiving outpatient BZD prescriptions, we identified those patients who were 60 years or older at the time of their last outpatient visit (n = 9,304). Using Zhan's criteria, we searched for other potentially inappropriate prescriptions, organized into the three categories of "always avoid," "rarely appropriate," and "some indications."[18] For simplicity, and following Goulding,[29] we will refer to Zhan's list of potentially inappropriate medications as ZL.

Analysis

The data in this study were clustered outpatient pharmacy data with 142,204 BZD and 1 million non-BZD prescriptions for 17,558 unique patients. The analysis consisted of descriptive statistics for the types of injuries and associated direct medical costs by CCS categories and settings of care. Separate frequency distributions for the subset of patients who were 60 years of age and older were generated for BZD prescriptions and for ZL prescriptions. The ZL prescriptions were further analyzed by unique patients and by the average prescriptions per unique patient. All analyses were conducted with Statistical Analysis System (SAS) version 8.2.[35] This study was reviewed by and received all necessary approvals from the Institutional Review Board.

Results

Based on a temporal alignment of BZD usage and health care utilization, 1,649 unique patients were identified as having inpatient or outpatient health care treatment with an ICD-9-CM coded injury code while being prescribed outpatient BZDs. Two hundred ninety seven patients had more serious injuries that required hospitalization. We analyzed the direct medical costs by CCS injury categories

associated with inpatient stays (Table 1) and average outpatient visit costs of 1,352 patients (Table 2).

The direct medical cost associated with inpatient stays for patients who were on BZDs at the time of their injuries, from Table 1, was approximately $2.89 million for 297 unique patients. Including outpatient costs associated with injuries while receiving BZDs (Table 2) for 1,352 unique patients raises the total health care costs to approximately $3.3 million.

Hospitalizations and associated costs by CCS injury code in the primary or secondary category for patients not on BZDs at the time are presented in Table 3. Patients in this group may or may not have ever received outpatient BZDs, but there was no BZD outpatient prescription temporally associated with their health care encounter. Thus, this set of patients injured while not receiving BZDs represents a facility-level comparison group for the types and health care costs of those injured on BZDs (Tables 1 and 2). We should note that the costs associated with hospitalizations for these patients are based on average costs of inpatient discharges for the hospital for the time period FY1999–2001. Finally, the outpatient and inpatient grouping in Table 3 was based on calculating a weighted mean of the average outpatient visit cost and average inpatient discharge cost.

Table 1. CCS* injuries and costs for inpatient hospitalizations while on benzodiazepines, all ages

CCS class	Frequency	Average cost $	Total cost $
225 Joint injury	5	6,195	30,975
226 Fracture hip	17	11,405	193,885
228 Fracture skull & face	6	4,160	24,960
229 Fracture arm	17	6,521	110,857
230 Fracture leg	18	10,943	196,974
231 Other fracture	21	10,569	221,949
232 Sprain	18	15,021	270,378
233 Intracranial injury	31	7,413	229,803
234 Crush injury	8	4,744	37,952
235 Open wound head	16	16,499	263,984
236 Open wound extremity	27	4,150	112,050
239 Superficial injury	25	3,995	99,875
240 Burns	3	6,911	20,733
241 Poison psychotropic	17	2,482	42,194
242 Poison other medication	35	6,010	210,350
243 Poison nonmedication	5	31,513	157,565
244 Other injury	28	23,780	665,840
ALL CCS	297		$2,890,310

*Clinical Classification Software

Thus, the outpatient and inpatient combined costs for each CCS class was less than an inpatient stay, as outpatient visits are generally less costly. As with patients who were treated for an injury while on BZDs, we did not attribute the costs of an episode of care to a set of inpatient and/or associated outpatient visits in this preliminary study.

Table 2. CCS* injuries and average costs for outpatient visits while on benzodiazepines, all ages

CCS class	Cost per visit ($)	Total number of visits	Total costs over 36 months ($)
225 Joint injury	162.12	95	15,401
226 Fracture hip	82.05	50	4,103
228 Fracture skull & face	237.83	82	19,502
229 Fracture arm	102.48	316	32,384
230 Fracture leg	129.50	302	39,109
231 Other fracture	90.66	146	13,236
232 Sprain	129.62	369	47,830
233 Intracranial injury	122.23	248	30,313
234 Crush injury	231.05	14	3,235
235 Open wound head	206.20	306	63,097
236 Open wound extremity	175.97	200	35,194
239 Superficial injury	108.75	308	33,495
240 Burns	146.83	58	8,516
241 Poison psychotropic	109.03	5	545
242 Poison other medication	82.29	79	6,501
243 Poison nonmedication	99.13	95	9,417
244 Other injury	125.98	304	38,298
Overall totals		2,977	$400,176

N = 1,352 unique patients
*Clinical Classification Software

Table 3. Inpatient discharges and outpatient visits with an injury for patients NOT using benzodiazepines at the time of injury health care encounter

	Outpatient and inpatient			Inpatient discharges		
	n	%	Avg cost*	n	%	Avg cost†
225 Joint injury	614	3.07	378	14	1.15	9,644
226 Fracture hip	323	1.62	5,324	123	10.07	13,847
228 Fracture skull & face	233	1.17	1,036	35	2.87	5,552
229 Fracture arm	1,911	9.56	510	73	5.98	10,773
230 Fracture leg	1,410	7.06	770	94	7.70	9,742
231 Other fracture	552	2.76	1,522	87	7.13	9,171
232 Sprain	4,941	24.73	176	24	1.97	9,702
233 Intracranial injury	926	4.63	2,530	294	24.08	7,707
234 Crush injury	76	0.38	1,793	30	2.46	4,189
235 Open wound head	1,801	9.01	324	39	3.19	5,631
236 Open wound extremity	1,139	5.70	633	74	6.06	7,210
239 Superficial injury	2,838	14.20	256	86	7.04	4,967
240 Burns	359	1.80	324	24	1.97	2,802
241 Poison psychotropic	24	0.12	2,473	19	1.56	3,095
242 Poison other medication	347	1.74	835	105	8.60	2,569
243 Poison nonmedication	257	1.29	425	23	1.88	3,740
244 Other injury	2,230	11.16	218	77	6.31	2,795
TOTAL	19,981		$11,535,505	1,221		$ 9,034,449

* Weighted mean of average outpatient visit cost and average inpatient discharge cost
†Average cost per inpatient discharge over 3 years (FY1999–2001)

Table 4. Frequency of prescribed benzodiazepines by strength (1999–2001), age 60+

Drug name	mg	Frequency	Percent
Alprazolam	0.25	6,827	11.59
Alprazolam	0.5	7,046	11.97
Alprazolam	1	2,283	3.88
Chorazepate	3.75	36	0.06
Chorazepate	7.5	43	0.07
Chlordiazepoxide	5	625	1.06
Chlordiazepoxide	10	1,977	3.36
Chlordiazepoxide	25	803	1.36
Clonazepam	0.5	3,168	5.38
Clonazepam	1	2,088	3.55
Diazepam	2	1,393	2.37

Table 4. Frequency of prescribed benzodiazepines by strength (1999–2001), age 60+, cont.

Drug name	mg	Frequency	Percent
Diazepam	5	8,266	14.04
Diazepam	10	1,959	3.33
Lorazepam	0.5	242	0.41
Lorazepam	1	1,230	2.09
Lorazepam	2	194	0.33
Oxazepam	10	5,078	8.62
Oxazepam	15	5,098	8.66
Oxazepam	30	1,052	1.79
Temazepam	15	5,731	9.73
Temazepam	30	3,668	6.23
Triazolam	0.25	75	0.13

N = 55,882

Of the 17,558 outpatients receiving BZD prescriptions, 9,304 were 60+ years of age. Table 4 contains frequencies for the various BZDs and drug strengths in milligrams prescribed to outpatients during the 3-year time period. During that time period there were 55,882 BZD prescriptions for those 60 years or older. Table 5 contains summary frequency statistics for the ZL drug prescriptions in the categories “always avoid” (AA), “rarely appropriate” (RA), and “some indications” (SI) for the group of patients 60 years or older.

Table 5 contains summary frequency statistics for the ZL drug prescriptions in the categories “always avoid” (AA), “rarely appropriate” (RA), and “some indications” (SI) for the group of patients 60 years or older.

Discussion

Potentially inappropriate prescriptive patterns have been studied in elderly in relation to institutions (e.g., hospitals, nursing homes, long-term care facilities),[5, 21, 36–41] as well as outpatient settings,[18, 29, 42–46] using a variety of criteria.[8, 14, 17, 18, 19, 21, 28, 37–40] Benzodiazepines, especially long-acting benzodiazepines, and other psychotropic medications are frequently listed as both potentially inappropriate in the elderly and a significant risk factor for adverse events, such as accidents or injuries, or readmission to the hospital.[1, 3, 4, 8–11, 16, 19–20, 41, 47–48] Fewer studies have examined the linkages between potentially inappropriate prescribing patterns in the outpatient setting and actual adverse events.[29, 43, 46, 48] Our study demonstrated the utility of linking administrative datasets containing prescriptions to health care utilization for adverse events and injuries.

Table 5. Frequency of prescriptions and unique patients by drug, age 60+

	Prescriptions		Unique patients	Average per patient
	n	%		
Always Avoid				
Barbiturates *	13	0.46	1	13.00
Belladonna alkaloids	24	0.85	2	12.00
Chlorpropamide	922	32.74	83	11.11
Dicyclomine	1002	35.58	221	4.53
Flurazepam	-	-	-	-
Hyosacyamine	378	13.42	88	4.30
Meperidine	38	1.35	22	1.73
Meprobamate	-	-	-	-
Pentazocine	198	7.03	29	6.83
Propantheline	48	1.7	14	3.43
Trimethobenzamide	193	6.85	38	5.08
Total	2816	100	466	
Rarely Appropriate				
Carisoprodol	101	0.33	12	8.42
Chlordiazepoxide	3405	11.40	438	7.77
Chlorzoxazone	22	0.07	4	5.50
Cyclobenzaprine	1325	4.44	629	2.11
Diazepam	11618	38.9	1732	6.70
Metaxalone	-	-	-	-
Methocarbamol	3834	12.84	828	4.63
Propoxyphene	9566	32.02	2060	4.64
Total	29871	100	4196	
Some Indications				
Amitriptyline	5550	20.54	823	6.74
Chlorpheniramine	3513	13	924	3.80
Cyprohopladine	602	2.23	127	4.74
Diphenhydramine	5110	18.91	1077	4.74
Dipyridamole	169	0.63	31	5.45
Disopyramide	66	0.24	9	7.33
Doxepin	2141	7.92	236	9.07
Hydroxyzine	4011	14.85	905	4.43
Indomethacine	1666	6.17	422	3.95
Methyldopa	35	0.13	7	5.00
Oxybutynin	3238	11.98	636	5.09
Promethazine	777	2.88	335	2.32
Reserpine	6	0.02	5	1.20
Ticlopidine	135	0.5	24	5.63
Total	27019	100	3901	

* Includes butabarbital, seconbarbital, and pentobarbital

This preliminary study is one part of a patient safety research agenda exploring innovative uses of information technology to improve medication safety in the outpatient setting. These descriptive studies tested the utility of VHA administrative datasets, especially the PBM datamart, in tracking BZD outpatient utilization on a population basis, and identifying risk factors for injuries and other adverse events in this population and suitable cohorts for inclusion in subsequent phases of the research.

We found that outpatient BZD usage was associated temporally with serious injuries and significant medical costs. The direct medical costs associated with inpatient stays for patients who were on BZDs at the time of their injuries were approximately $2.89 million for 297 unique patients (Table 1). In addition, during the study period, 1,352 unique patients had 2,977 outpatient visits, costing almost $400,000, while receiving outpatient BZD prescriptions (Table 2). The outpatient costs reflect the primary diagnosis fields grouped into CCS injury classes. Including outpatient costs for injuries while on BZDs raises the total health care costs for injuries while receiving BZDs to approximately $3.3 million.

Because the CCS classes homogenize injuries, it is not clear whether BZD users had more severe injuries within a particular CCS class. By way of example, both open and closed fractures of the femur are grouped into one CCS class. It is clear that the open femur fractures are more severe injuries than the closed ones and could require more health care services and a longer length of hospital stay. There may also be comorbidities and/or important demographic features that could result in additional health care utilization and costs. The exact nature of the impact of BZD usage on the severity of the injuries remains an issue for further study.

We identified almost 6 percent (59,766/1,040,933) of the prescriptions for the 60+ year-old cohort as potentially inappropriate according to the ZL criteria. Approximately 5 percent (466/9,304) of this older group of outpatients received an “always avoid” medication (average of 6 prescriptions during the study period), compared with 2.6 percent for Zhan.[18] Forty five percent (4,196/9,304) of the unique patients in our elderly group received a prescription for “rarely appropriate” drugs, compared with Zhan’s 9.1 percent. Finally, 42 percent (3,901/9,304) of the patients who were in the older cohort received medications categorized as having “some indications,” compared with 13.3 percent in Zhan’s study.

Unique individuals might have received medications in more than one of the ZL categories. Since all members of our study cohort received at least one BZD prescription during the 3-year period, and our age criteria were slightly lower, the proportion of inappropriate prescribing may be slightly overstated. Nevertheless, our findings are consistent with those of other researchers. For instance, Liu and Christensen reviewed studies reporting inappropriate prescribing based on the Beers explicit criteria.[17] Their review found the prevalence of elderly patients using at least one inappropriately prescribed drug ranging from a high of 40 percent for nursing home patients to 21.3 percent for community-dwelling patients 65+ years old.[16] Goulding analyzed 6 years of National Ambulatory

Medical Care Survey and National Hospital Ambulatory Medical Care Survey data (1995–2000) and applied both the Beers 1997 criteria and the Zhan's list of potentially inappropriate medications.[29] Goulding reported 2.75–3.98 percent of physician office visits or hospital outpatient visits for years 1995–2000 (each year was analyzed separately) resulted in an "always avoid" or "rarely appropriate" prescription, and 3.43–4.47 percent resulted in a "some indications" prescription.[29] While these studies employed slightly different approaches, our results confirm that the amount of inappropriate prescribing in the elderly remains high.

We should note some limitations in this preliminary study and some areas of future research. Our study population consisted of community-dwelling, predominantly older, and overwhelmingly male (90 percent) veterans receiving outpatient prescriptions from one VHA hospital system, including the medical center, and associated outpatient clinics and community-based outpatient clinics. Patient records that were included in the study were selected on the basis of those receiving an outpatient BZD prescription during the 3-year study period. Since we examined 3 years of prescription data, we modified the age criterion and included patients who were 60 years or older during the study period. While this method permitted inclusion of data for patients less than 65 years of age, that age is somewhat arbitrary when considering inappropriateness, and often used for convenience or is related to use of Medicare datasets.

We selected Zhan's criteria of potential inappropriate medications to apply to our study population. The ZL criteria do not account for drug dosage, drug-drug, or drug-disease interactions. Fick et al. attempted to take these factors into account in their criteria.[22] In this study, we did not analyze the impact of BZD drug dose and duration on either the occurrence of adverse events or the appropriateness of the prescription controlling for possible confounding factors like comorbidities or drug or alcohol abuse, which could potentially increase a patient's risk for an injury. However, our research group has recently modeled the impact of BZD dose, duration, comorbidities, and other variables on the risk of an injury.[48] Using the Elixhauser comorbidity measures[49] and overlapping the BZD drug data (1999–2001) with discharge data with a 1-year look back period (1998), we found that of the 17,558 patients prescribed BZD, 939 had an Elixhauser comorbidity of alcohol abuse, and 502 had a drug abuse comorbidity. Future refinements to these analyses will examine the impact of drug-drug and drug disease interactions on the risk of an injury.

The administrative data did not support examining the mechanism of injury. The mechanism of injury (E-codes) could not be ascertained for all the injuries under study because of the lack of E-coding for most of the health care injury encounters. Our analysis shows that less than 50 percent of injury discharges in the VHA system have an E-code. This is comparable to recently published national studies of civilian injury hospitalizations where E-coding was present for 60 percent of the discharges.[47] Clustering injury-related visits into episodes of care and attributing costs to particular injuries, separate from other medical conditions, i.e., unrelated comorbid conditions, proved to be a challenge.

Future studies will refine the episodes of care associated with the treatment of particular types of injuries. The current study examined only direct costs associated with the hospital phase of care for an injury. We did not link the costs for the outpatient portion of care for an injury with the hospitalizations to create a total cost for an injury episode of care, due to the complexity of these analyses and the preliminary nature of this study. We are currently developing economic models for episodes of care. We will be replicating this research using all prescriptions for the population served by this hospital system. Our analyses are also being extended to Veterans Integrated Service Network (VISN) and national veteran populations. These studies are currently underway in conjunction with the VISN 8 PBM and the VHA Center for Medication Safety.

Conclusion

PBM data linked with clinical administrative data can be used to identify evidence of a broad spectrum of adverse events (patient injuries) linked to potentially inappropriate prescribing patterns in elderly outpatients. This preliminary study provides information and a methodology that can be used by Pharmacy Benefit Managers, clinicians, and patient safety researchers to more effectively target patient safety interventions and to promote evidence-based practice. This pilot study is currently being expanded to include a Beers criteria-based study of outpatient prescriptions in VISN 8.

This study was made possible by the unique richness of computerized data available within the VHA. The ability to link detailed pharmacy data with clinical data is essential for studying the impact of medications on the risk for injuries and costs. Future injury risk studies will take advantage of these datasets to enhance patient safety and reduce medication adverse events.

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