BRIEF REPORT

Completeness and accuracy of International Classification of Disease (ICD) external cause of injury codes in emergency department electronic data

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The accuracy of external cause of injury codes (E codes) for work-related and non-work-related injuries in Massachusetts emergency department data were evaluated. Medical records were reviewed and coded by a nosologist with expertise in E coding for a stratified random sample of 1000 probable work-related (PWR) and 250 probable non-work-related (PNWR) cases. Cause of injury E codes were present for 98% of reviewed cases and accurate for 65% of PWR cases and 57% of PNWR cases. Place of occurrence E codes were present in less than 30% of cases. Broad cause of injury categories were accurate for about 85% of cases. Non-specific categories (not elsewhere classified, not specified) accounted for 34% of broad category misclassifications. Among specified causes, machinery injuries were misclassified most often (39/60, 65%), predominantly as cut/pierce or struck by/against. E codes reliably identify the broad mechanism of injury, but inaccuracies and incompleteness suggest areas for training of hospital admissions staff, providers, and coders.

Knowledge of the external causes of injuries is critical to be able to adequately direct injury prevention efforts. In large administrative databases, this information can be obtained through the International Classification of Disease (ICD) external cause of injury codes (E codes). Many injury prevention experts and organizations have advocated submission of these codes for inclusion in acute care hospital databases.[1] However, few studies have looked at the overall accuracy of E codes for injury surveillance.[2–5]

As a part of a feasibility study of using electronic emergency department (ED) data for occupational injury surveillance, we evaluated the completeness and accuracy of E codes for work-related and non-work-related injuries reported to a statewide Emergency Department Injury Surveillance System (EDISS). In addition, we conducted a qualitative analysis of the most common E code errors in order to identify potential areas for training hospital personnel.

METHODS

EDISS collected ED data from a sample, stratified by geography and patient volume, of 12 Massachusetts acute care hospitals. Electronic administrative data were collected on all non-fatal, non-admitted visits that were assigned an ICD Ninth Revision Clinical Modification (ICD-9-CM) diagnostic code (in any of six fields) in the range 800–999, and/or any ICD-9-CM E code in the range of E800–E999. The ICD-9-CM codes in EDISS were assigned by trained coders at the hospitals. The information reported included patient demographics, diagnostic codes, E codes, payer source, and the presence and content of an injury-at-work field. Probable work-related (PWR) cases were defined as those visits with either workers' compensation designated as payer or an injury-at-work value of ''yes'', or both. If neither of these criteria were met, the cases were considered probable non-work-related (PNWR).

A study sample of PWR and PNWR cases was drawn from patients aged 14 through 75 years reported to EDISS during the period 1 March 1999 through 29 February 2000 using stratified proportional sampling (PROC SURVEYSELECT; SAS V.8; SAS, Inc, Cary, North Carolina, USA). PWR cases were over-sampled because the primary research interest was work-related injuries. Statistical significance of differences between the study sample and EDISS were determined using a Wald statistic.

Chart reviews of sampled cases were performed by data abstractors, who collected diagnostic codes, E codes, and narrative information about the cause and place of occurrence of the injury from the medical records.

An expert nosologist validated the injury diagnosis and assigned validation E codes for the injury cases based on the narrative information from the medical record. If the cause (place) of injury was not documented in the medical record, the case was categorized as ''Cause (place) not documented'' and the appropriate code was assigned (E988.9, E849.9). Completeness of E coding was measured as the proportion of abstracted cases that had cause or place of occurrence E codes in the electronic EDISS database. Accuracy of E codes was measured as the proportion of E codes in the electronic EDISS database that exactly matched the validation E code (specific digits and number of digits). Broad cause of injury accuracy was assessed using 16 cause of injury categories in the ICD-9-CM Framework for Presenting Injury Mortality Data developed by the International Collaborative Effort on Injury Statistics.[6]

RESULTS

There were 108 328 visits reported to EDISS for the study period. Of these, 17 820 were identified as PWR injuries. Initially 1048 PWR cases and 262 PNWR cases were selected for the study sample; of these, 1250 (95.4%) had medical records available for review. The proportion of male PNWR cases in the study sample was significantly less than the proportion in EDISS ($p = 0.046$); otherwise, the age and gender distributions were similar.

A total of 1232 primary cause of injury E codes were available for the 1250 cases in the study sample (table 1). Fifteen cases were judged not to be injuries by the expert coder. Approximately 60% of the cause of injury E codes assigned by hospital coders were four digit codes; the remainder were three digit codes. Transcription errors from medical records to the electronic records were less than 1%.

Abbreviations: ED, emergency department; EDISS, Emergency Department Injury Surveillance System; ICD, International Classification of Disease; ICD-9-CM, ICD Ninth Revision Clinical Modification; PNWR, probable non-work-related; PWR, probable work-related

Table 1 Completeness and accuracy of cause of injury E codes, Emergency Department Injury Surveillance System (EDISS), Massachusetts, March 1999–February 2000

	Probable work-related			Probable non-work-related			All EDISS cases (weighted estimate)	
	Number	Number (%) with E code	Number (%) of accurate E codes	Number	Number (%) with E code	Number (%) of accurate E codes	Estimated (%) with E codes	Estimated (%) of accurate E codes
All injury cases	993	981 (98.8)	634 (64.6)	242	236 (97.5)	135 (57.2)	(97.6)	(57.6)
Cause of injury documented in the medical record	944	932 (98.7)	623 (66.8)	232	226 (97.4)	133 (58.8)	(97.5)	(59.2)
Cause of injury not documented in the medical record	49	49 (100.0)	11 (22.4)	10	10 (100.0)	2 (20.0)	(100.0)	(20.1)
Cases determined not to be an injury	7	7(100)	0 (0.0)	8	8 (100)	0 (0.0)	(100.0)	(0.0)
All cases	1000	988 (98.8)	634 (64.2)	250	244 (97.6)	135 (55.3)	(97.7)	(55.7)

Coding for cause of injury (table 1) was very complete (97–99%), as was documentation of cause in the medical record (944/1000 and 232/250, PWR and PNWR, respectively). Cause of injury E codes were correct for 64.6% of PWR cases and 57.2% of PNWR cases.

Coding for place of occurrence was much less complete (43% and 26%, PWR and PNWR cases, respectively), and documentation of place of occurrence in the medical record was also low (239/1000 and 125/250, PWR and PNWR cases, respectively; table 2). Among records for which place of occurrence was documented and E codes were available, accuracy was high (row 2 of table 2), but overall, less than 21% of cases had available and correct E codes for place of occurrence. The submission of place of occurrence E codes to EDISS varied considerably by hospital (0–91% complete).

Agreement on 16 cause of injury categories[6] was found for 84.3% of PWR cases and 84.8% of PNWR cases. Table 3 shows the distributions of the incorrect cause of injury categories by validation cause of injury categories. Machinery injuries had the highest proportion of misclassified codes (65%, 39 of 60). Injuries with a validated cause of ''not specified'' accounted for the greatest number of misclassifications (54%, 51 of 94). ''Cut/pierce'' was the cause of injury category that was most often assigned incorrectly (bottom row, table 3), followed by ''struck by/against'' and ''overexertion''.

A review of the abstracted medical record narratives indicated that the frequent misclassification of cause of injury as ''cut/pierce'' resulted from coding based on the nature of injury rather than on the cause of injury. For example, ''jagged lac(eration) L(eft) thumb on table saw …'' and ''… metal bar hit right ear, sustaining a lac(eration)…'' were coded as ''cut/pierce'' rather than ''machinery'' and ''struck/by'', respectively. Laceration injuries for which the cause was unspecified or ambiguous in the medical record were also often coded as ''cut/pierce''. Similarly, ''overexertion'' was often coded as the cause of sprains, strains, twisting, and avulsion injuries caused by falls or being struck by/against an object or person. ''Struck by/against'' was erroneously coded for injuries caused by crushing, which correctly belong under ''other specified causes'', and for injuries where the patient was struck by a machine, which are properly coded as machinery injuries.

DISCUSSION

The estimated proportion of correct cause of injury E codes found in this study (57.6%) was similar to that reported in other studies of E codes of ED data[5 7] and somewhat less than that reported for hospital discharge data.[2] These relatively high rates of errors in E coding at the detailed level indicate a need for additional training for hospital staff in the documentation and coding of the cause of injury.

The validation E codes in this study are based on the medical record and assume the record is a correct description of the actual cause. If the medical record is not correct, accurate coding may still result in misclassification. This study did not try to validate the medical record; however, the finding that documentation of the cause of injury was very complete (95%)

Table 2 Completeness and accuracy of place of occurrence E codes, Emergency Department Injury Surveillance System (EDISS), Massachusetts, March 1999–February 2000

	Probable work-related			Probable non-work-related				
	Number	Number (%) with E code	Number (%) of accurate E codes	Number	Number (%) with E code	Number (%) of accurate E codes	Estimated (%) with E code	Estimated (%) of accurate E codes
All injury cases	993	431 (43.4)	100 (23.2)	242	64 (26.4)	52 (81.3)	(27.2)	(78.5)
Location of injury documented in the medical record	239	127 (53.1)	90 (70.9)	117	52 (44.4)	45 (86.5)	(44.9)	(85.8)
Location of injury not documented in the medical record	754	304 (40.3)	10 (3.3)	125	12 (9.6)	7 (58.3)	(11.0)	(55.8)
Cases determined not to be an injury	7	7 (100)	0 (0.0)	8	8 (100)	0 (0.0)	(100)	(0.0)
All cases	1000	438 (43.8)	100 (22.8)	250	72 (28.8)	52 (72.2)	(29.5)	(69.9)

Table 3 Distribution of incorrect hospital assigned cause of injury categories by validation cause of injury category, Emergency Department Injury Surveillance System (EDISS), Massachusetts, March 1999–February 2000

Validated injury cause* (E codes)	% misclassified	Misclassified cause	Number (%) in misclassified category
Machinery (E919.0–E919.9)	65 (39/60)	Cut/pierce	21 (54)
		Struck by/against	13 (33)
		Falls	2 (5)
		Overexertion	2 (5)
		Missing	1 (3)
Not specified (E887, E928.9, E929.9, E958.9, E968.9, E988.9, E976, E997.9)	54 (51/94)	Cut/pierce	22 (43)
		Overexertion	8 (16)
		Struck by/against	7 (14)
		Other specified	5 (10)
		Not elsewhere classified	4 (8)
		Falls	3 (6)
		Natural/environmental	1 (2)
		Missing	1 (2)
Not elsewhere classified (E928.8, E929.8, E958.8, E959, E988.8, E989, E977, E995, E997.8, E998, E999)	31 (9/29)	Overexertion	4 (44)
		Struck by/against	3 (33)
		Falls	1 (11)
		Other specified	1 (11)
Other specified (E846–E848, E914–E915, E918, E921.0–E921.9, E923.0–E923.9, E925.0–E926.9, E929.0–E929.5, E955.5, E955.9; E958.0, E958.4, E960.1, E965.5–E965.9, E967.0–E967.9, E968.4, E985.5; E988.0, E988.4, E971, E978, E990–E994, E996, E997.0–E997.2)	19 (18/95)	Struck by/against	17 (94)
		Overexertion	1 (6)
Natural/environmental (E900.0–E909, E928.0–E928.2, E958.3, E988.3)	17 (3/15)	Missing	3 (100)
Falls (E880.0–E886.9, E888, E957.0–E957.9, E968.1, E987.0–E987.9)	11 (22/201)	Overexertion	16 (73)
		Missing	6 (27)
Fire/burn (E890.0–E899, E924.0–E924.9, E958.1, E958.2, E958.7, E961, E968.0, E968.3, E988.1, E988.2, E988.7)	11 (4/37)	Missing	2 (50)
		Poisoning	1 (25)
		Natural/environmental	1 (25)
Poisoning (E850.0–E869.9, E950.0–E952.9, E962.0–E962.9, E980.0–E982.9, E972)	9 (1/11)	Missing	1 (100)
Struck by/against (E916–E917.9, E960.0, E968.2, E973, E975)	9 (17/192)	Falls	7 (41)
		Overexertion	6 (35)
		Cut/pierce	4 (24)
Cut/pierce (E920.0–E920.9, E956, E966, E986, E974)	3 (8/ 250)	Missing	3 (38)
		Falls	2 (25)
		Overexertion	2 (25)
		Machinery	1 (13)
Transportation (E800–E819, E958.5, E958.6, E988.5, E988.6)	1 (1/74)	Machinery	1(100)
Overexertion (E927)	1 (1/186)	Missing	1(100)
All causes (E800–E999)	14 (174/1247)	Cut/pierce	47 (30)
		Struck by/against	40 (25)
		Overexertion	39 (25)
		Falls	15 (9)
		Other specified	6 (4)
		Not elsewhere classified	4 (3)
		Machinery	2 (1)
		Natural/environmental	2 (1)
		Poisoning	1 (1)

*Causes of injuries grouped according to the ICD-9 Framework for Presenting Injury Data.[6]

indicates that a cause, if not the cause, of an injury is being addressed by clinical personnel and is available for analysis.

The findings for the accuracy of coding and completeness of documentation for injury place of occurrence are much less encouraging. Place of occurrence E codes were available and correct in less than 21% of records, and documentation of the place of occurrence was largely missing.

The finding that there was about 85% accuracy for broad external cause of injury categories indicates a level of accuracy that is adequate for general category surveillance, although there is room for improvement. However, the levels of accuracy achieved for the wide range of injuries and causes in this broad, population-based data may not extend to individual types of injury or cause. The detailed analysis indicated that nearly two-thirds of machinery injuries were misclassified, suggesting that many machinery injuries go unrecognized. Systematic misclassification has also been reported for E coding of drowning cases.[8]

Our analysis indicates that information on the cause of injury is nearly always available in the medical record, but location of the injury is poorly documented. Healthcare providers should be encouraged to include these elements in clinical notes to aid surveillance activities and prevention efforts. Our detailed analysis also points to some common errors that could serve as a focus for training of hospital-based coders. We had no information on the training of the hospital coders or on quality control procedures used at the time of the study. Training opportunities and certification of medical coders through professional organizations

Key points

- Cause of injury E codes were very complete (98%) for injury admissions in the emergency department.
- Only 30% of reviewed injury admissions had location of injury E codes.
- Cause of injury E codes were accurate for 65% of probable work-related cases and 57% of probable non-work-related cases.
- Broad cause of injury categories from the International Collaborative Effort Matrix were correct for about 85% of cases.
- Common misclassifications suggest accuracy of E codes could be substantially improved through training of hospital staff, including admissions staff, providers, and hospital coders.

have increased since that time. Consequently, the level of accuracy found in this study probably represents a lower limit to the accuracy that we could expect under current conditions.

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LACUNAE

Laws slashing ranks of gun dealers

The USA once had more gun dealers than gas stations, but now only five states do: Alaska, Idaho, Montana, Oregon, and Wyoming.

The Violence Policy Center reports that the number of gun dealers in the USA has dropped by 194 998 since 1994. The study (see http://vpc.org/studies/dealers07.pdf) found that the number of basic federal licences required to sell guns in the USA plummeted 79% from 245 628 in 1994 to 50 630 in 2007.

California posted the largest decrease in the number of gun dealers, dropping from 20 148 in 1994 to 2120 in 2007—a decrease of 89%.

The drop in the number of gun dealers coincides with a continuing decline in household gun ownership. According to National Opinion Research Center data, the percentage of US households that reported having any guns in the home dropped from 43.9% in 1994 to 34.5% in 2006.

For the full press release visit http://www.vpc.org/press/0708ffl.htm. Contributed by Peter Jacobsen.