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Hospitalizations from Injuries: A Report on the Completeness of External-Cause-of-Injury Coding in the State's Hospital Discharge Data North Carolina, 1997-1999

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ABSTRACT

Objectives: The purpose of this study is to assess the completeness of the recording of external cause of injury codes (E-codes) on North Carolina hospital discharge records, for those patients with an injury as the primary cause of admission. E-codes are very important for public health efforts to identify the causes of injuries and design programs to prevent injuries.

Methods: North Carolina hospital discharge records for 1997 through 1999 with a primary diagnosis of injury were examined to determine the frequency of E-coding by the specific type of injury, age, race, gender, length of stay, payer classification, and level of trauma center.

Results: Overall, from 1997 through 1999, 83 percent of North Carolina hospital discharge records with a primary diagnosis of injury had an E-code recorded. For most of the major categories of injury, the recording of E-codes was 95 percent or higher. There was little difference in E-coding by age, race, or gender. Patients with shorter lengths of stay had a higher rate of E-coding. Patients with Medicare as the main source of payment had a relatively low rate of E-coding. Hospitals with the highest level of trauma center designation had the lowest rate of E-coding.

Conclusions: Recording of E-codes for hospitalizations due to injury is generally high, especially considering that the reporting of E-codes on hospital discharge records is voluntary in North Carolina. Greater awareness of the importance of E-codes might encourage hospitals to continue and to improve the reporting of E-codes for injury-related hospitalizations, which would enhance our ability to design effective injury prevention programs.

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INTRODUCTION

The purpose of this study is to determine what proportion of the injury-related primary diagnosis codes (N-codes) on the hospital discharge abstracts filed in North Carolina from 1997 through 1999 have an accompanying code which identifies the external cause of the injury (E-code) for which the patient was hospitalized. The study also reviews whether E-coding hospital data has changed during this time period.

N-codes are the ICD-9-CM numeric, nature-of-injury codes of the standardized International Classification of Diseases (ICD) system developed by the World Health Organization and subsequently modified in the United States for expanded use in clinical settings. N-codes identify diagnoses related to injury and poisoning (ICD-9-CM, 800-999). E-codes are supplementary classifications which "...permit the classification of environmental events, circumstances, and conditions as the cause of injury, poisoning, and other adverse effects."¹ For example, if a patient were discharged with a primary diagnosis of "fracture," an accompanying E-code could explain whether the broken bone was due to an unintentional motor vehicle crash or a fall down a flight of stairs.

The use of E-codes, in contrast to N-codes that identify a type or location of a medical condition on the body for therapeutic purposes, is one of the most effective ways injury epidemiologists and public health practitioners can identify (a) how many people are seriously hurt or die from intentional and unintentional injuries, (b) what caused the injuries, (c) how to develop strategies to prevent them, and (d) how to evaluate the success of the intervention programs.^{2,3,4}

Most hospitals in the state of North Carolina are required to report the primary and secondary diagnoses explaining the admission of a patient to their facility. In 1991, an advisory committee to the U.S. Department of Health and Human Services recommended that E-codes be included in hospital discharge data. In the following year, the National Uniform Billing Committee approved the inclusion

of a field to record an external cause-of-injury code on their standardized hospital billing form, the UB-92, which is frequently used by states as the basis for collecting data in their hospital discharge database. However, completion of this E-code field was not federally mandated, and completion of the E-code field was left to the discretion of each state. The result is that there are now 23 states in the country in which E-coding is mandated in hospital discharge data, and four states in which E-coding is voluntary. The rest of the states do not collect E-code information.⁴ Currently, the provision of an E-code on the hospital discharge abstract is voluntary in North Carolina, although considerable effort was exerted a decade ago to mandate E-coding. One field is available on the UB-92 forms in North Carolina in which to record an E-code related to the patient's primary N-code diagnosis.

E-codes for injury-related primary diagnoses have been routinely available on the abstracts in the North Carolina hospital discharge database since 1997. Assigning an external cause of injury code to the many injury-related N-codes often requires additional manpower and training of each hospital's medical records staff. The cost of coding this one additional field on the UB-92 is estimated to be about \$600 per hospital per year.⁴ Until now, the completion status of E-coding on North Carolina's hospital discharge abstracts has not been known. An assessment of the completeness of E-coding is essential for public health planners at the state and county level. E-codes identify injuries according to intent (i.e., unintentional, suicide, assault), mechanism (i.e., motor vehicle, firearm, poison, etc.) and detailed circumstances (e.g., drivers vs. passengers in motor vehicle crashes or handguns vs. rifles in firearm incidents).⁴ This level of detail about the cause of an injury has become increasingly important since it is often the basis for decisions that are made on whether funds are needed to develop or maintain programs to prevent or mitigate the effects of injuries. This study assesses the completeness of E-coding in hospital discharge abstracts with injury-related primary diagnoses in the state's hospital discharge database from 1997 through 1999.

METHODS

The Injury and Violence Prevention Unit, a program within the state's Department of Health and Human Services (N.C. DHHS), requested the State Center for Health Statistics (SCHS) to review the completeness of E-coding of all abstracts with an injury-related primary diagnoses (ICD-9-CM, 800-999) in the state's hospital discharge database from 1997 through 1999. The SCHS is legislatively mandated to maintain copies of North Carolina's hospital discharge data files in order to respond to N.C. DHHS agencies' requests for data to support public health initiatives. The SCHS conducted this quality assurance assessment on the hospital discharge data and provided the Injury and Violence Prevention Unit with summarized, aggregate data. The data are for all patients discharged from hospitals located in North Carolina.

All hospital discharge abstracts with an injury-related primary diagnosis code (N-code, 800-999) in the data sets for 1997, 1998, and 1999 were reviewed for the presence of an external-cause-of-injury code in the designated E-code field. It is important to keep in mind that these hospital discharge abstracts represent hospitalizations, not persons, and therefore *cannot* be used to count the number of injuries that occurred in the state in a year. An unknown number of hospital discharge abstracts describe re-admissions for a single injury. However, these data can be helpful in assessing the burden that injuries place on the individual, the medical care system, and the state.

First, the completeness of E-coding is assessed in terms of all of the state's hospital discharge abstracts with injury-related primary diagnoses from 1997 through 1999 in order to provide a better understanding of the quality of all of the hospital discharge data, which will serve as one of the major components of the state's injury surveillance system. Second, the completeness of E-coding is assessed in a selected subset of injury-related N-codes which excludes certain categories of injuries, consistent with the way national injury-related statistics are often presented. Completeness for all of the

discharge records is examined by several demographic and hospital factors. The completeness of E-coding is also examined for 21 specific categories of injury (see Table 1), using the ICD-9-CM codes recommended by the National Center for Health Statistics.⁵

The completeness of E-coding is reported by diagnostic category for each of the three years and for the three years combined in Table 1, and for the three-years combined in Tables 2-7. The difference in E-coding rates is calculated by subtracting the percentage of records with E-codes in 1997 from the percentage of records with E-codes in 1999. The completeness of E-coding for all hospital discharge abstracts with an injury-related primary diagnosis is tabulated by age (Table 2); race (Table 3); gender (Table 4); length-of-stay (Table 5); patients' payer classification (Table 6); and trauma center status (Table 7).

RESULTS

There were 2,787,594 hospitalizations in North Carolina from 1997 through 1999. Seven percent (6.7%) of these discharges (185,956) had an injury-related primary diagnosis (Table 1). Thirty-six percent of these injury-related hospitalizations were classified as fractures (67,049); 33 percent were classified as complications of medical care (63,173); seven percent as poisonings; five percent as traumatic brain injury; and four percent as internal injury.

Completeness of E-Coding by Nature-of-Injury Categories. Table 1 summarizes the E-code reporting in the North Carolina hospital discharge database from 1997 through 1999 by nature-of-injury categories. Over the three-year period there were a total of 185,956 hospital discharge records with an injury-related primary diagnosis: 1997, 60,090; 1998, 63,448; 1999, 62,418. The percentage of hospital discharge records with completed E-codes for total injury-related primary diagnoses increased from 81.7 percent in 1997 to 84.0 percent in 1999, an E-coding difference of plus 2.3 percent over the three year period.

Table 1. External Cause-of-Injury Reporting Status: North Carolina, 1997-1999

Nature-of-Injury (ICD-9-CM:800-999) Categories	1997		1998		1999		Composite 1997-1999		Differences in % Discharges with E-codes (%1999-%1997)
	Number of Discharges	% with E-codes	Number of Discharges	% with E-codes	Number of Discharges	% with E-codes	Number of Discharges	% with E-Codes	
Fractures	21,899	95.5	22,897	96.0	22,253	95.4	67,049	95.7	-0.1
Dislocations	407	92.8	391	91.0	367	95.6	1,165	93.1	2.8
Sprains & Strains	1,202	85.5	1,184	91.8	1,031	90.9	3,417	90.4	2.4
Crushing	70	98.5	74	98.6	76	97.3	220	98.2	-1.2
Amputation	215	96.2	199	97.4	214	98.5	628	97.4	2.3
Internal Injury	2,517	95.0	2,649	95.9	2,735	96.0	7,901	95.7	-0.6
Traumatic Brain	3,211	94.7	2,954	94.4	3,006	94.1	9,171	94.4	-0.6
Spinal Cord	298	96.6	341	93.8	345	94.7	984	95.0	-1.9
Blood Vessel	207	95.1	211	94.3	202	96.0	620	95.2	0.9
Open Wounds	2,179	95.9	2,191	96.0	1,992	96.4	6,362	96.1	0.5
Superficial Injury	133	89.4	112	96.4	127	94.4	372	93.3	5.0
Contusions	772	95.5	887	95.9	834	94.2	2,493	95.3	-1.3
Burns	883	95.8	921	97.8	894	97.7	2,698	97.1	1.9
Other/Unspecified Injury	244	94.6	413	97.3	410	94.8	1,067	95.8	0.2
Late Effects	16	81.2	18	83.3	26	96.1	60	88.3	14.9
Foreign Bodies	381	90.8	389	90.4	405	90.6	1,175	90.6	-0.2
Early Complications	166	92.7	189	89.9	172	94.7	527	92.4	2.0
Poisonings	4,003	97.4	4,144	97.2	4,258	97.1	12,405	97.3	-0.3
Toxic Effects	616	98.8	582	98.6	617	95.6	1,815	97.7	-3.2
Other/Unspecified Effects	767	84.6	920	91.3	967	89.4	2,654	88.7	4.8
Adverse Effects of Medical Care	19,904	54.6	21,782	59.6	21,487	62.4	63,173	59.0	7.8
TOTALS									
Total Injury-related N-Codes	60,090	81.7	63,448	83.3	62,418	84.0	185,956	83.1	2.3
Total with Exclusions ¹	34,237	95.1	35,424	95.7	34,486	95.3	104,147	95.4	0.2
All Other Discharges	841,786	N/A	882,801	N/A	877,051	N/A	2,601,638	N/A	N/A

¹Excludes late effects; effects of foreign bodies; early complications; poisonings; toxic effects, other/unspecified effects; adverse effects of medical care.

DATA SOURCE: N.C. Hospital Discharge Data Base, 1997-1999. N.C. State Center for Health Statistics, Raleigh, N.C.

The completeness of E-coding, however, varied by nature-of-injury categories. For example, fractures (67,049), the largest category of hospital discharges with injury-related primary diagnoses, had an E-code 95 percent of the time. In contrast, adverse effects of medical care (63,173), the second largest number of discharges with an injury-related primary diagnosis, had an E-code assigned 59 percent of the time. The difference between 1997 and 1999 in the percentage of discharge abstracts with a recorded E-code for adverse effects of medical care was 7.8 percent: 54.6 percent of the records had an E-code in 1997, compared to 62.4 percent in 1999.

If one excludes records with an N-code of late effects (60), effects of foreign bodies (1,175), early complications (527), poisonings (12,405), toxic effects (1,815), other/unspecified effects (2,645), and adverse effects of medical care (63,173), the completeness rate of E-coding for 1997-1999 increases from 83.1 percent to 95.4 percent.

Completeness of E-Coding by Age. Table 2 illustrates the age-profile of patients discharged with an injury-related primary diagnosis and the E-code reporting status. The completeness of E-coding ranged from 77 percent for patients ages 45 to 64 to 92 percent for ages 15 to 24. The greatest improvement over time in the percent of discharge abstracts with completed E-codes (3.6%) occurred in the records for patients with the lowest proportion of records with E-codes, i.e., those ages 45 to 64.

Completeness of E-Coding by Race. Table 3 documents E-code reporting status by race. This table indicates that there is little difference by race on the percent of hospital discharge abstracts with a completed E-code field. However, from 1997 through 1999, patients' race was missing in 23 percent of the hospital discharge abstracts. The rate of missing data on race increased steadily in this three-year period from 15.6 percent in 1997 to 29.7 percent in 1999.

Completeness of E-Coding by Gender. Patients' gender was recorded on virtually all of the records. There was missing information on gender for only 26 of the records with an injury diagnosis (Table

Table 2. External Cause-of-Injury Reporting by Age: North Carolina, 1997-1999

Age	1997-1999		
	All Injury-Related Records		
	No. of Discharges	% with E-codes	Differences in % Discharges with E-codes (%1999-%1997)
Infants	1,377	80.5	-0.3
1-4	3,422	87.7	-0.7
5-14	7,117	88.0	-0.3
15-24	16,522	91.6	-0.6
25-44	42,292	85.5	2.4
45-64	42,527	77.4	3.6
65 and over	72,699	82.4	2.8
Unknown	0	0	0
Total	185,956	83.1	2.3

Table 3. External Cause-of-Injury Reporting by Race: North Carolina, 1997-1999

Race	1997-1999		
	All Injury-Related Records		
	No. of Discharges	% with E-codes	Differences in % Discharges with E-codes (%1999-%1997)
Black	31,466	81.4	0.5
White	104,633	83.2	1.4
Other	7,688	85.0	-0.3
Unknown	42,169	83.7	6.0
Total	185,956	83.1	2.3

Table 4. External Cause-of-Injury Reporting by Gender: North Carolina, 1997-1999

Gender	1997-1999		
	All Injury-Related Records		
	No. of Discharges	% with E-codes	Differences in % Discharges with E-codes (%1999-%1997)
Female	96,693	82.9	2.3
Male	89,237	83.3	2.2
Unknown	26	96.1	-5.5
Total	185,956	83.1	2.3

Table 5. External Cause-of-Injury Reporting by Length-of-Stay: North Carolina, 1997-1999

Length-of-Stay	1997-1999		
	All Injury-Related Records		
	No. of Discharges	% with E-codes	Differences in % Discharges with E-codes (%1999-%1997)
Unknown	3	66.7	N/A
1 day	33,973	86.8	4.3
2 days	29,001	84.4	2.7
3 days	24,755	89.0	2.2
4 days	20,284	81.2	1.9
5 days	16,506	82.9	3.4
6 days	12,837	83.1	3.2
7 days	10,122	82.4	1.2
8-14 days	25,896	81.7	1.0
15-28 days	9,178	77.7	-3.5
29-56 days	2,688	75.3	-2.0
57+ days	713	68.9	-4.5
Total	185,956	83.1	2.3

Table 6. External Cause-of-Injury Reporting by Payer Classification: North Carolina, 1997-1999

Payer Classification	1997-1999		
	All Injury-Related Records		
	No. of Discharges	% with E-codes	Differences in % Discharges with E-codes (%1999-%1997)
Medicare	84,537	79.7	2.7
Medicaid	18,456	83.4	1.9
Champus	1,368	85.6	5.1
Private Insurance	44,272	83.4	2.4
HMO	11,520	84.3	3.9
Worker's Comp.	6,022	91.8	2.4
Self-pay/Indigent/Charity	15,912	94.5	-0.7
Other/Unknown	3,869	86.6	-2.9
Total	185,956	83.1	2.3

4). There was little difference in the completeness of E-coding by gender.

Completeness of E-Coding by Length-of-Stay. Patients' length-of-stay in the hospital was recorded on all but three of the hospital discharge records (Table 5). Most patients with an injury-related primary diagnosis were hospitalized for a week or less. On average, the percentage of abstracts with an E-code of patients hospitalized with a primary injury-related diagnosis for a week or less exceeded the overall percentage. In general, E-coding consistently decreased as the length-of-stay increased.

Completeness of E-Coding by Patient's Payer Classification. Patients' payer classification was recorded on all but two percent of the hospital discharge records with an injury-related primary diagnosis from 1997 through 1999. The E-coding completeness ranged from 79.7 percent for Medicare patients to 94.5 percent for the payer classification labeled "self-pay/indigent/charity."

Completeness of E-Coding by Level of Trauma Center. Hospitals with trauma centers have augmented facilities and personnel to treat persons who have suffered the more severe or life threatening injuries. Currently, the designated trauma centers in North Carolina include five Level I's, three Level II's, and two Level III's. Level I trauma centers

Table 7. External Cause-of-Injury Reporting Status by Level of Trauma Center: North Carolina, 1997-1999

Trauma Center Level	1997-1999		
	All Injury-Related Records		
	No. of Discharges	% with E-codes	Differences in % Discharges with E-codes (%1999-%1997)
Level I	46,495	75.7	-4.6
Level II	19,779	87.6	12.0
Level III	5,148	98.8	-0.7
Non-designated Hospitals	114,534	84.6	3.6
Total	185,956	83.1	2.3

offer the complete range of trauma care from injury prevention through rehabilitation, including a research component. They are regional resource centers that serve in a leadership role to a large number of referring hospitals. Level I facilities have a trauma surgeon available within 20 minutes, twenty-four hours a day, and a fourth-year or senior surgical resident available 24 hours a day in-house, for responses within 20 minutes. The Level I facilities in North Carolina are Carolinas Medical Center, Charlotte; Duke Medical Center, Durham; University Health Systems of Eastern Carolina, Greenville; UNC Health Care System, Chapel Hill; and Wake Forest University Baptist Medical Center, Winston-Salem.

Level II trauma centers usually provide initial trauma care for any severity of trauma but may not have as comprehensive a list of services (or immediate availability of as many sub-specialists) as a Level I center. Trauma research is not a primary focus. Level II trauma surgeons respond within 20 minutes of notification. The Level II facilities in North Carolina are Mission St. Joseph's, Asheville; New Hanover Regional Medical Center, Wilmington; and WakeMed, Raleigh.

Level III trauma centers usually exist in more rural areas without immediate benefit of a Level I or II center. These hospitals provide initial assessment, resuscitation, and stabilization for all types of trauma patients, but usually transfer the most serious trauma patients to a Level I or II facility for surgical care. Surgeons are available within 30 minutes of notification. The Level III trauma centers are Cleveland Regional Medical Center, Shelby and Northeast Medical Center, Concord.

From 1997 through 1999, 38 percent of the patients hospitalized for an injury-related primary diagnosis were treated in trauma centers: Level I (25%), Level II (11%), Level III (3%) (Table 7). The other patients with injuries (62%) were treated in non-designated hospitals. In the total data set, 83 percent of the hospital discharge abstracts with injury-related primary diagnoses had completed an E-code field, but there was marked variation by trauma

center status. Level I trauma centers had the lowest E-coding completeness rate (75.5%), and the percentage of the records with E-codes decreased over the three-year period (-4.6%). E-coding completeness in Level II trauma centers (87.6%) was better than that in Level I centers, and also showed the greatest improvement in E-coding completeness (+12.0%) over time. The injury-related abstracts from Level III trauma centers had E-codes 98.8 percent of the time.

DISCUSSION

The most important finding from this study is the high level of *voluntary* E-coding of injury-related primary diagnoses in the NC hospital discharge database from 1997 through 1999. If one includes all hospital discharge abstracts with an injury-related primary discharge diagnosis (ICD-9-CM codes 800-999), the proportion of records with E-coding increased over the three-year study period from 81.7 percent in 1997, to 83.3 percent in 1998, to 84.0 percent in 1999. If one excludes from consideration those records with codes for late effects (ICD-9-CM, 905-909), effects of foreign bodies (ICD-9-CM, 930-939), early complications (ICD-9-CM, 958), poisonings by drugs, medicinal and biological substances (ICD-9-CM, 960-979), toxic effects (ICD-9-CM, 980-989), other/unspecified effects (ICD-9-CM, 990-995), and complications of medical care (ICD-9-CM, 996-999), as is often done in national statistics on injury-related morbidity and mortality data, the completeness of E-coding in the records of the NC hospital discharge database over the three-year study period is 95 percent (1997, 95.1%; 1998, 95.7%; 1999, 95.3%).

As of February 2001, 27 states in the United States reported entering E-codes on the discharge summaries in their hospital discharge databases. Of these 27 states, 23 had mandatory E-coding and four had voluntary E-coding. Data on the completeness of E-coding for the 23 states with mandatory E-coding is not consistently available in the published literature. However, in the four states with voluntary E-coding, the completion rate of E-coding was reported as >80 percent in North Carolina, >90 percent in Maine and

Minnesota, and >99 percent in Alaska. However, it appears that North Carolina is the only state among the four states with voluntary coding that reported its E-code completeness based on *all* records with a primary diagnosis related-injury (ICD-9-CM, 800-999). When North Carolina uses the restricted list of N-codes mentioned above, 95 percent of the NC injury-related hospital discharge abstracts have E-codes, making the state's E-code completion rate consistent with those of Maine and Minnesota.

More than 20 percent of the records in the hospital discharge database have missing information on race. This suggests that the use of race in the analysis of injury data from the hospital discharge database, especially in the calculation of injury rates, should be done with caution.

Neither the age nor the gender of the patient appears to be a significant factor in determining whether an E-code is assigned to an injury-related primary diagnosis on the hospital discharge abstract. The patients' length-of-stay was associated with the completeness of E-coding: the shorter the length of stay, the greater the proportion of the records with an E-code. The type of trauma center in which a patient was treated was strongly associated with E-code completeness. The majority of patients with a primary injury-related diagnosis were cared for in hospitals without trauma center designation, and the completeness of E-coding in these hospitals increased from 1997 through 1999. The completeness of E-coding was lower for the injury patients admitted to hospitals with trauma center capacities, and lowest in the hospitals with Level I trauma centers.

Ninety to 95 percent of the hospital records with an injury-related primary diagnosis whose payer status was classified as "self-pay/indigent/or charity" had E-codes assigned, whereas patients whose hospitalizations were covered by Medicare were below the state rate of E-coding for each of the years.

External cause-of-injury codes are useful in the hospital setting and at the state and local level for public health. E-codes identify the mechanism/cause and the manner/intent of an injury that are indispensable in developing injury prevention and control initiatives. In contrast, nature-of-injury codes identify the type of physical insult to the body, which is essential for patient-specific treatment and rehabilitation. Within the hospital setting, E-codes can be used to support injury prevention programs, assess the quality of care patients receive in the Emergency Department or after admission to the hospital, or to assess health care costs. Within the public health arena, E-coded hospital (as well as vital statistics) data can be used to monitor patterns and trends in the causes of non-fatal and fatal injuries. An assessment of external cause-of-injury codes, especially those for non-fatal events which represent a significant proportion of the burden of injury, can help the State Department of Health and Human Services, local health departments and health-related agencies, and the state's academic injury research and prevention centers set priorities for our limited resources to prevent or mitigate the effects of intentional and unintentional injuries.

Only four states in the U.S. record E-codes on their hospital discharge abstracts without a state-legislated mandate. There was much discussion in North Carolina a decade ago as to whether E-coding should be mandated. In spite of the general reluctance to enter E-codes for injury admissions for adverse effects of medical procedures and medications, the system of voluntary E-coding in North Carolina appears to work well. Should modifications to the collection of external cause of injury coding be made, it might be constructive to include more fields on the hospital discharge abstract for the coding of external causes of injury. The addition of more external cause-of-injury fields would enhance the quantity and possibly the quality of information on which injury prevention is based. The inclusion of E-codes on all hospital discharge abstracts for patients discharged

with a primary diagnosis of adverse effects of medical care could provide insight into the understanding and prevention of injuries that occur to patients after they have sought treatment for other conditions.

The provision of E-codes for all discharges with an injury-related diagnosis could enhance the state's ability to monitor, prevent, and control intentional and unintentional injuries. Greater awareness of the usefulness of the E-codes might encourage hospitals to allocate more staff and resources to recording this information on the hospital discharge records.

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