

Comparison of Incidence of Hospital Utilization for Poisoning and Other Injury Types

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SYNOPSIS

Objectives. We investigated the incidence of hospital utilization for injuries and compared poisoning with other forms of injury. Previous studies have suggested poison control centers reduce health-care costs by decreasing hospital utilization.

Methods. We conducted a one-year retrospective study involving patients treated for injuries at acute-care hospitals in Kentucky in 2008. We also compared inpatient discharges with discharges directly from the emergency department (ED) to determine hospitalization rates. The primary data sources were the Kentucky Hospital Billing database and the Kentucky Regional Poison Control Center (KRPPCC) database.

Results. In 2008, there were 377,642 hospital encounters for injuries in Kentucky. The most common mechanisms of injury were falls, struck by/against, motor vehicle traffic crashes, and overexertion. Three causes of injury were greater than one standard deviation above the mean in percentage of inpatient admissions: poisoning (41.3%), firearms (38.4%), and drowning (22.4%). During this same year, KRPPCC reported 46,258 poisonings, with 76.5% of patients managed outside of a health-care facility, 11.4% of patients treated and released from the ED, 7.1% of patients admitted to inpatient care, 2.3% of patients admitted to psychiatric care, and 2.7% lost to follow-up.

Conclusions. Three causes of injury had the greatest percentage of patients admitted for inpatient medical care—poisoning, firearms, and drowning—suggesting a high level of severity in these injuries presenting to the ED. We believe availability and use of a poison control center reduced hospital utilization for poisoning primarily by managing a large number of low-severity patients outside of the hospital system.

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Overutilization of emergency departments (EDs) for non-emergent care remains a problem.¹⁻⁴ For a number of patients, including those with injuries, use of the ED may seem justified from the patient's perspective because the patient believes his or her symptoms are serious.⁵ However, utilization of EDs can be impacted by a number of factors, including cost (e.g., patient deductible), level of severity, use of a primary care physician, and availability of a poison control center (PCC).^{1,3,4,6,7}

PCCs in the U.S. manage more than 75% of reported poisonings outside of a health-care facility.⁸ This management has resulted in significant health-care cost savings—estimated at >\$900 million per year—by reducing ED utilization.⁹ In 2005, Medicare, Medicaid, and the State Children's Health Insurance Program were the primary payers in 47% of nonfatal poisoning hospital admissions, so much of these savings directly benefited federal and state governments.^{10,11} The reduction of ED utilization occurred primarily in patients who did not need emergent medical care but would likely have used the ED had there not been a PCC to contact.¹²

An example of a minor poisoning case that could be managed at home would be a normally healthy 2-year-old child who ingests 10 over-the-counter, 100-milligram (mg) ibuprofen tablets. While this would likely be frightening for the parent and cause mild gastritis and stomach pain for the child, it would not require ED care or direct, hands-on medical intervention. However, if this same child ingested 10 over-the-counter, 25-mg diphenhydramine tablets, an ED visit would be warranted.

A number of studies have examined the cost savings by PCCs from reduced ED utilization.^{7,12-19} The primary concept of this reduction is that 24-hour, free public access to highly trained health-care professionals allows appropriate triage and frequent redirection from what would have been, for many of these patients, a self-referral to the hospital ED.

To investigate this idea further, we evaluated hospital encounters for all injuries, including poisoning, for one year to compare the number of inpatient discharges with the number of patients discharged directly from the ED for these injuries. We investigated the incidence of hospital utilization for injuries and compared poisoning with other forms of injury. For the purpose of this study, we considered the ratio of inpatient discharges to total hospital encounters to be the hospital admission rate. Additionally, we reviewed all poisonings reported to the Kentucky Regional Poison Control Center (KRPPCC), which served the same population during the same time period, as a second

source of information on the number of poisonings occurring in the population.

METHODS

Data sources

We conducted a one-year retrospective study involving all patients treated for an injury or poisoning at any licensed, acute-care hospital in the state of Kentucky in 2008. The primary data sources were the Kentucky Hospital Billing database and the KRPPCC database.

KRPPCC database. We obtained PCC data for 2008 from the KRPPCC. KRPPCC created an individual electronic medical record on each patient and stored these in a searchable database. As part of each medical record, a number of data were recorded, including patient demographics (age, gender, and geographic location), specific substances involved in the case, resultant clinical effects, therapies employed, and medical outcome. The "patient management site" variable was coded as: (1) patient managed on-site (outside of a health-care facility), (2) patient already in (en route to) a health-care facility when the PCC was contacted, (3) patient referred by the PCC to a health-care facility, (4) other, or (5) unknown. Patients managed in a health-care facility were coded as: (1) treated/evaluated and released, (2) admitted to critical care, (3) admitted to non-critical care, (4) admitted to a psychiatric facility, or (5) lost to follow-up. We excluded from the study patients managed by KRPPCC outside of Kentucky (e.g., in Indiana). KRPPCC receives calls from all acute-care hospitals within Kentucky, as well as from the general public in all 120 state counties.

Kentucky Hospital Billing database. Since 1996, Kentucky Administrative Regulations (900 KAR 7:030, "Data reporting by health-care providers") have mandated reporting of all inpatient hospitalizations by licensed, acute-care hospitals and all encounters involving outpatient surgical or mammography procedures or services by the same hospitals, as well as ambulatory surgery centers. In addition to these mandated submissions, effective January 1, 2008, the regulation was updated to include reporting of all ED and observation care visits. Observation care typically involves a stay of less than 24 hours, with no admission.

Among the data elements facilities are required to report are patient demographics (age, gender, and race/ethnicity), admission and discharge dates, diagnostic and procedure codes, charges billed, patient disposition, and external cause of injury codes (hereafter, E-codes).

Analysis

In Kentucky, hospital outpatient billing records are classified into one of five service types, based on the reported Current Procedural Terminology and revenue codes from the Centers for Medicare and Medicaid Services. The service types and their definitions are provided in Figure 1. If a patient receives outpatient services (e.g., in an ED) and is admitted, the inpatient billing record will include those services; there will not be a separate outpatient billing record.

For this study, we counted as hospital encounters all inpatient records and any outpatient record classified as ED or observation care. We excluded records classified as other outpatient and outpatient surgery because our primary interest was ED utilization. We also excluded mammography records.

To identify injury and poisoning cases in the hospital database and classify them by the mechanism of injury, we followed the State and Territorial Injury Prevention Directors Association's (STIPDA) Consensus Recommendations for Using Hospital Discharge Data for Injury Surveillance.²⁰ Based on STIPDA guidelines, observations with a principal diagnosis listed in Figure 2 were excluded from this study. We then classified each injury or poisoning observation into one of 19 mechanism categories based on the first listed E-code. Each category includes injuries or poisonings of all manner, whether unintentional, self-inflicted, assaultive, or undetermined. The poisoning mechanisms are provided in Figure 3.

RESULTS

In 2008, there were 377,642 hospital encounters for injuries in Kentucky. Of these patients, 347,859 (92.1%) were treated and released from the ED; 3,626 (1.0%) received an observational stay, and 26,157 (6.9%) were admitted as inpatients (Table, Figure 4). The most common mechanisms of injury that had any kind of hospital encounter (e.g., ED, inpatient, or observational stay) were falls, struck by/against, motor vehicle traffic crashes, and overexertion. The most common

Figure 1. Codes and related service types for Kentucky hospital outpatient billing records, 2008

Code	Definition
OS	Outpatient surgery
OC	Observation care
ED	Emergency department
OT	Other outpatient
MA	Mammography

Figure 2. Principal diagnoses excluded from study based on STIPDA case definition for injury and poisoning on hospital discharge databases

ICD-9 code(s)	Description
<800	Other than injury or poisoning
909.3	Late effects of complications of surgical and medical care
909.5	Late effects of adverse effects of drug, medicinal, or biological substance
995.0–995.4	Other anaphylactic shock
995.6–995.7	Angioneurotic edema
	Unspecified adverse effect
995.86	Effect of drug, medicinal, or biological substance
995.89	Allergy, unspecified
	Shock due to anesthesia
	Anaphylactic shock due to adverse food reaction
	Malignant hyperpyrexia or hypothermia due to anesthesia
996–999	Complications due to certain specified procedures
	Complications affecting specified body systems NEC
	Other complications of procedures NEC
	Complications of medical care NEC

STIPDA = State and Territorial Injury Prevention Directors Association

ICD-9 = International Classification of Diseases, Ninth Revision

NEC = not elsewhere classified

mechanisms of injury that resulted in an inpatient hospitalization were falls, poisoning, and motor vehicle traffic crashes.

When we evaluated the cause of the hospital encounter by specific type of injury, the mean percentage of all patients admitted to inpatient care was 10.7% (standard deviation [SD] = 11.5). Three causes of injury were greater than one SD above the mean in percentage of inpatient admissions: poisoning (41.3%), firearms (38.4%), and drowning (22.4%).

When evaluating the cause of the hospital encounter for the combined groups of patients admitted for inpatient care and patients with an observational stay, the mean was 13.4% (SD=14.7) of patients. Three causes of injury were greater than one SD from the mean: poisoning (50.7%), firearms (41.7%), and drowning (39.5%).

During this same one-year period, KRCC reported 46,258 poisonings in Kentucky. Patients were either managed outside of a health-care facility (76.5%, $n=35,396$), treated and released from the ED (11.4%, $n=5,268$), admitted to inpatient critical care (5.7%, $n=2,624$), admitted to inpatient non-critical care

Figure 3. Poisoning mechanism categories into which acute-care hospital encounters for injury and poisoning were classified, Kentucky, 2008

E-code	Description
E850–E858	Accidental poisoning by drugs, medicinal substances, and biologicals
E860–E869	Accidental poisoning by other solid and liquid substances, gases, and vapors
E950	Suicide and self-inflicted poisoning by solid or liquid substance
E951	Suicide and self-inflicted poisoning by gases in domestic use
E952	Suicide and self-inflicted poisoning by other gases and vapors
E962	Assault by poisoning
E980	Poisoning by solid or liquid substance, undetermined whether accidentally or purposely inflicted
E981	Poisoning by gases in domestic use, undetermined whether accidentally or purposely inflicted
E982	Poisoning by other gases, undetermined whether accidentally or purposely inflicted

E-code = external cause of injury code

(1.4%, n=648), admitted to psychiatric care (2.3%, n=1,050), or lost to follow-up (2.7%, n=1,272).

DISCUSSION

Severity of diagnosis or injury has a significant effect on the ratio of ED patients who are hospitalized.^{1,21} In our study, when evaluating patients requiring hospital admission, three causes of injury for the hospital encounter were greater than one SD above the mean: firearms, poisoning, and drowning. One other cause showed hospitalization rates that were greater than the mean but had less than one SD: suffocation.

The high ratio of hospitalization for firearms is likely due to the severity of the injury.^{21,22} This is also probably the case with suffocation and drowning. Caution should be considered with the rate of suffocation and drowning because the actual numbers for these two causes are very low; therefore, a shift of just a few cases would have a significant impact on the hospitalization ratio (Table). However, the highest hospitalization ratio in our study was for poisoning, which suggests that a large proportion of poisoned patients who do arrive at the ED have a high severity of injury. Similar high hospitalization rates for poisoning have been reported previously from hospital data in Nebraska

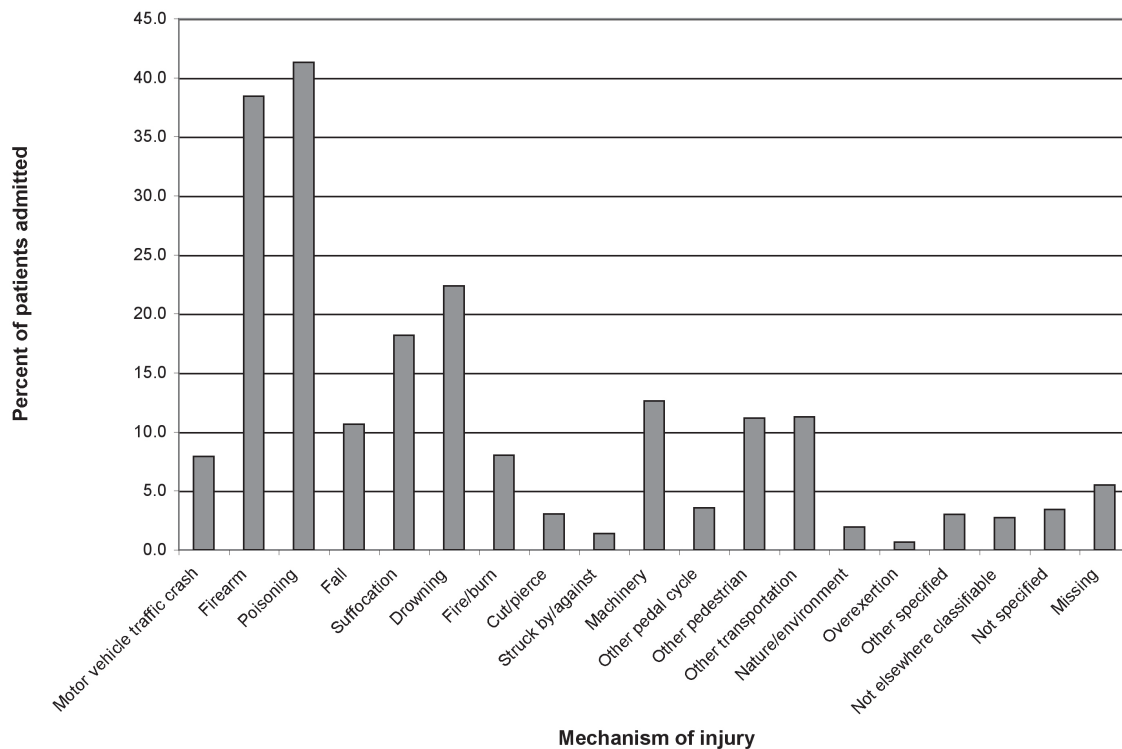
Table. Acute-care hospital encounters for injury and poisoning, by mechanism of injury and service type, Kentucky, 2008

Mechanism of injury	Service type			Total	Percent inpatients
	Emergency department ^a	Observational care ^b	Inpatient		
Motor vehicle traffic crash	38,697	414	3,354	42,465	7.9
Firearms	428	24	282	734	38.4
Poisoning	4,736	899	3,967	9,602	41.3
Fall	86,639	853	10,430	97,922	10.7
Suffocation	163	8	38	209	18.2
Drowning	46	13	17	76	22.4
Fire/burn	4,055	49	357	4,461	8.0
Cut/pierce	10,749	49	340	11,138	3.1
Struck by/against	42,959	157	607	43,723	1.4
Machinery	1,051	15	154	1,220	12.6
Other pedal cycle	2,831	27	106	2,964	3.6
Other pedestrian	184	7	24	215	11.2
Other transportation	6,227	100	804	7,131	11.3
Nature/environment	14,802	127	295	15,224	1.9
Overexertion	34,526	44	234	34,804	0.7
Other specified	11,796	73	370	12,239	3.0
Not elsewhere classified	5,093	26	143	5,262	2.7
Not specified	9,714	50	345	10,109	3.4
Missing	73,163	691	4,290	78,144	5.5
Total	347,859	3,626	26,157	377,642	6.9

^aTreated and released

^bHeld as outpatient for observation <23 hours and released

Figure 4. Percentage of patients admitted for inpatient care for injury or poisoning, by mechanism of injury, Kentucky, 2008



and Missouri.²¹ In contrast to this ratio of high severity and/or hospitalization, PCCs in the U.S. report that the large majority of poisonings are of lower severity, with more than 75% of patients managed outside of a health-care facility and only 6% admitted for inpatient medical care.⁸ These findings are similar to our findings, where only 7% of poisonings reported to the KRPPCC resulted in an admission for inpatient medical care. This finding suggests that a large number of low-severity poisonings are not presenting to the hospital, which is consistent with previous studies showing that PCCs reduce ED use by managing low-severity patients outside of a health-care facility.^{7,12-19}

Poisoning is the only injury with a preestablished, 24-hour, free public service for triage and medical advice. When we evaluated poisonings reported to KRPPCC during the one-year study period, we found the large majority of poisonings were of lower severity and were managed outside of a health-care facility. We believe our data support the hypothesis that PCCs have a significant impact on reduction of unnecessary ED utilization, which is consistent with previous studies on this subject. Our study located >35,000 poisonings managed outside of the hospital setting by KRPPCC.

Assuming half of these low-severity poisoning patients had self-referred to the ED if they did not have access to a PCC, the ED census for this cause of injury would have increased by more than 300%, with an increase in hospital charges of more than \$25 million in 2008.^{12,16} This figure is based on mean hospital charges of \$1,433 for the 4,736 patients treated in Kentucky EDs for poisoning in our sample. We believe this study provides an interesting way of evaluating a public health program's impact on health-care utilization.

The implications of this study are that loss of PCC services would likely cause a significant increase in ED usage for non-emergent care patients who could be managed in a lower-cost setting. While the expansion of this kind of service to other injuries is probably limited, a different model of telephone case management has been used by pediatric nurse triage lines with documented success.²³

Limitations

There were a number of limitations to this study. The criteria we used for selecting injury and poisoning patients were based on the principal diagnosis only. Patients having a secondary injury or poisoning

diagnosis with a primary diagnosis other than injury were excluded from this study even if an E-code was present. An expanded definition was recently proposed for use with ED data, which would include injuries and poisonings with a valid E-code regardless of the principal diagnosis.²⁴ It has been shown that this expanded definition is not appropriate for use with inpatient data.²⁵ This incompatibility prevented our full use of the expanded definition when comparing the inpatient and ED datasets.

We used E-codes to classify observations by mechanism; however, for 22% of the identified injury and poisoning cases, no E-code was reported. We investigated these cases, and it turns out that an E-code was reported for nearly all (95%) of the patients with a principal diagnosis of poisoning. Of the cases that were missing E-codes, 96% of the patients had a principal diagnosis of trauma (e.g., fracture or open wound). Additionally, the rate of inpatient hospitalization for this group was 6%, which was well below the mean. Therefore, these cases were unlikely to significantly affect our findings.

We did not attempt to match patients reported by the hospital database with a diagnosis of poisoning to patients reported by KRCC. However, the number of patients reported by the hospital database and KRCC were consistent and likely represented the same patient population. Previous work matching and comparing these two groups suggests the majority of these patients were, in fact, the same patients.²⁶ KRCC is routinely contacted for consultation by the EDs of all acute-care hospitals within the state.

CONCLUSION

In summary, three causes of injury had the greatest percentage of patients admitted for inpatient medical care—poisoning, firearms, and drowning—suggesting a high level of severity in these injuries presenting to the ED. We believe availability and use of a PCC helped reduce hospital utilization for poisoning primarily by managing a large number of low-severity patients outside of the hospital system.

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