Sensitivity of Hospitals' E-Coded Data in Identifying Causes of Children's Violence-Related Injuries

DIANE G. WINN, RN, MPH
PHYLLIS F. AGRAN, MD, MPH
CRAIG L. ANDERSON, DHSc, MPH

The authors are with Health Policy and Research, University of California at Irvine. Ms. Winn is Associate Director, Pediatric Injury Prevention Research Group; Dr. Agran is Associate Professor of Pediatrics and Director, Pediatric Injury Prevention Research Group; and Dr. Anderson is an Injury Epidemiologist.

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Tearsheet requests to Diane G. Winn, RN, MPH, Health Policy and Research, University of California, Irvine, CA 92717–5800; tel. 714–824–7410; FAX 714–824–8091.

Synopsis

E codes classify causes of injury as unintentional, intentional, and undetermined. E-coded discharge data from hospitals provide an opportunity to use this source of morbidity data for planning, implementation, and evaluation of injury and violence prevention activities. This study explores the extent to which E-coded data from hospitals identify injuries that result from violent acts.

Cases were identified through a multihospital population-based surveillance system of pediatric injuries. Those cases with injury as a result of violence, designated by study criteria, were compared with those with E codes that were classified as intentional. The analysis indicated that 25 percent of injuries to children resulting from violence may not be accounted for through the use of E codes.

The majority of the undetected injury cases resulting from violence involved child abuse. Researchers and other persons who design and conduct injury and violence prevention programs should be aware of the undercount and associated issues when using E-coded hospital discharge data for surveillance of injuries resulting from violence.

ACCURATE AND RELIABLE DATA regarding external causes of injury are crucial for surveillance and subsequent planning, implementation, and evaluation of injury control and violence prevention programs (*1–3*). Hospital discharge data, an existing source of information for nonfatal injuries, will become increasingly useful as E coding (cause of injury codes) is implemented. California has mandatory E coding for all first admissions for an injury; several other States have enacted, or are in the process of enacting, mandatory E coding of hospital discharge data.

A limited number of studies, however, have documented that hospital discharge data may undercount certain categories of injury (*4–7*). Critical to the use of E-coded hospital discharge data for violence prevention activities is the issue of determining which injuries were the result of interpersonal violence and suicide.

E codes fall into three categories which address intent: "accidental," "intentional," and "undetermined." The range of E codes that are usually identified as intentional in the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD–9 CM) are E950–E959 (suicide and self-inflicted injuries specified as intentional) and E960–E969 (homicide and injury purposefully inflicted by other persons with intent to injure or kill, by any means) (*8*). The E980 series—undetermined cause—have guidelines which specify that an undetermined cause of injury code is to be assigned if, after a thorough investigation by the medical examiner, coroner, or other legal authority, it cannot be determined whether the injuries are accidental, suicidal, or homicidal. These include self-inflicted injuries, but not poisoning, when not specified as accidental or as intentional.

Violence has been defined by the National Center for Injury Prevention and Control, Centers for Disease Control and Prevention, as ". . . the threatened or actual use of physical force or power against another person, against oneself, or against a group or community which either results in, or has a high likelihood of resulting in injury, death, or deprivation." The purpose of this study was to determine the

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extent to which E-coded hospital data identifies the range of injuries resulting from violence experienced by children.

Methods

Cases were identified through a multihospital surveillance system of 0–14-year-old residents of central Orange County, CA, who were hospitalized or died as a result of injury in 1991–92. Medical records were reviewed approximately 1 month after discharge, and information related to cause and circumstances of injury was abstracted onto a standardized questionnaire. Information regarding social work and child protective services referrals, disposition, and outcomes was recorded. The injury and E codes as assigned by medical records personnel at the participating hospitals were also abstracted from the medical record.

From the total sample of 1,380 hospitalizations because of injuries, there were 781 cases that provided the sample for this study. Excluded from this sample were 172 cases with no E codes recorded on the chart at time of chart review. Although E codes are reported to the State, the assigned E codes were not indicated on the medical records from one hospital that contracts with a health maintenance organization. The 427 cases that were transport-related, late effects, adverse effects, or therapeutic misadventures were also excluded.

Cases were reviewed by study personnel to determine if violence was a cause of injury using the following algorithm. First, those that were documented on the medical record as purposefully inflicted were classed as violence-related. Second, cases that met criteria for child abuse as discussed in the "Child Abuse Prevention Handbook" of the California Attorney General's Office, that is, history of the injury, conflict in describing circumstances of the injury, type of injury, delay in seeking treatment were classified as violence-related (*9*). (All children in this second group were discharged from the hospital to foster, residential care or their home with followup by a public health nurse and a person from the child protective services.) Third, those injuries that resulted from aggressive acts such as forceful fighting—mention was made of a fist—were also included in the violent injury group.

All other injuries were classified as nonviolent except for nine that had inadequate information to make a determination and were excluded. These cases all involved minor injuries such as a single contusion or unknown drug ingestion by a young child—cases where there was too little information on the medical record to make a determination. Also included in the nonviolent injury category were those with an E code E950–E969 in which an injury was inflicted by a child less than 2 years of age. Children of this age are not able to make inferences and thus may not have the cognitive ability to form the intent to harm another person (*10,11*).

Sensitivity of the E codes to identify violence-related injuries (the probability of correctly identifying a true case) was calculated by dividing the number of true positives by the total number of violence-related injury cases (true positives plus false negatives). Specificity of the E codes to identify injuries that did not result from violence (the probability of correctly identifying a true noncase) was calculated by dividing the number of true negatives by the total number of injury cases that did not result from violence (true negatives plus false positives). Confidence limits were calculated using the exact method and the binomial distribution.

Results

Fifty cases with intentional E codes of 950–968.9 were determined to be violence-related injuries by the study criteria. Two cases assigned an intentional E code by hospital personnel were classified as nonviolent because they were caused by a child younger than 2. The first was that of a 4-year-old child who was struck in the eye with a screwdriver by his nearly 2-year-old brother. The second case involved a 13-month-old who bit herself and was hospitalized as a result of the infected bite.

Seventeen cases did not have intentional E codes but were determined to fit the study criteria for injuries resulting from violence. Hospital E coded data and study criteria agreed on nonviolent causes of injury for 712 cases. E codes correctly identified injuries resulting from violence in three-fourths of the cases (sensitivity = 74.6 percent, confidence interval (CI) 64.1–84.5 percent) and correctly identified injuries that were not the result of violence in nearly all of the cases (specificity 99.7 percent, CI 99.2–99.9 percent).

Examples of Injury Cases Resulting from Violence with Unintentional E Codes Assigned by Hospitals

Hospital assigned E code and description[1]	*Child's age and circumstances of injury*	*Injury*
E988.9—Injury by unspecified means, undetermined if accidental or purposely	2 months, found abandoned with comminuted femur fracture, discharged to Orangewood Children's Home.	Comminuted right femur fracture.
E884.2—Fall from chair or bed.	7 months, reported child fell from bed to floor, delay of 5 days in seeking treatment, discharged to Orangewood Children's Home.	Bilateral nondisplaced left parietal and left occipital skull fracture.
E884.2—Fall from chair or bed.	8 months, reported child fell from bed to floor, delay of 3 days in seeking care, discharged to foster care.	Left parietal skull fracture.
E924.0—Accident caused by hot liquids, vapors, including steam.	9 months, mother gave conflicting stories about baby being burned while being bathed, father suspected of scalding child, discharged to Orangewood Children's Home.	2nd degree burns to perianal area and lower abdomen (10–12 percent body surface area).
E884.2—Fall from chair or bed.	11 months, reported child fell off couch, child attended by mother's boyfriend at the time; while in hospital, family suspected of turning ventilator off two times causing child to arrest and sustain hypoxic brain injury.	Spinal cord injury, (brachial plexus) quadriplegia, ventilator dependent.
E885—Fall on same level from slipping, tripping, or stumbling.	1 year, reported child fell from crib 1 month ago, to emergency room 5 times for symptoms since fall, discharged home with public health nurse and child protective services followup.	Duodenal perforation with subhepatic mass and fluid collection, mild brain atrophy, old fractures of extremities (fractured femur on X-ray).
E915—Foreign body accidentally entering other orifice.	18 months, aspiration of bread, shaken forcefully by stepfather.	Retinal and subarachnoid hemorrhage (old tibia fracture on X-ray).
E988.9—Injury by unspecified means, undetermined if accidential or purposely inflicted.	21 months, initially reported to have fallen from crib, coroner later determined abuse.	Occipital fracture, subdural and subarachnoid hemorrhage. orrhage.
E924.0—Accident caused by hot liquids.	2 years, placed in overheated bath, delay of 11 days in seeking treatment, discharged to foster care.	Cellulitis, 2nd degree burns to legs and buttocks.
E887—Fracture, cause unspecified.	3 years, initially parents stated child fell from swing, later determined hit by father.	Right supraorbital fracture.
E928.9—Unspecified accident, stated as accidentally inflicted.	3 years, reported child fell off bed, later determined to be abuse by stepfather.	Severe displacement right humerus, old bruises.
E898.1—Accident caused by fire-flames.	4 years, mother stated child playing with lighter, mother suspected of inflicting injuries, child discharged to foster care.	First, second, and third degree burns to abdomen, arms, and legs (unusual burns on back), bruised face.
E917.0—Struck accidentally by objects or persons.	4 years, hit by mom with wooden spoon when being disciplined, spoon slipped from hand and hit child in eye.	Ruptured globe.

(continued next page)

Examples of Injury Cases Resulting from Violence with Unintentional E Codes Assigned by Hospitals *(continued)*

Hospital assigned E code and description[1]	*Child's age and circumstances of injury*	*Injury*
E917.0—Struck accidentally by objects or persons.	12 years, hit in chest with fist by 13-year-old, fell hitting head against object.	Occipital hematoma, concussion.
E936.1—Adverse effects of hydantoin derivatives.	13 years, hit with fist forcefully by 13-year-old.	Head contusion, dermatitis (readmitted 2 days later, epidural hematoma diagnosed).
E886.9—Fall on same level from collision, pushing, or shoving, by or with other person.	13 years, pushed from behind in physical education and hit arm against locker.	Open fracture right radius and ulna.
E922.9—Accident caused by unspecified firearm missile.	14 years, shot in buttock while running away, driveby shooting.	Open wound buttock, perforated rectum.

[1]Reference *8*.

' . . . injuries caused by violent and aggressive acts and assaults may still be underreported because intent is difficult to establish and intentionality is defined differently by various disciplines and people.'

Thirteen of the 17 cases, which were not E coded as intentional but were determined to be violence-caused by study criteria, involved injured children less than 5 years of age. These children were admitted with injuries that were initially stated to have been "accidentally caused" and were later determined to be abuse-caused or were highly suspicious of being caused by abuse. The other four cases involved preteens and young teens engaged in aggressive behavior that resulted in injury. Cases illustrative of the discrepancies between the unintentional E-coded cases and cases determined by study criteria to be caused by violence are presented in the box.

Discussion and Conclusion

One-quarter of the injuries associated with violence (17 of 67) as defined in this study were not identified by E codes. This is a conservative estimate of undercount because study criteria for defining violence-caused injuries were strict. The majority of the injuries that were the result of violence inflicted on children involved abuse since 13 of the 17 misclassified cases in this study were highly suspicious of child abuse.

Several factors influence the assignment of E codes and may explain this underreporting of violence-related injuries when using intentional E codes. First, the training, curriculums, and guidelines for using E codes are inadequate. Hospital personnel are restricted in the use of the undetermined cause of injury codes which are to be used after a thorough investigation cannot determine whether the injuries are accidental, suicidal, or homicidal. They may code injuries as intentional or unintentional even when it is questionable, and they do not have the benefit of an investigation.

Some of the more subjective aspects of these codes may also play a role in the assignment of E codes. For example, physicians and coders are concerned about labeling persons and have biases which influence documentation and coding. Certain codes such as child abuse, rape, and suicide could be considered controversial.

Documentation on the medical record is another major factor influencing the assignment of E codes. Frequently there is inadequate information to determine the cause as intentional. With short hospital stays, investigations of injuries that may be the result of abuse may be incomplete at the time of discharge and thus cannot be documented on the medical record as child abuse. Several cases that we classified as abuse fell into this category. We need to emphasize that these cases were most likely but were not confirmed cases of injury resulting from the violent acts of another person. There is the possibility for an error

to be made in the other direction as well, and only followup after discharge could provide an accurate determination.

Several measures can be taken to increase the sensitivity of E codes to identify injuries resulting from violence in hospitals' discharge data. Improved documentation on medical records and standardized guidelines and training for E coding would result in more accurate assignment of E codes (*1,12–14*). However, injuries caused by violent and aggressive acts and assaults may still be underreported because intent is difficult to establish and intentionality is defined differently by various disciplines and people (*15–18*).

Relying on E codes to identify injuries resulting from violence is further complicated by the fact that there are varying degrees of the injuries and a range of motives leading to the injuries; that is, some injuries were not intended but were the result of a violent action of another person. Nonetheless, in the absence of other nonfatal sources of data and with the availability of E codes, hospital discharge data can provide a valuable tool for injury prevention efforts. Researchers and others involved in designing and implementing violence and child abuse prevention programs should be aware, however, of the underreporting and other associated issues—for example, miscoding and misclassification—when using E-coded hospital discharge data for surveillance of injuries resulting from violence.

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