Developing a Veterans Health Administration (VHA) Serious Injury Surveillance System that Includes Adverse Event Hospitalizations

Robert R. Campbell, Douglas D. Bradham, Aurora Sanchez-Anguiano, Dennis H. Werner, Andrea M. Spehar, Dustin French, Polly Palacios

Abstract

Objectives: The objective of this study was to examine the feasibility of applying the State and Territorial Injury Prevention Directors Association (STIPDA) consensus recommendations for using hospital discharge data in injury and adverse event surveillance to the Veterans Health Administration (VHA) population. The utility of developing an injury surveillance system that also included adverse events due to medical care was examined for its potential contributions to VHA patient safety programs and research. **Methods:** Selected variables from all VHA hospital inpatient discharges for 5 fiscal years (1998–2002) were extracted from the National Patient Care Dataset. The resultant dataset had more than 2.8 million records. The selected variables extracted included demographic and clinical information. Discharges for injuries and adverse events due to medications and medical complications were identified using the primary admitting diagnosis in accordance with STIPDA recommendations. The injuries and adverse events were grouped into categories using the Clinical Classification Software developed by the Agency for Healthcare Research and Quality (AHRQ). The medical care costs for these injury and adverse event hospital discharges were obtained from the VHA Decision Support System (DSS). **Results:** Over the study time frame, 153,153 injury and adverse event discharges occurred, with more than 1.8 million inpatient days, and $2.0 billion in direct medical care costs. In any given year, injury and adverse event discharges accounted for approximately 10 percent of total hospital medical costs and approximately 5 percent of the total discharges. Hospitalizations for adverse events associated with medical care, or medication adverse events, represented more than 50 percent of the hospitalizations. **Conclusions:** VHA administrative hospital discharge datasets can be used following STIPDA recommendations to monitor trends in the incidence and costs of veterans' hospitalizations for injuries as well as adverse events. The information gained from this enhanced injury surveillance system has the potential to positively affect current VHA patient safety and injury prevention initiatives.

Introduction

Patient safety has been defined by the Institute of Medicine (IOM) as "freedom from accidental injury."[1] The IOM, in its 1999 report further noted, "[T]his definition recognizes that this is the primary safety goal from the patient's

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
MAY 2005	**N/A**	**-**

4. TITLE AND SUBTITLE
Developing a Veterans Health Administration (VHA) Serious Injury Surveillance System That Includes Adverse Event HOspitalizations

5a. CONTRACT NUMBER
5b. GRANT NUMBER
5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)

5d. PROJECT NUMBER
5e. TASK NUMBER
5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Agency for Healthcare Research and Quality Office of Communications and Knowledge Transfer 540 Gaither Road, Suite 2000 Rockville, MD 20850

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSOR/MONITOR'S ACRONYM(S)
11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release, distribution unlimited

13. SUPPLEMENTARY NOTES
Published in Advances in Patient Safety: From Research to Implementation. Volumes 1-4, AHRQ Publication Nos. 050021 (1-4). February 2005. Agency for Healthcare Research and Quality, Rockville, MD. http://www.ahrq.gov/qual/advances/.

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**UU**	**16**	

perspective."[1] VHA former Undersecretary for Health, Kenneth W. Kizer, M.D., underscored the primacy of patient safety in health care: "The medical imperative is clear: to make health care safe, we need to redesign our systems to make errors difficult to commit and create a culture in which the existence of risk is acknowledged and injury prevention is recognized as everyone's responsibility."[2] The VHA is the largest integrated public health care delivery system in the United States. It currently provides health care services to more than 6.8 million enrolled veterans. VHA facilities are located in all 50 states and Puerto Rico. The system currently includes 162 hospitals, hundreds of hospital-based outpatient clinics, long-term care facilities, and more than 850 community outpatient clinics.

Injury surveillance systems have been operational and producing public information on trends in injuries at the state and national level under the auspices of the Centers for Disease Control (CDC)'s National Center for Injury Prevention and Control for many years. There are no comparable comprehensive injury-surveillance systems operating and reporting publicly at the national level in the VHA system. Injury surveillance systems have traditionally not included data on adverse events due to medical care or medications.[3–7] Adverse event tracking and reporting have historically the province of risk management and, recently, of increased interest in patient safety initiatives. The patient safety movement is of relatively recent origin in the United States and the VHA's National Center for Patient Safety is a leader in this movement.

The veteran population is rapidly aging and is at risk for the same kinds of serious injuries requiring hospitalization that have been tracked with comprehensive injury-surveillance systems focused on the non-VHA population for many years. The VHA also recognizes that many injuries to patients occur as the result of medical care and is developing many comprehensive patient safety initiatives. The VHA emphasizes a culture of safety and focuses its patient safety initiatives and reporting on systems issues associated with adverse events. These reporting systems are confidential and are used internally to improve patient safety programs. There is no comparable publicly reported information on injuries and adverse events requiring hospitalizations for the VHA similar to the data readily available on the AHRQ Web site.

STIPDA is a major policy and coordinating organization for state and national injury surveillance systems in the United States. It recently published a consensus statement on the utility of using hospital discharge data for injury and adverse event surveillance.[3] The utility of applying the public health injury surveillance model to patient safety research has been reported elsewhere in the literature.[4] The goal of this research was to examine the utility of developing a national veteran injury-surveillance system based on the public health injury-surveillance approach using STIPDA case-finding recommendations. It would use all of the VHA hospital discharge data and, for the first time, track and trend patient injuries requiring hospitalizations due to all causes. This system would combine elements similar to the state's current injury surveillance systems and add patient-safety related data designed to monitor injuries resulting from medical care.[5–8] The data

derived from this system would be examined for its potential contribution to injury prevention and patient safety programs in the VHA.

The surveillance system would be based on STIPDA's recent recommendations on the use of hospital discharge data for injury and adverse event surveillance. Medication-related hospitalizations and hospitalizations for complications due to medical care are unique new additions in this injury surveillance study. Past studies of patient safety—such as the Harvard medical practice studies in New York, Colorado, and Utah—have primarily focused on studying the delivery of care associated with hospitalizations. These studies were based on a sample of medical record reviews and attempted to identify errors and preventability, but did not extensively examine comprehensive discharge datasets for all admissions coded for adverse events due to medical care.[9–10] Recently researchers have used hospital discharge datasets to publish studies of injury hospitalizations or of hospitalizations for adverse events related to medical care.[11–16] Currently there is a great deal of interest in developing national patient-safety data systems.[16–20] This interest parallels national efforts in injury surveillance and patient safety.[1,18, 19]

The STIPDA report noted that hospital discharge data have several attributes that make them ideal candidates for injury surveillance research.[3] First, injury hospitalizations are an indication of the seriousness of the injury and are prime targets for injury prevention efforts. Secondly, they noted that hospital discharge datasets are now being collected in 42 states and represent one of the most widely available sources of standardized statewide health care data.[3] Population-based surveillance is the preferred level of analysis for injury and adverse event surveillance.[1, 3, 19, 21] Finally, because of the geographic information available in hospital discharge data, they provide an opportunity for prevention programs to be based at the county and city level. STIPDA also noted "hospital discharge data may be more useful than vital records for surveillance in less-populated areas for particular types of injuries that seldom result in death but do result in hospitalizations."[3]

Methods

Study design

The study was a national retrospective analysis of the number and types of hospitalizations for injuries and adverse events that occurred in the VHA system during fiscal years 1998–2002. Injuries and adverse events are defined by International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) diagnosis codes that have been aggregated into mutually exclusive categories using the AHRQ-developed Clinical Classification Software (CCS.)[22] The CCS categories that define injuries and adverse events are listed in Table 1.

Table 1. Trends in VHA injury and adverse event hospitalizations: by discharge frequency

CCS Code	CCS Injury Class	FY1998	FY1999	FY2000	FY2001	FY2002	Totals by CCS	% Total Discharges
237	Complication of device, implant, or graft	8,723	8,717	8,950	9,056	8,990	**44,436**	29.01%
238	Complications of surgical procedures or medical care	6,603	7,217	7,216	7,831	8,738	**37,605**	24.55%
226	Fracture of neck of femur (hip)	2,825	2,791	2,671	2,623	2,346	**13,256**	8.66%
242	Poisoning by other medications and drugs	1,785	1,846	1,744	1,733	1,607	**8,715**	5.69%
230	Fracture of the lower limb	1,682	1,735	1,662	1,741	1,547	**8,367**	5.46%
244	Other injuries and conditions due to external causes	1,157	1,189	1,154	1,287	1,184	**5,971**	3.90%
231	Other fractures	943	978	872	967	915	**4,675**	3.05%
229	Fracture of the upper limb	857	874	777	783	742	**4,033**	2.63%
225	Joint disorders and dislocations, trauma-related	765	647	628	539	501	**3,080**	2.01%
232	Sprains and strains	723	631	565	577	487	**2,983**	1.95%
233	Intracranial injury	720	694	674	666	659	**3,413**	2.23%
241	Poisoning by psychotropic agents	715	724	623	657	506	**3,225**	2.11%
239	Superficial Injury, contusion	582	519	540	570	578	**2,789**	1.82%
236	Open Wounds of extremities	549	551	520	497	517	**2,634**	1.72%
228	Skull and face fractures	438	398	346	310	276	**1,768**	1.15%
240	Burns	355	324	280	304	240	**1,503**	0.98%
234	Crushing injury or internal injury	336	336	312	362	325	**1,671**	1.09%
235	Open Wounds of head, neck, and trunk	307	290	247	239	236	**1,319**	0.86%
243	Poisoning by non-medicinal substances	242	251	250	219	193	**1,155**	0.75%
227	Spinal cord injury	122	137	111	91	94	**555**	0.36%
	TOTAL INJURY DISCHARGES by FY	**30,429**	**30,849**	**30,142**	**31,052**	**30,681**		**100.00%**
	5 year TOTAL INJURY DISCHARGES						**153,153**	

*CCS = Clinical Classification Software

Case identification

In collaboration with other interested organizations, STIPDA published recommendations for the appropriate use of hospital discharge data for injury surveillance purposes. In particular, its recommendation that the primary admitting diagnosis be used to identify injury hospitalizations was adopted as the injury case-finding method for this study.[3] The VHA hospital discharge datasets have diagnosis coding that allow the primary admitting diagnosis to be readily identified.[23]

Sources of data

Selected variables from all of the VHA hospital inpatient discharge datasets for 5 fiscal years (1998–2002) were extracted from the centralized VHA data repository at the Austin Automation Center (AAC, Medical Inpatient SAS datasets.)[23] This produced a discharge dataset with more than 2.8 million discharge records from the Patient Treatment File (PTF.) The selected variables extracted included demographic information on the patient; all ICD-9-CM coded clinical diagnoses associated with the inpatient stay; information on procedures and surgeries associated with the hospitalization; and discharge status. The direct medical care costs associated with these 5 fiscal years of discharges were obtained from the DSS data at the AAC. The AHRQ's single level Clinical Classification Software was used in the feasibility study to group the primary discharge diagnoses into clinical classes. The hospital discharges coded with the 20 CCS injury classes (225–244) were identified and incorporated into the database.[22] These CCS injury classes, comprising mutually exclusive groupings of ICD-9-CM codes in the 800–999 range, included various types fractures; sprains; wounds; complications due to procedures or use of medical devices; and medication and other poisoning-related discharges.[22]

The clinical information included the primary admitting diagnosis, up to nine additional secondary diagnoses, information concerning the length of stay, and the Diagnosis-Related Group (DRG) assigned to the hospitalization. Demographic variables included age, gender, race, the percentage of service-connected disability for the veteran, and information concerning the Veterans Integrated Service Network (VISN) and the facility where the care was provided. The DSS cost data of VHA provided average cost data by CCS injury categories for the analyses. Enrollment and workload data were obtained from the VHA Planning System Support Group (PSSG) enrollment data and from VHA national and VISN health care utilization reports.[24]

Analyses

The primary admitting diagnosis ICD-9-CM codes were aggregated into the 20 injury categories using the AHRQ's CCS injury coding taxonomy. The CCS is an ICD-9-CM grouper software program that was used to aggregate the diagnosis codes into mutually exclusive diagnosis categories. It was used because it is a

widely available, standardized taxonomy used by the VHA and the civilian sector. Also, data based on CCS injury categories is readily available on the AHRQ Web site with national and state-specific data on trends and costs associated with the injury and adverse event categories.[25] The primary focus of the analysis was on identifying the number, relative proportions, time trends, and costs associated with injury and adverse event hospitalizations. Particular emphasis was placed on analyses of the adverse event hospitalizations to emphasize their importance in VHA patient safety-related programs and initiatives.

Descriptive analyses produced frequency distributions for hospitalizations by CCS injury and adverse event classes. Injury hospitalizations, medication-related hospitalizations (CCS categories 241 and 242), and adverse events (CCS categories 237 and 238) were analyzed. Five-year trends in the number of injury discharges were computed nationally and by VISNs over the 5-year time period. Injury hospitalization costs were computed using national average cost data from the VHA DSS. The national average inpatient discharge costs by fiscal year for each CCS category of injury were used to calculate the direct medical care costs associated with the hospitalizations. Costs were computed and trended for each CCS injury class nationally, and by VISNs, over the 5 years. The proportion of total injuries associated with each CCS category was computed. Analyses were conducted using Microsoft Access, Microsoft Excel, and Statistical Analytical System (SAS) software Version 8.2.

We received human subject protection permissions to conduct this study from the VHA Research and Development Committee and the associated University Institutional Review Board.

Results

Overall trends

There were 153,153 hospitalizations involving 99,550 unique patients with an injury or adverse event over the 5-year time period. Approximately 53 percent of the study admissions were coded as adverse events related to medical care, 39 percent were injury coded, and 8 percent were medication coded. By major CCS categories, there were 82,041 hospitalizations associated with adverse events related to medical care (CCS categories 237 and 238), 59,172 injury hospitalizations, and 11,940 medication-related hospitalizations (CCS categories 241 and 242). There were over 1.8 million bed days of care (BDOC) and over $2.0 billion in direct medical care costs associated with these hospitalizations.

CCS categories

The overall trends in specific CCS category discharges and total BDOC were fairly constant over the 5 years for the VHA system. The estimates of the inpatient total costs of direct medical care per year, however, increased from approximately $383 million to more than $450 million. Analyses conducted at the 22 VISN level found that there was considerable variation in the number, proportions, and direct

costs of medical care in the individual CCS injury classes. National trends in the number of discharges associated with the CCS categories are listed in Table 1.

Inpatient mortality

There were 3,916 patients (3.9 percent of the 99,550 unique patients) who were coded for inpatient deaths associated with these hospitalizations over the 5-year study period. Approximately 2.6 percent of the total discharges (153,153 total discharges) over the 5 years were coded with inpatient deaths**.** For individual CCS categories, the highest percentages of the total discharges coded with an inpatient death over the 5-year period were associated with intracranial injuries (10.6 percent), hip fractures (6 percent), and spinal cord injuries (5.6 percent).

The adverse events associated with medical care (CCS 237 and 238) jointly accounted for 4.7 percent of the inpatient deaths overall for the 5-year time frame. However, when one examines the trends in the percentage of inpatient deaths associated with these two adverse event CCS categories by individual fiscal year (FY), the trends show that the percentage grew from approximately 45 percent in FY1998 (335 of 745) to nearly 60 percent in FY2002 (482 of 808). Nearly 50 percent (1934 of 3916) of the total inpatient deaths over 5 years in this study were associated with CCS categories 237 and 238. The trends in number of inpatient admissions by CCS categories coded for mortality are displayed in Table 2.

Complications of medical care

The CCS categories coded for complications associated with a device, implant, or graft (CCS 237) and complications of surgical procedures or medical care (CCS 238) were analyzed using the CCS multilevel categories to provide more information about the types of cases aggregated into these two categories. Complications associated with devices, implants, or grafts accounted for 53 percent (44,436 of 82,041) of the hospitalizations. Complications due to surgical procedures or medical care accounted for 47 percent (37,605 of 82,041) of the admissions. These 82,041 discharges were disaggregated and analyzed using the CCS multilevel software. There were 79,906 cases analyzed using the multilevel coding taxonomy. Nearly 25 percent of the admissions over the 5 years were coded for “malfunctions” of a device, implant, and graft. Discharges coded for “postoperative infections” and “other complications of surgical and medical procedures” constituted 18 percent and 15 percent of the admissions respectively. The results of this analysis are in Table 3.

Drug adverse event admissions

There were 11,940 admissions coded as poisonings due to psychotropic drugs or due to other medications and drugs during the study period. Approximately 27 percent of the total admissions associated with medication adverse events were associated with psychotropic drugs. Poisonings due to benzodiazepine tranquilizers consistently ranked as the primary ICD-9-CM coding for drug

Table 2. Trends in inpatient mortality associated with injuries and adverse event hospitalizations

		FY1998		FY1999		FY2000		FY2001		FY2002		% Deaths	Totals Discharge	% Total Mortality
CCS Injury Class	FY98	%Mortality	FY99	%Mortality	FY00	%Mortality	FY01	%Mortality	FY02	%Mortality	TOTAL	**in CCS**	**by CCS**	**by CCS**
Complication of device, implant, or graft	**190**	**25.50%**	**174**	**22.57%**	**178**	**23.27%**	**191**	**23.10%**	**179**	**22.15%**	**912**	**23.29%**	**44,436**	**2.05%**
Fracture of neck of femur (hip)	175	23.49%	157	20.36%	155	20.26%	180	21.77%	125	15.47%	792	20.22%	13,256	5.97%
Complications of surgical procedures or medical care	**145**	**19.46%**	**189**	**24.51%**	**170**	**22.22%**	**215**	**26.00%**	**303**	**37.50%**	**1022**	**26.10%**	**37,605**	**2.72%**
Intracranial injury	77	10.34%	68	8.82%	78	10.20%	75	9.07%	64	7.92%	362	9.24%	3,413	10.61%
Other injuries and conditions due to external causes	39	5.23%	46	5.97%	51	6.67%	38	4.59%	41	5.07%	215	5.49%	5,971	3.60%
Other fractures	26	3.49%	24	3.11%	27	3.53%	27	3.26%	17	2.10%	121	3.09%	4,675	2.59%
Poisoning by other medications and drugs	**21**	**2.82%**	**30**	**3.89%**	**41**	**5.36%**	**36**	**4.35%**	**21**	**2.60%**	**149**	**3.80%**	**8,715**	**1.71%**
Fracture of the lower limb	19	2.55%	16	2.08%	18	2.35%	19	2.30%	19	2.35%	91	2.32%	8,367	1.09%
Crushing injury or internal injury	11	1.48%	4	0.52%	5	0.65%	11	1.33%	6	0.74%	37	0.94%	1,671	2.21%
Fracture of the upper limb	9	1.21%	7	0.91%	7	0.92%	8	0.97%	5	0.62%	36	0.92%	4,033	0.89%
Superficial Injury, contusion	7	0.94%	9	1.17%	3	0.39%	4	0.48%	7	0.87%	30	0.77%	2,789	1.08%
Poisoning by non-medicinal substances	6	0.81%	1	0.13%	4	0.52%	0	0.00%	2	0.25%	13	0.33%	1,155	1.13%
Poisoning by psychotropic agents	**5**	**0.67%**	**7**	**0.91%**	**2**	**0.26%**	**3**	**0.36%**	**4**	**0.50%**	**21**	**0.54%**	**3,225**	**0.65%**
Burns	4	0.54%	6	0.78%	3	0.39%	3	0.36%	1	0.12%	17	0.43%	1,503	1.13%
Spinal cord injury	4	0.54%	9	1.17%	8	1.05%	6	0.73%	4	0.50%	31	0.79%	555	5.59%
Open Wounds of extremities	3	0.40%	4	0.52%	3	0.39%	3	0.36%	2	0.25%	15	0.38%	2,634	0.57%
Joint disorders and dislocations, trauma-related	2	0.27%	5	0.65%	6	0.78%	3	0.36%	3	0.37%	19	0.49%	3,080	0.62%
Skull and face fractures	2	0.27%	3	0.39%	3	0.39%	2	0.24%	1	0.12%	11	0.28%	1,768	0.62%
Open Wounds of head, neck, and trunk	0	0.00%	10	1.30%	3	0.39%	2	0.24%	2	0.25%	17	0.43%	1,319	1.29%
Sprains and strains	0	0.00%	2	0.26%	0	0.00%	1	0.12%	2	0.25%	5	0.13%	2,983	0.17%
TOTALS:	**745**	**100.00%**	**771**	**100.00%**	**765**	**100.00%**	**827**	**100.00%**	**808**	**100.00%**	**3916**	**100.00%**	**153,153**	

Table 3. Frequencies of CCS multilevel codes for medical adverse events over time (CCS 237-238)

Code description	FY1998	FY1999	FY2000	FY2001	FY2002	Totals	%Total
Malfunction of device, implant, and graft	4,142	4,018	4,022	3,805	3,,629	19,616	24.55%
Infection and inflammation—internal prosthetic device, implant, and graft	2,226	2,235	2,252	2,511	2,560	11,784	14.75%
Other complications of internal prosthetic device, implant, and graft	2,053	2,055	2,169	2,362	2,228	10,867	13.60%
Complications of transplants and reattached limbs	156	200	237	214	210	1,017	1.27%
Cardiac complications	251	279	268	329	307	1,434	1.79%
Respiratory complications	130	137	136	145	154	702	0.88%
Gastrointestinal complications	424	426	423	443	480	2,196	2.75%
Urinary complications	160	225	193	218	292	1,088	1.36%
Hemorrhage or hematoma complicating a procedure	747	920	978	1,085	1,073	4,803	6.01%
Postoperative infection	2,692	2,819	2,784	2,960	2,846	14,101	17.65%
Other complications of surgical and medical procedures	2,199	2,411	2,434	2,651	2,603	12,298	15.39%
Totals	15,180	15,725	15,896	16,723	16,382	**79,906**	100.00%

poisoning admissions over the five-year study period. Admissions with ICD-9-CM codes as due to the "adverse effects of medical or biological substances" and "poisonings due to antidepressants" were also problematic drug adverse events. The CCS classes associated with these psychotropic drugs and medications do not include illicit drugs such as heroin or cannabis.

Frequency of admission by unique patients

The 153,153 injury and adverse event coded admissions were associated with 99,550 unique patients. More than 90 percent of the unique patients who were admitted over the study period had one or two injury-coded admissions. Only a very few number of patients had more than 10 admissions over the 5-year time frame. Table 4 summarizes trends in adverse event discharges (CCS classes 237–238, 241–242), total direct costs of medical care, BDOC, average lengths of stay (ALOS), and the number of unique patients.

Discussion

The trends in the number of injury and adverse event coded hospitalizations in the VHA and their costs have remained fairly constant over the 5-year study period. This is similar to observed trends in these 20 CCS categories available online from the AHRQ Web site. In any given year, the injury and adverse event-related VHA discharges accounted for approximately 5 percent of the total discharges, but consumed nearly 10 percent of the acute hospital expenditures. Previous studies have reported similar cost profiles associated with injury and adverse event hospitalizations.[6–14] The opportunities for tracking, trending, and committing resources these injuries and adverse events through injury prevention

Table 4. Trends in adverse event hospitalizations: discharges, costs, BDOC, ALOS, unique patients

CCS Class‡	FY	Average Cost Discharge	Total Disch	Total Costs	BDOC*	ALOS†	Unique Patients
237	1998	$15,036.31	8,723	$131,161,732	85,890	9.8	7,261
	1999	$14,537.85	8,717	$126,726,438	77,185	8.9	7,173
	2000	$14,078.96	8,950	$126,006,692	73,531	8.2	7,304
	2001	$15,006.09	9,056	$135,902,486	76,296	8.4	7,524
	2002	$15,596.80	8,990	$140,215,232	65,039	7.2	7,279
Totals			**44,436**	**$660,012,581**	377,941	**8.5**	
238	1998	$11,304.47	6,603	$74,643,415	70,617	10.7	5,901
	1999	$10,891.33	7,217	$78,602,729	71,828	10.0	6,462
	2000	$11,869.17	7,216	$85,647,931	69,353	9.6	6,482
	2001	$12,546.20	7,831	$98,249,292	73,676	9.4	7,035
	2002	$12,240.89	8,738	$106,960,897	65,279	7.5	7,027
Totals			**37,605**	**$444,104,264**	350,753	**9.3**	
241	1998	$5,686.09	715	$4,065,554	5,998	8.4	684
	1999	$5,936.08	724	$4,297,722	4,966	6.9	702
	2000	$5,997.26	623	$3,736,293	4,024	6.5	606
	2001	$6,922.00	657	$4,547,754	4,660	7.1	634
	2002	$6,692.92	506	$3,386,618	2,434	4.8	496
Totals			**3,225**	**$20,033,941**	22,082	**6.8**	
242	1998	$4,875.53	1,785	$8,702,821	10,330	5.8	1,729
	1999	$5,189.34	1,846	$9,579,522	10,249	5.6	1,772
	2000	$5,875.36	1,744	$10,246,628	10,254	5.9	1,677
	2001	$6,220.85	1,733	$10,780,733	9,732	5.6	1,668
	2002	$6,278.95	1,607	$10,090,273	7,884	4.9	1,550
Totals			**8,715**	**$49,399,976**	**48,449**	**5.6**	

* Bed days of care
† Average length of stay
‡ Clinical Classification Software

and patient safety programs is evident from these kinds of injury surveillance analyses.

National initiatives in research on patient safety using hospital discharge data are currently underway, as previously noted. Some important observations must be made about the use of hospital discharge data for injury surveillance and adverse event reporting. First, one cannot use hospital discharge data alone for epidemiological studies of the incidence and prevalence of injury conditions. An injury hospitalization represents one possible tier on the "injury pyramid" as a setting of care. Measuring the incidence of injuries at this level will not provide a complete picture of the incidence, prevalence, mortality, morbidity, and costs associated with treating any particular category of injury across the many settings

of care where injuries are treated. Second, hospital discharge data is primarily collected for billing purposes and not to conduct injury studies, which is why there is no specific information available on the timing, or the preventability, of the injury in discharge data.[3] One cannot generally tell with certainty from the diagnosis coding in discharge datasets whether the injury or adverse event was present on admission or developed while in the hospital. This is especially problematic unless one chooses to use the STIPDA criteria that focus on the admitting diagnosis. However, by using only the admitting diagnosis to identify cases included in the surveillance system, one runs the risk of underestimating the true number of injury cases. This is especially true in the case of adverse events that occurred during hospitalization and are coded in the secondary diagnosis fields. Diagnosis coding issues to identify injury cases of interest in medical discharge records are well-established issues in the injury surveillance field. Previous STIPDA consensus statements have focused on specification of the particular codes used to define important types of injuries.[8]

This study chose to adopt the STIPDA case-finding definition to combine injuries and adverse events in one dataset. This approach was chosen because the VHA is a comprehensive, nationally managed care program with an enrolled population. There are clinical and financial incentives inherent in the VHA system that would support these kinds of comprehensive public health-oriented injury and adverse event studies. There are comprehensive electronic medical records and related health care datasets that allow for the detailed study of injuries and adverse events on a national basis.

The debate about what kinds of cases to study in patient safety research is well known. Whether one chooses to study all injuries coded as related to medical care, or only a subset of preventable injuries that are clearly related to medical error is a judgment call.[4, 26] If one chooses to study only admitting diagnosis for injuries and adverse events there will be an underreporting of cases. Many adverse events occur during the inpatient episode and may be coded in the secondary diagnosis fields, such as postoperative wound infections. Previous pilot studies by the authors have shown that by adopting the STIPDA case-finding definition and not including a search of the secondary diagnoses, one would identify approximately 50 percent of the injury and adverse event hospitalizations in any given year. By way of example, in FY2002 in the VHA, there were 30,681 hospital discharges with an admitting diagnosis for an injury or adverse event. If one included the secondary diagnosis fields, the total coded admissions would be 65,848. Similar results can be observed in the online AHRQ Healthcare Cost and Utilization Project (HCUP) HCUPNet data, where one can select the primary diagnosis or all listed diagnoses.[25] Future research studies will incorporate the secondary diagnoses to ensure a more comprehensive study of injuries and adverse events involving hospitalizations and will also include veteran injuries and adverse events that are paid for in non-VHA facilities by Medicare.

There are other limitations inherent in using hospital discharge data in injury surveillance systems that include adverse events. Important risk factors are not routinely entered in discharge datasets. Risk factor identification facilitates injury-

prevention program development and should be an important component of injury surveillance systems.[21] Injury coding is incomplete in hospital discharge datasets.[21] Recent reports demonstrate that ICD-9-CM mechanism of injury coding (E-coding) is present in about 60 percent of the discharge records on a national level.[8, 15] Pilot studies conducted by the authors have found that approximately 50 percent of the VHA injury hospitalizations in the study dataset had an E-code. Increased national attention to reporting the ICD-9-CM mechanism of injury code and the place of occurrence codes is important for injury prevention and adverse event tracking initiatives.[1, 21]

This analysis may have limitations in its generalizability because it involved a predominantly male veteran population. Approximately 5 percent of the injury hospitalizations in the VHA involved females. However, it provides a unique contribution to the injury surveillance and adverse event literature because no published national time trend data or analysis on veteran injury or hospitalizations for adverse events exists. The utility of adapting the public health injury surveillance model using the STIPDA consensus-driven case definitions for an "injury hospitalization" applied to VHA hospital discharge data has been demonstrated. The use of the AHRQ Clinical Classification Software to present the data in 20 injury and adverse event categories produced the first national study of its kind using VHA discharge datasets. Because the case-finding definitions have been "standardized" using the CCS categories, one can compare the VHA experience with the public and private sector using readily available data online and published studies from AHRQ.

The VHA has well-established patient safety initiatives and adverse event tracking and reporting systems under the guidance of its National Center for Patient Safety.[27] These programs include well-established and effective programs in surgery and medication safety.[28, 29] The current analysis of major types of drugs that lead to hospitalizations for poisonings in this study will augment the current medication safety programs being undertaken by the VA's new Center for Medication Safety.[29] The study results also provide an opportunity for comparisons of injury and adverse event hospitalizations with the non-VHA sector because of the availability of similar data on the HCUPNet Web site.[25] Analysis of the non-VHA hospital sector's data, available from the AHRQ Healthcare Utilization Project (HCUP), can provide information on the types of complications that occur in the use of medical devices in rehabilitation, and complications due to medical care.[29]

This current analysis and injury surveillance dataset does not replace important VHA patient safety programs that are centered on inpatient reporting systems, rather it supplements those initiatives. It can produce data about the development of injuries and complications outside of the hospital setting. These injuries or adverse events can occur in other types of health care settings, at home, or elsewhere in the community. Additionally, an important component in any injury surveillance or patient safety program is information on baseline measurements to gauge the effects of intervention programs over time. This dataset provides additional information about injuries and adverse events that

develop or occur outside of the inpatient setting and may be used to supplement the current patient safety reporting systems in the VHA.

Conclusions

The feasibility of using VHA hospital discharge data to identify and track trends in injuries that include iatrogenic injuries has been demonstrated. The merging of injury surveillance data with patient safety data may produce a more comprehensive picture of the incidence and costs associated with hospitalizations for serious injuries of all types. Hospital discharge data is widely available at the state level and in many national non-VHA datasets based on well-established sampling frames.[30, 31] Several countries base important parts of their national patient safety reporting systems on analyzing injury hospitalizations and patients' experiences (e.g., the UK, Australia, New Zealand, and Canada.)[32–35] The utility and feasibility of using the AHRQ-developed CCS to group ICD-9-CM codes into mutually exclusive injury and poisoning groupings provides a consistent framework to present and compare the data across health care systems. Additionally, the availability of national and state estimates using the HCUPNet online data system for injuries, and the new Inpatient Quality Indicators, allows for comparisons of patient safety-related measures to be made at the state, regional, and national levels.[25] The STIPDA recommendation to use the primary admitting diagnosis as the primary means to identify injury and adverse event-related admissions in hospital discharge data represents the culmination of many years of discussion and consensus-building on case finding definitions. It provides another perspective on the burden to society of hospitalizations for serious injuries and adverse events.

This project built upon the authors' earlier studies on VHA injury surveillance and emerging initiatives in patient safety reporting systems to produce this VHA study dataset and analyses. The opportunities to build upon the basic structure of the current injury surveillance dataset with links to data from other settings of care, pharmacy data, and cost data is an opportunity to further both injury surveillance and patient safety-related research.

One of the unique features of the VHA administrative datasets for health services research is the use of a patient identifier that allows many administrative datasets to be linked. The use of this "scrambled social security number" in the VHA datasets greatly facilitates the identification of true incidence of injuries by unique patients.[23] It also allows one to develop and track episodes of care associated with the treatment for an injury across inpatient, outpatient, and other health care settings. Future VHA research will expand upon current patient safety research initiatives and use the surveillance data to track the incidence of fall-related injuries and medication adverse events; develop cost and utilization models to track the treatment of injuries in episodes of care; and identify risk factors for injuries to aid in focused injury prevention and patient safety programs. The VHA is a leader in patient safety research and intervention

programs that can provide important models and research that may be generalizable to other health care sectors.

Acknowledgments

The research reported/outlined here was supported by the Department of Veteran Affairs, Veterans Health Administration, Health Science Research Service. Robert R.Campbell, Ph.D., was the principal investigator in Tampa, FL. The views expressed in this article are those of the authors and do not necessarily represent the views of the Department of Veterans Affairs.

Author affiliations

VISN 8 Patient Safety Center of Inquiry, Tampa, FL (RRC, ASA, DHW, AMS, DF, PP.), VISN 5 Health Services Research and Development, Baltimore, MD (DDB).

Address correspondence to: Robert Campbell, J.D., MPH, Ph.D., VISN 8 Patient Safety Center of Inquiry, 11605 North Nebraska Ave., Tampa, FL 33612; e-mail: Robert.campbell3@med.va.gov; telephone: 813-558-3962.

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