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EXECUTIVE SUMMARY

This study evaluates the reporting of external cause of injury codes (E codes) on injury-related discharges in the Healthcare Cost and Utilization (HCUP) databases. The HCUP databases are developed through a Federal-State-Industry partnership sponsored by the Agency for Healthcare Research and Quality (AHRQ). Injuries are identified by *Healthy People 2010* as one of the 10 high-priority public health issues in the United States. Unintentional injuries are the leading cause of death for Americans under age 35 (CDC, 2001). Data on injuries are essential to evaluate the effectiveness of existing policies and programs, as well as to determine the need for new prevention programs. Hospital discharge data from inpatient and outpatient settings, such as emergency rooms, can be used to identify significant injuries that are priority targets for prevention. E codes are an essential component of injury surveillance efforts because they describe the cause of injury.

Injury-related discharges were identified in the HCUP databases using *International Classification of Diseases, 9th Revision, Clinical Modification* (ICD-9-CM) codes. These codes were also employed to identify records with medical misadventures/adverse reactions. The percentage of injuries with injury-related E codes was determined for each of the 2001 HCUP databases: Nationwide Inpatient Sample (NIS), State Inpatient Databases (SID), State Emergency Department Databases (SEDD), and State Ambulatory Surgery Databases (SASD). E code reporting on medical misadventures/adverse reaction events was evaluated separately from other types of injuries. E code completeness for both injuries and medical misadventures in the HCUP databases was compared to E coding in similar administrative databases, such as the 2001 National Hospital Discharge Survey (NHDS) and the 2001 National Hospital Ambulatory Medical Care Survey (NHAMCS). The variation in E coding across the HCUP states was examined in relation to state-specific policies, procedures, and edit checks.

The reporting of E codes for injury-related records was relatively complete in the HCUP databases. Across the 33 states that provided inpatient data to HCUP, E code completeness on injury records averaged 87.2 percent. Nineteen of the 33 states reported E codes on at least 90% of their inpatient injury records. Across the nine states that provided emergency department data to HCUP, E code completeness on injury records averaged 92.5%, with most states reporting E codes on at least 94% of their injury records. Across the 18 states that provided hospital-based ambulatory surgery data to HCUP, E code completeness averaged 80.1 percent.

E code reporting on injury records in the HCUP databases was higher than in other publicly available databases. For example, the HCUP NIS database included E codes on 85.7% of its injury records, as compared to 68.0% of the injury records in the NHDS. Similarly, E code completeness on injury records across the nine SEDD states averaged 92.5%, as compared to 80.8% completeness in the NHAMCS.

Reporting of E codes for medical misadventure/adverse reaction records lagged behind the reporting of E codes for injuries in the HCUP databases. E code completeness for medical misadventures/adverse reactions was 39.2% in the NIS, an average of 40.2% in the SID, an average of 57.6% in the SEDD, and an average of 42.8% in the SASD. In contrast, there was no lag in E code reporting on medical misadventure and injury discharges in the NHDS, with results reflecting 67.9% completeness for medical misadventures and 68.0% completeness for injuries. For medical misadventures, the NHDS (67.9% completeness) had better E code reporting than the NIS (39.2% completeness).

Variation in E code completeness existed for both injuries and medical misadventures across states. States with mandates requiring that E codes be submitted on injury records had better E code completeness. If mandates were either formally or informally enforced by the statewide data organization, then the E code completeness was even greater.

INTRODUCTION

Healthy People 2010 identifies injuries as one of the 10 high-priority public health issues in the United States. Unintentional injuries are the leading cause of death for Americans under age 35 (CDC, 2001). The Centers for Disease Control and Prevention (CDC) estimate that the federal government spends approximately \$12.6 billion each year in injury-related medical costs (CDC, 2001). Data on injuries are essential to evaluate the effectiveness of existing policies and programs, as well as to determine the need for new prevention programs. Hospital discharge data from inpatient and outpatient settings, such as emergency rooms, can be used to identify significant injuries that are priority targets for prevention.

In hospital discharge data, information on injuries is reported using *International Classification of Diseases, 9th Revision, Clinical Modification* (ICD-9-CM) codes. External cause of injury codes (E codes) are a supplement to the ICD-9-CM codes that classify data on the cause of an injury. The Medicare uniform hospital billing form (UB-92) contains a dedicated field for recording one E code and the newer 837 Health Care Claim Transaction Set Standards allows inclusion of up to 10 E codes. The accuracy and completeness of E code reporting is essential in injury surveillance efforts because E codes describe the cause of injury.

The Agency for Healthcare Research and Quality (AHRQ) has used E codes in various projects. The AHRQ Patient Safety Indicators (PSI) use E codes to identify self-inflicted injuries, poisonings, and medical misadventures. In applying the AHRQ Patient Safety Indicators for the 2003 National Healthcare Quality Report, it was noted that there was an uneven use of PSI-related E codes across states (Coffey et al., 2003). Another AHRQ-sponsored study employed E codes to identify firearm-related hospitalizations in a national database derived of hospital discharge data. Similarly, this study also noted that the completeness of E coding for injuries seemed to vary by state (Coben and Steiner, 2003).

Given concerns over the variability in completeness of E code reporting, AHRQ decided to evaluate the completeness of E coding in the Healthcare Cost and Utilization Project (HCUP) databases. For the 2001 data year, these databases are comprised of inpatient and outpatient data from 33 states. For the list of HCUP data sources, please refer to Appendix A. The primary objectives of this evaluation included determining the completeness of E code reporting within the HCUP databases and considering the results in relation to comparable national databases. Secondary objectives included identifying policies and procedures around E codes within participating HCUP states and correlating the variation in E code completeness with state-specific policies and procedures. Because the nature of E coding differs for injuries versus misadventure/adverse reactions, completeness was examined separately for these two categories.

METHODS

Defining Injury and Medical Misadventure/Adverse Reaction Events

To investigate the completeness of E codes in the HCUP databases, we first needed to determine the following:

- The range of ICD-9-CM diagnosis codes that define injury and medical misadventure/adverse reaction events.
- The range of E codes that are used to describe the external cause of injury and medical misadventure/adverse reactions.

To define the ICD-9-CM diagnosis and E code ranges for injury events, we consulted the 2003 State & Territorial Injury Prevention Directors Association (STIPDA) report (STIPDA, 2003). The STIPDA report provided the injury-related codes and recommended using hospital discharge data for injury surveillance. Appendix B lists the ICD-9-CM diagnosis and E codes recommended by STIPDA and used in this evaluation. For medical misadventures/adverse reaction events, a team of physicians reviewed the ICD-9-CM codes and recommended specific ranges. These ranges are also described in Appendix B.

We then considered whether injury and medical misadventure/adverse reaction events should be identified based on the principal diagnosis on a discharge record, secondary diagnoses, or all diagnoses listed. Preliminary results examined all three options; however, subsequent results focused on discharges in which the principal diagnosis indicated an injury or medical misadventure/adverse reaction. It should be noted that utilizing the principal diagnosis for identifying injuries complies with the 2003 STIPDA recommendations.

Reporting Completeness of E Codes

Another step toward investigating the completeness of E codes in the HCUP databases included determining how to report results in a standard format that facilitated comparisons. The 2003 STIPDA report outlined three formats as follows:

- Percentage of all discharges with an injury principal diagnosis that have an external cause of injury code
- Barell Injury Diagnosis Matrix that classifies injuries by body region and nature of the injury
- Mechanism by Intent Matrix that groups valid E codes by cause of injury and manner (e.g., unintentional, self-inflicted, and assault).

We used all three formats to report E code completeness for both injury and medical misadventure/adverse reaction events.

Percentage Calculation

E code completeness was calculated as follows:

Percent of injury events with an injury E code =

$$\frac{\text{\# of records with an injury diagnosis that have a valid injury E code}}{\text{\# of records with an injury diagnosis}} \times 100$$

Percent of medical misadventure/adverse reaction events with a medical misadventure/adverse reaction E code =

$$\frac{\text{\# of records with a medical misadventure/adverse reaction diagnosis that have a valid medical misadventure/adverse reaction E code}}{\text{\# of records with a medical misadventure/adverse reaction diagnosis}} \times 100$$

Barell Injury Diagnosis Matrix

The Barell Matrix categorizes injury diagnoses into regions of the body and the nature of the injury (e.g., fractures, dislocations, open wounds, and burns). This matrix divides the body into five main regions (i.e., head and neck, spine and back, torso, extremities, and unclassified by site) and 36 specific areas. For simplicity, we used only the five main body regions for reporting. The Barell Matrix was included to determine if completeness of E coding varied by body region or nature of the injury.

Within each body region, we examined the percent of injury records with an injury E code, overall and by the 11 categories for nature of injury. Within the Barell Matrix, the percent of discharges with an E code is reported. Information on discharge counts and rates per 100,000 population for the HCUP databases is available in HCUP Deliverable #351, "E Code Tables." Since the range of ICD-9-CM codes used for the Barell Matrix specifically classifies injuries (i.e., records with ICD-9-CM diagnosis codes in the range 800-995), it could not be used for examining E code completeness for medical misadventures/adverse reaction events identified by ICD-9-CM codes 996-999.

Mechanism by Intent Matrix

The Mechanism by Intent Matrix classifies both injury and medical misadventure/adverse reaction E codes. Injury records were categorized using E codes in the range E800-E999 into five intent categories: unintentional, intentional, undetermined intent, adverse effects of medical treatment, and blank cause. Within unintentional injuries, we simplified the 17 different mechanisms into six collapsed categories (i.e., falls, motor vehicle traffic, struck by or against, cut or pierce, unspecified mechanism, and other mechanisms). We determined the collapsed categories based on the highest frequency injuries. Intentional injuries were categorized as assault, self-inflicted, or other causes of violence. The Mechanism by Intent Matrix was used to determine if E code completeness varied by intent or mechanism.

Identifying Available Databases

To evaluate the completeness of E codes in the HCUP databases, we needed to identify both the HCUP databases that were appropriate for the evaluation and other comparative databases. The HCUP databases selected for this evaluation included data for three different health care settings:

- Inpatient hospitalizations:
 - The 2001 Nationwide Inpatient Sample (NIS), a nationally stratified *sample* of hospitals with all of their discharges from 33 states, weighted to provide national estimates.
 - The 2001 Statewide Inpatient Databases (SID), a *census* of hospitals with all of their discharges from 33 participating states.

- Emergency departments:
 - The 2001 State Emergency Department Databases (SEDD), a *census* of hospitals with their complete emergency department encounters from nine participating states.
- Ambulatory surgeries:
 - The 2001 State Ambulatory Surgery Databases (SASD), a *census* of facilities with all of their same-day surgeries from 18 participating states. All 18 states included information from hospital-based ambulatory surgery facilities; nine states included information from freestanding facilities.

Comparative national databases were available from other sources for inpatient and emergency department settings. These databases included the following:

- Inpatient hospitalizations:
 - The 2001 National Hospital Discharge Survey (NHDS), which is a probability sample of hospitals and discharges, weighted to produce national estimates. The NHDS is maintained by the National Center for Health Statistics (NCHS).
- Emergency departments:
 - The 2001 National Electronic Injury Surveillance System-All Injury Program (NEISS-AIP), which is a nationally representative sample of U.S. hospital emergency departments and encounters, weighted to produce national estimates. The NEISS-AIP is a collaborative effort by the National Center for Injury Prevention and Control and the U.S. Consumer Product Safety Commission. For this evaluation, information from the 2001 NEISS-AIP was obtained using WISQARS™ (Web-based Injury Statistics Query and Reporting System), an interactive database that provided customized reports of injury-related data (<http://webappa.cdc.gov/sasweb/ncipc/nfirates2001.html>). NEISS-AIP counts were calculated for all cases and for cases that were treated and released. The SEDD is similar to the latter count, in which cases are treated and released.
 - The 2001 National Hospital Ambulatory Medical Care Survey (NHAMCS), which is a probability sample of hospitals and patients, weighted to produce national estimates. NHAMCS is maintained by NCHS. NHAMCS includes both emergency and outpatient department visits. For this evaluation, we used the *National Hospital Ambulatory Medical Care Survey: 2001 Emergency Department Summary* (McCraig and Burt, 2003). Table 13 of the Summary includes national estimates for the Mechanism by Intent Matrix based on the NHAMCS.

Evaluating the Completeness of E Codes in the HCUP Databases

We first examined the percent of injury and medical misadventure/adverse reaction records with E codes within the HCUP databases: inpatient, emergency department, and ambulatory surgery. Completeness was examined along the three dimensions described above: overall, by the modified Barell Matrix, and by the Mechanism by Intent Matrix. Using these frameworks for reporting E code completeness, the HCUP results were compared to other national data sets (i.e., NHDS, NEISS-AIP, NHAMCS), where appropriate. When possible, HCUP results were

compared with E code completeness reported by other data organizations that have used state-specific data. These other state-specific results were extracted from public reports and articles examining E code reporting. Finally, the variation in the state-specific E coding was explored.

Exploring the Variation of State-Specific E Code Reporting

To investigate the variation in reporting of E codes in the HCUP state databases (i.e., SID, SEDD, and SASD), we considered numerous state-specific factors:

- The number of diagnosis fields used to collect ICD-9-CM fields
- The number of fields specifically used to report E codes
- Policies and procedures for E code reporting
- Edit checks for verifying the presence of E codes.

The information on state-specific policies, procedures, and edit checks were collected from the HCUP State Partners.

Determining State-Specific Policies and Procedures for E Code Reporting and Edit Checking

To determine state-specific policies and procedures around E codes in the HCUP states, we interviewed each HCUP State Partner by telephone using a structured discussion guide. The discussion guide contained a series of questions aimed at developing a comprehensive understanding of the state-specific use of E codes. The questions targeted three areas of interest:

- State-specific reporting policies and regulations
- State-specific edit checks on the use of E codes
- State-specific evaluations of E coding.

The complete discussion guide is included in Appendix C.

Each HCUP Partner was consulted to determine the best person within the organization to be interviewed about the state-specific policies and procedures. Telephone interviews, which ranged from 30 to 60 minutes, were arranged with the appropriate people. For consistency, only one individual conducted the interviews. Contacts in 32 of the 33 HCUP states were interviewed; no contact was available in Illinois. Individual responses to the questions in the discussion guide were tracked and then summarized across states. Information gathered during these interviews is described in HCUP Deliverable #352, "E Code Discussion Guide and Summary."

Limitations and Caveats

A key aspect of the telephone interviews focused on whether the state had mandates for the submission of E codes on injury-related diagnoses. Some states had regulations for collection (i.e., rules defined by the state data organization) instead of mandates passed by the state legislature. After the telephone interviews, the strict definition of "mandates for collection" was broadened to include E code reporting regulations. Five states, Kentucky, Maryland, New Jersey, Texas, and Utah, were reclassified as having mandates/regulations using the broader definition.

RESULTS AND DISCUSSION

Because E code practices for injury and medical misadventures/adverse reactions may vary according to the clinical setting, the results are discussed separately by both event type and setting. The results are organized first by event (e.g., injury and medical misadventure/adverse reactions) and within the setting (e.g., inpatient, emergency department, and ambulatory surgery). Under each setting for an event, three main sub-headings exist:

- E code completeness for the HCUP databases
- E code reporting in comparable data sets
- Variation in HCUP state-specific E code completeness with respect to State policies and procedures for E code reporting and edit checking.

E Code Evaluation: Injury Discharges in Inpatient Data

Based on the HCUP NIS, injury discharges, defined using the principal diagnosis, account for approximately 4.6% of all U.S. discharges. Across the states in the SID, the percent of injury records based on the principal diagnosis was similar to the NIS and ranged from 4.1% to 6.0 percent. If all listed diagnoses, including both principal and secondary diagnoses, were considered in defining injury records, the percent of injury-related discharges using the NIS increased to 6.8% of all U.S. discharges and ranged from 5.9% to 8.7% across the 33 states in the SID. Refer to Table 1 in Appendix D for details and Figure 1 in Appendix E for results by principal and all listed diagnoses.

E Code Completeness of Injury Discharges in the HCUP Inpatient Data

Percentage Calculation

The percent of injury records, based on the principal diagnosis, with an injury E code in one of the secondary diagnoses was 85.7% using the HCUP NIS. In the 33 SID states, the percent of injury records with an injury E code varied from 52.6% to 99.4 percent. Almost ninety percent of the states reported E codes on at least 70% of the injury discharges; more than half reported E codes on at least 90% of the injury discharges. See Table 2 in Appendix D and Figure 2 in Appendix E for state-specific details.

Barell Injury Diagnosis Matrix

Using the Barell Matrix to evaluate E code completeness for injuries in different regions of the body, there was little variation in the percent of E codes reported in the NIS:

- For all injuries, E codes were reported on 85.7% of the discharges.
- For each of the four body regions, as well as unspecified, the percent of E codes reported varied only between 82.1% and 88.5 percent.

SID data also featured consistent reporting of E codes for injuries to different regions of the body. States that have an overall high percentage of E code reporting have high percentages of E code reporting across all body regions; states that have an overall low percentage of E code

reporting have low percentages of E code reporting across all body regions. We found no significant variation in E code completeness across different body regions. Please refer to Table 3 in Appendix D for state-specific details. Figure 3a in Appendix E illustrates the completeness of E coding in the NIS overall and by body region. Figures 3b, 3c, and 3d contrast the completeness of E coding across three states: Connecticut with nearly complete E code reporting, Georgia with average E code reporting, and West Virginia with relatively poor E code reporting.

Consistency was also reflected in E code reporting within the NIS and SID when examining the completeness of E codes by the modified Barell Matrix that included the five body regions and 12 categories for nature of injury (e.g., fracture, open wounds, burns, and amputations). Please refer to Table 4a to 4e in Appendix D for national and state-specific information by body region within the modified Barell Matrix.

Mechanism by Intent Matrix

Using the Mechanism by Intent Matrix, injuries in the HCUP NIS were categorized as follows:

- *Unintentional* injuries accounted for 73.6% of all injuries
- *Intentional* injuries accounted for 11.4% of all injuries
- *Undetermined intent* injuries accounted for 1.2% of all injuries
- *Blank or no cause* accounted for 11.7% of all injuries.

Previously, we reported that 85.7% of injury-related discharges in the NIS included E codes indicating that 14.3% of the injuries had no E code reported (versus the 11.7% reported using the Mechanism by Intent Matrix, above). The reason for this discrepancy is that the Mechanism by Intent Matrix used a broader range of E codes to classify injuries (i.e., all E codes in the range E800-E999). The initial 85.7% figure was calculated using a more narrow range that specifically excluded E codes for place of injury (E849) and medical misadventures (E870, E930, and E940).

Across the states in the SID, the average percent of injuries classified by intent was very similar to the NIS. There was little variation in the percent of injuries that were intentional (range of six percentage points) and undetermined intent (range of two percentage points). However, for unintentional injuries, the percentage varied greatly (range of 42 percentage points) as did the percentage of injuries with no E code (range of 46 percentage points). If the occurrence of injuries with no E code was high, then the number of unintentional injuries reported was relatively low. This suggests that states with incomplete E coding may underestimate the overall numbers of unintentional injuries while providing a fairly accurate account of the number of intentional injuries. Please see Table 5 in Appendix D and Figure 5 in Appendix E for details on national and state-specific information by injury intent.

The Mechanism by Intent Matrix also categorized *unintentional* injuries by mechanism. For the HCUP NIS, unintentional injuries were classified in terms of the following causes:

- *Falls* accounted for 52.4% of all unintentional injuries
- *Motor vehicle traffic* accounted for 18.2% of all unintentional injuries
- *Struck by or against* accounted for 3.0% of all unintentional injuries
- *Cut or pierced* accounted for 1.6% of all unintentional injuries

- *Unspecified mechanism* accounted for 3.1% of all unintentional injuries
- *Other mechanisms* accounted for 21.8% of all unintentional injuries.

Across the states in the SID, the average percent by mechanism for unintentional injuries was similar to the NIS percent. Refer to Table 6 in Appendix D and Figure 6 in Appendix E for details on national and state-specific information by mechanism for unintentional injuries.

Lastly, the Mechanism by Intent Matrix was used to categorize *intentional* injuries by mechanism. For the HCUP NIS, intentional injuries were linked to the following causes:

- *Self-inflicted injuries* accounted for 62.9% of intentional injuries
- *Assaults* accounted for 36.2% of intentional injuries
- *Other causes of violence* accounted for 0.8% of intentional injuries.

Across the states in the SID, the average percent by mechanism for intentional injuries was again similar to the NIS percent. Refer to Table 7 in Appendix D and Figure 7 in Appendix E for details on national and state-specific information by mechanism for intentional injuries.

E Code Reporting on Inpatient Injury Discharges in Comparable Data Sets

NHDS Comparison

The NHDS estimates that the proportion of U.S. inpatient discharges that were injury records was slightly higher than the number estimated using the NIS:

- Based on principal diagnosis, injuries account for 5.0% of inpatient discharges using the NHDS, which was significantly higher than the estimate of 4.6% of inpatient discharges using the NIS.
- Based on all listed diagnoses, injuries account for 6.9% of inpatient discharges using the NHDS, which was not significantly different from the estimate of 6.8% of inpatient discharges using the NIS.

See Table 1 in Appendix D for a comparison of the NHDS to the NIS and SID. Figures 1a, 1b, and 1c in Appendix E present results by principal, secondary, and all listed diagnoses.

In terms of E code reporting, the injury records in the NHDS records were less complete than the NIS. Sixty-eight percent of the injury records in the 2001 NHDS have injury-related E codes, as compared with 85.7% of the injury records in the 2001 NIS. In the 1996 NHDS, E code completeness on injury hospitalizations was 64% – similar to the completeness in 2001 (Hall and Owings, 2000). The degree of E code completeness in the 2001 NHDS is consistently lower than the 2001 NIS when reporting by body region within modified Barell Matrix. The percentage of E codes reported in the NHDS by body region varied from 59.6% for spine and back injuries to 79.2% for injuries that were unclassified by site. In contrast, the completeness in the NIS for these body regions was 82.1% and 87.7%, respectively. Refer to Table 3 in Appendix D and Figure 3 in Appendix E for E coding completeness by body region. Table 4a to Table 4e in Appendix D provides detail for the NHDS by modified Barell Matrix.

Using the Mechanism by Intent Matrix, the percentage of injuries that were intentional and with undetermined intent was relatively similar between the NHDS and NIS:

- *Intentional injuries* were 9.2% of all injuries in the NHDS and 11.4% in the NIS.

- *Injuries with undetermined intent* were 0.9% of all injuries in the NHDS and 1.2% in the NIS.

The largest difference appeared for two categories: 1) the percentage of injuries that were unintentional and 2) the percentage of injuries with no E code. The NHDS showed 58.0% of injury records were unintentional (NIS data indicated 73.6%) and 28.8% had no E code (NIS data indicated 11.7%). Within unintentional injuries, the proportion of records by mechanism (e.g., falls, motor vehicle traffic accidents, etc.) was similar between the NHDS and the NIS. Within intentional injuries, the percentage of records that were assault, self-inflicted, and other causes of violence was also similar between the NHDS and NIS. See Table 5, Table 6, and Table 7 in Appendix D for details on the NHDS and NIS by intent, by mechanism for unintentional injuries, and mechanism for intentional injuries, respectively. This information can also be seen in Figure 5, Figure 6, and Figure 7 in Appendix E.

CDC State Injury Indicators Report Comparison

In 2001, The CDC applied the recommendations in the STIPDA report to 1997 and 1998 hospital discharge data from 12 states in their *State Injury Indicators Report (SIIR)*. These states included California, Colorado, Kentucky, Louisiana, Massachusetts, Michigan, Missouri, New Mexico, Oklahoma, Oregon, Texas, and Washington. For states that participate in HCUP, E code completeness reported for injury hospitalizations in 1997 and 1998 were very similar to the percentages calculated using the HCUP SID for 2001. Following are examples of the E code completeness on injury hospitalizations:

- California – 100% completeness in 1997 SIIR, 100% completeness in 1998 SIIR, and 95.0% completeness in the 2001 SID.
- Colorado – 98.6% completeness in 1997 SIIR, 98.6% completeness in 1998 SIIR, and 99.1% completeness in the 2001 SID.
- Kentucky – 54.0% completeness in 1997 SIIR, 62.0% completeness in 1998 SIIR, and 76.4% completeness in the 2001 SID.
- Massachusetts – 98.0% completeness in 1997 SIIR, 97.6% completeness in 1998 SIIR, and 98.6% completeness in the 2001 SID.
- Michigan – 70.0% completeness in 1997 SIIR, 79.2% completeness in 1998 SIIR, and 85.5% completeness in the 2001 SID.
- Missouri – 96.0% completeness in 1997 SIIR, 95.0% completeness in 1998 SIIR, and 98.3% completeness in the 2001 SID.
- Oregon – 58.0% completeness in 1997 SIIR, 65.2% completeness in 1998 SIIR, and 87.9% completeness in the 2001 SID.
- Washington – 99.0% completeness in 1997 SIIR, 99.0% completeness in 1998 SIIR, and 97.3% completeness in the 2001 SID.

Information on E code completeness in Texas was not available in the CDC report.

Two Other Comparative Studies

A separate study conducted by the Washington State Department of Health reported that the completeness of E coding on inpatient discharge records with a principal diagnosis of injury was 99% in 1998 (LeMier, Cummings, and West, 2001). In the 2001 Washington SID, E code completeness was 97.3 percent.

In a study of Maryland hospital discharges, the percent of trauma discharges with E codes reported increased from 40% in 1979 to 55% in 1988 (Marganitt et al., 1990). For the 2001 Maryland SID, E code completeness was 95.7 percent.

Variation in HCUP State-Specific E Code Completeness on Inpatient Injury Discharges with Respect to State Policies and Procedures for E Code Reporting and Edit Checking

The percent of injury records in which E codes were reported varied considerably across the 33 states from 52.6% to 99.4 percent. E code completeness was examined in relation to various factors. These factors included:

- Number of diagnoses coded
- Number of separate fields reserved for cause of injury E codes
- States with mandates or regulations for E code reporting on injury records
- States that have a mechanism to enforce mandates or regulations on E coding
- States without mandates, but with policies or procedures that encourage submission of E codes on injury records
- States that verify the presence of E codes on injury records.

Number of Diagnoses Coded and Separate E Code Fields

Because E codes are not used as a basis for reimbursement, they often receive low priority in the selection process of ICD-9-CM codes reported. When the number of diagnosis codes allowed on a discharge record is limited, E codes may not be included. On average, the 22 states that coded a maximum of nine to 12 diagnoses on their discharge records had E codes on 84.3% of their injury discharges. This finding was in contrast to the 93.1% E code completeness on injury records for the 11 states that coded a maximum of 15 to 30 diagnoses. The presence of a separate cause of injury E code field made little difference to the E code completeness. In the 10 states without a separate E code field, the average percent of injury records with an E code was 85.5 percent. In the 23 states with at least one separate E code field, the average percent of injury records with an E code was 88.0 percent. Table 8 in Appendix D presents state-specific information on the number of diagnoses and separate cause of injury E code fields collected by the data organization and the percent of injury records with E codes for each state. Figure 8 in Appendix E graphs the percent of E code completeness by the maximum number of diagnoses coded.

Mandates and Enforcement

For the 10 states without mandates or regulations for E code submission on injury records, the average percent of injury records with E codes was 79.4 percent. By comparison, the percent of injury records with E codes in the 22 states with mandates or regulations averaged 92.2 percent. In the eight states that have formal or informal measures to enforce their mandates or regulations, the average percent of injury records with E codes increased to 97.0 percent, with little variation across states. For the remaining 14 states with no enforcement measures for their mandates, the average E code completeness was 89.4 percent.

The states with the highest percentage of E code completeness and the smallest variation were the states that had both mandates and enforcement measures (8 states ranging from 94.9% to 98.8%). The states with the lowest average percentage of E code completeness and the largest variation were the states without a mandate and enforcement measures (10 states ranging from 52.6% to 99.1%). North Carolina and Colorado are notable exceptions because neither of these states has mandates or enforcement procedures, yet their E code reporting on inpatient injury discharges is high, 95.5% and 99.1%, respectively. Refer to Table 9 in Appendix D for information on which states have mandates or regulations for E code submission on injury records and which states enforce those mandates/regulations. Figure 9a in Appendix E presents the percent of injury records with E codes for states with and without mandates and regulations. Figure 9b presents the percent of injury records with E codes for states that enforce their mandates, as compared with states that either have no mandates/regulations or do not have a mechanism to enforce them.

Encourage Submission

Of the 10 states without mandates or regulations for collecting E codes on injury records, half of the states have policies that encourage the submission of E codes. These policies appear to have little effect on the percent of injury records with E codes. On average, the five states with policies to encourage submission of E codes on injury records have E codes on 78.0% of their injury records, as compared with an average E code completeness of 80.8% for the other five states. Refer to Table 10 in Appendix D and Figure 10 in Appendix E for details on the states that do not have mandates or regulations to collect E codes on injury records.

Verify with Edit Checks

Of the 32 HCUP states interviewed for this project, 26 states either verify the presence of E codes on injury records or examine their data for invalid or improper E codes. On average, these types of edit checks made little difference in the percent of injury records with E codes. For the 26 states that performed some sort of edit checks, the average E code completeness on injury records was 88.8 percent. For the six states that do not check for E codes, the average E code completeness on injury records was 85.5 percent. For the states without a mandate for collection of E codes, the presence of an edit check does not seem to make a difference in the reporting of E codes. The average E code completeness for the 6 states that do not have a mandate but do perform edit checks was 78.8 percent. For the 4 states that do not have a mandate and also do not perform edit checks, the average E code completeness was 80.3 percent. Refer to Table 11 in Appendix D and Figure 11 in Appendix E for details on the states that do and do not perform edit checks on the use of E codes in relation to inpatient data.

E Code Evaluation: Injury Records in Emergency Department Data

Contrary to the HCUP inpatient data, in which approximately five percent of hospitalizations were injury-related, the percentage of such records in the emergency department data was much higher. Across the nine states in the SEDD, the percent of injury records based on the principal diagnosis ranged from 26.4% to 34.8 percent. Please note that the HCUP emergency department databases include only those patients treated and released from the emergency department; the HCUP inpatient databases include patients that have been seen in the emergency department and subsequently admitted to the hospital. Refer to Table 12 in Appendix D for state-specific details. Figure 12 in Appendix E presents results by principal and secondary diagnoses.

E Code Completeness of Injury Records in the HCUP Emergency Department Data

Percentage Calculation

The percent of injury records with E codes also appeared higher in the HCUP emergency department data than in the HCUP inpatient data. Based on the principal diagnosis, the percent of injury records with an injury E code in one of the secondary diagnoses averaged 87.2% across the 33 states in the HCUP SID. In contrast, the percent of E code completeness in the nine states in the SEDD ranged from 71.9% to 99.4%, with an average completeness of 92.5 percent. The higher percentage of E code reporting in the nine states with emergency department data is not too surprising, considering that these nine states also had complete E code reporting in their inpatient data (average of 94 percent). Therefore, it does not appear that the health care setting itself (inpatient versus emergency room) affects E code completeness as much as a state's policy on E code reporting. See Table 13 in Appendix D and Figure 13 in Appendix E for state-specific details for both SEDD and SID data.

Barell Injury Diagnosis Matrix

Similar to the inpatient data, there was little variation in the percent of E code completeness when using the Barell Matrix to evaluate completeness for injuries to different regions of the body. States that have comprehensive E code reporting overall also have good E code reporting by body region. For example, the Connecticut SEDD has overall E code completeness of 99.4%, and by body region, the E code completeness was between 97.2% and 99.8 percent. See Table 14 in Appendix D for state-specific details. Figures 14a and 14b in Appendix E compare the completeness of E coding in Connecticut and Minnesota.

The consistency of E code reporting within a state also held true when assessing the completeness of E codes by the modified Barell Matrix, which included the five body regions and 12 categories for nature of injury (e.g., fracture, open wounds, burns, and amputations). See Table 15a to 15e in Appendix D for state-specific information by modified Barell Matrix.

Mechanism by Intent Matrix

Using the Mechanism by Intent Matrix to categorize injuries using E codes, the HCUP emergency department data revealed a higher percentage of unintentional injuries and a lower percentage of all other types of injuries compared to the SID, as demonstrated below:

- *Unintentional* injuries accounted for an average of 90.3% of the SEDD injuries, but only 75.2% of the SID injuries.
- *Intentional* injuries accounted for an average of 4.1% of the SEDD injuries and 11.2% of the SID injuries.
- *Undetermined intent* injuries accounted for an average of 0.3% of the SEDD injuries and 1.2% of the SID injuries.
- *No E code* was reported on an average of 5.2% of the SEDD injuries and 10.2% of the SID injuries.

Refer to Table 16 in Appendix D and Figure 16 in Appendix E for details on state-specific information by injury intent in the SEDD. Table 5 and Figure 5 present the state-specific information for the SID.

Using the Mechanism by Intent Matrix to categorize unintentional injuries reveals that the distribution of cases differs greatly between the HCUP emergency department data, which includes only those patients treated and released from the emergency department, and the HCUP inpatient data, as specified below:

- *Falls* accounted for an average of 26.3% of the SEDD unintentional injuries and 51.7% of unintentional SID injuries.
- *Motor vehicle traffic* accounted for an average of 12.1% of the SEDD unintentional injuries and 18.8% of unintentional SID injuries.
- *Struck by or against* accounted for an average of 15.7% of the SEDD unintentional injuries and 3.1% of unintentional SID injuries.
- *Cut or pierced* accounted for an average of 10.7% of the SEDD unintentional injuries and 1.5% of unintentional SID injuries.
- *Unspecified mechanism* accounted for an average of 4.7% of the SEDD unintentional injuries and 2.8% of unintentional SID injuries.
- *Other mechanisms* accounted for an average of 30.5% of the SEDD unintentional injuries and 22.1% of unintentional SID injuries.

Refer to Table 17 in Appendix D and Figure 17 in Appendix E for details on state-specific information by mechanism for unintentional injuries for the SEDD. Table 6 and Figure 6 present the percentages for the SID.

Great variation also exists in the distribution of intentional injury cases in the HCUP emergency department data, as compared with the HCUP inpatient data, as detailed below:

- *Assaults* accounted for an average of 79.9% of the SEDD intentional injuries and 33.9% of intentional SID injuries
- *Self-inflicted injuries* accounted for an average of 17.6% of the SEDD intentional injuries and 65.5% of intentional SID injuries
- *Other causes of violence* accounted for an average of 2.5% of the SEDD intentional injuries and 0.6% of intentional SID injuries.

See Table 18 in Appendix D and Figure 18 in Appendix E for details on state-specific information by mechanism for intentional injuries. Table 7 and Figure 7 present the percentages for the SID.

E Code Reporting on Emergency Department Injury Records in Comparable Data Sets

NEISS-AIP Comparison

Using the Mechanism by Intent Matrix to classify types of injuries, the numbers were relatively similar between the HCUP SEDD and the NEISS-AIP, as detailed below:

- *Unintentional* injuries accounted for an average of 90.3% of the SEDD injuries, 92.7% of the NEISS-AIP for all cases, and 93.3% for the NEISS-AIP for treated and released emergency department cases.
- *Intentional* injuries accounted for an average of 4.1% of the SEDD injuries, 7.3% of the NEISS-AIP for all cases, and 6.7% for the NEISS-AIP for treated and released emergency department cases.

The percent of unintentional and intentional injuries may have been lower in the SEDD because NEISS-AIP counts were only reported by these two injury types. Unlike in the SEDD, records were not categorized by the other types of injuries, such as undetermined intent, adverse effects of medical treatment, or blank cause. Refer to Table 16 in Appendix D and Figure 16 in Appendix E for details on NEISS-AIP and SEDD-specific information by intent.

Focusing specifically on *unintentional* injuries, the SEDD was similar to the NEISS-AIP for all categories, with the exception of two: struck by/against and motor vehicle traffic unintentional injuries. The SEDD had a higher percentage for struck/by unintentional injuries and a lower percentage for motor vehicle traffic injuries. Refer to Table 17 in Appendix D and Figure 17 in Appendix E for details on NEISS-AIP and SEDD-specific information for unintentional injuries.

For *intentional* injuries, the distribution of assaults and self-inflicted injuries in the SEDD was different than the NEISS-AIP for treated and released cases, as detailed below:

- *Assaults* accounted for an average of 79.9% of the SEDD intentional injuries and 89.6% of NEISS-AIP treated and released cases.
- *Self-inflicted injuries* accounted for an average of 17.6% of the SEDD intentional injuries and 7.2% of NEISS-AIP treated and released cases.

Refer to Table 18 in Appendix D and Figure 18 in Appendix E for details on NEISS-AIP and SEDD-specific information for intentional injuries.

NHAMCS Comparison

In comparing the SEDD to the NHAMCS, the percentages of intentional and undetermined intent injuries were similar, but the SEDD reflected a higher percentage of unintentional injuries and a lower percentage of injuries with no E code, as demonstrated below:

- *Unintentional injuries* accounted for an average of 90.3% of the SEDD injuries, but only 71.9% of the NHAMCS injuries.
- *Intentional injuries* accounted for an average of 4.1% of the SEDD injuries and 4.7% of the NHAMCS injuries.
- *Undetermined intent injuries* accounted for an average of 0.3% of the SEDD injuries and 0.5% of the NHAMCS injuries.
- *No E code* was reported on an average of 5.2% of the SEDD injuries, while 19.2% of the NHAMCS injuries reported no E code.

Refer to Table 16 in Appendix D and Figure 16 in Appendix E for details on NHAMCS and SEDD-specific information by intent.

Focusing specifically on *unintentional* injuries, the SEDD was similar to the NHAMCS for all types of unintentional injuries. Refer to Table 17 in Appendix D and Figure 17 in Appendix E for details on NEISS-AIP, NHAMCS, and SEDD-specific information for unintentional injuries.

For *intentional* injuries, the distribution on assaults and self-inflicted injuries in the SEDD was similar to the NHAMCS. Refer to Table 18 in Appendix D and Figure 18 in Appendix E for details on NEISS-AIP, NHAMCS, and SEDD-specific information for intentional injuries.

Variation in HCUP State-Specific E Code Completeness on Emergency Department Injury Records with Respect to State Policies and Procedures for E Code Reporting and Edit Checking

In the nine states that provide emergency department data to HCUP, the percentage of injury records with E codes varied across states. Seven of the nine states reported E codes on more than 94% of the injury-related emergency department records. The two remaining states, Maine and Minnesota, reported E codes on far fewer injury-related records, 80.1% and 71.9%, respectively. Given the substantial difference in completeness in these two states relative to the other seven states, we considered several factors that may explain this differential reporting pattern.

Number of Diagnoses Coded

Both Maine and Minnesota coded a maximum of 10 diagnosis code fields; the other seven states coded between 10 and 17 diagnoses. See Table 19 in Appendix D for state-specific information. Figure 19 in Appendix E depicts E code completeness by the maximum number of diagnoses coded.

Mandates and Enforcement

Maine and Minnesota are the only two states without mandates for the collection of E codes on injury records. Of the seven states that have mandates for collection, three have a mechanism to enforce mandates. See Table 20 in Appendix D for state-specific information. Figure 20a in Appendix E shows the percentage of injury records with E codes for states with and without mandates and regulations. Figure 20b presents the percentage of injury records with E codes for states that enforce their mandates, in comparison with states that either have no mandates/regulations or do not have a mechanism to enforce them.

Verify with Edit Checks

While Maine and Minnesota have much lower E code completeness relative to the other states, the large difference between Minnesota's completeness (71.9%) and Maine's completeness (80.1%) is also noteworthy. This differential may be partially explained by Minnesota's lack of edit checking for the presence of E codes on injury records and Maine's use of edit checks. See Table 21 in Appendix D and Figure 21 in Appendix E for details on whether states perform edit checks on the use of E codes in their data.

E Code Evaluation: Injury Records in Ambulatory Surgery Data

In the HCUP inpatient data, approximately five percent of hospitalizations were injury-related, based on the principal diagnosis, while 31 percent of records were injury-related in the emergency department data. Across the 18 states in the SASD, the percent of injury records in hospital-based ambulatory surgery centers averaged 8.8%, ranging from 2.8% to 20.1 percent. In the nine states that report data for freestanding ambulatory surgery facilities, the percent of injury records was small, averaging 3.8% and ranging from 2.2% to 6.0 percent. Refer to Table 22 in Appendix D for state-specific details and Figure 22 in Appendix E for results by principal and secondary diagnoses.

E Code Completeness of Injury Records in the HCUP Ambulatory Surgery Data

Percentage Calculation

The percentage of injury records with E codes in the HCUP ambulatory surgery data appeared either less than or equal to the E code completeness in the HCUP inpatient data. The E code completeness in the hospital-based SASD data for 13 of the 18 states was similar to the inpatient data reported for that state, with a percent difference of less than 7 percent. For the other five states, the E code completeness in their hospital-based SASD data was considerably lower than their inpatient data, with a percent difference of 15% to 92 percent. The E code completeness in the freestanding facilities was poor (less than 55%) in all but one state. See Table 23 in Appendix D for state-specific details. Figure 23a in Appendix E shows E code completeness for the hospital-based SASD, as compared with the SID. Figure 23b in Appendix E shows E code completeness in the SASD for the hospital-based facilities, as compared with the freestanding facilities.

Barell Injury Diagnosis Matrix

For the HCUP inpatient and emergency room data, there was little variation in the percent of E code completeness when using the Barell Matrix to evaluate completeness for injuries to different regions of the body. However, the HCUP ambulatory surgery data did not reflect the same consistency. The E code completeness for injuries to the head/neck and extremities appeared relatively similar to the overall rate, but the E code completeness on injuries to the spine/back and torso was somewhat lower. For example, the Colorado hospital-based SASD has an overall E code completeness of 95.3%; by body region, the completeness was between 77.8% and 98.9 percent. Refer to Table 24 in Appendix D for state-specific details. Figures 24a and 24b in Appendix E compare the completeness of E coding in Colorado and Maryland.

This inconsistency in E code reporting within a state also held true when looking at the completeness of E codes by the modified Barell Matrix that included the five body regions and 12 categories for the nature of injury (e.g., fracture, open wounds, burns, and amputations). See Table 25a to 25e and Table 26a to 26e in Appendix D for state-specific information by modified Barell Matrix for the hospital-based and freestanding facilities, respectively.

Mechanism by Intent Matrix

Utilizing the Mechanism by Intent Matrix to categorize injuries using E codes, the HCUP ambulatory surgery data showed that most of the injuries were unintentional. The percentage of unintentional injuries varies with the percent of records with no E code recorded. The percentages for the other types of injuries, intentional and undetermined intent, remained relatively consistent across the states. See Table 27 in Appendix D and Figure 27 in Appendix E for details on state-specific information by injury intent in the SASD.

The *unintentional* injuries in the hospital-based ambulatory surgery facilities tend to be for falls, cut/piercing, and other mechanism. Seven of the 18 states have a high percentage of *unspecified mechanism* (greater than 20%) for the unintentional injuries in the hospital-based facilities. In contrast, the percent of *unspecified mechanism* in the HCUP inpatient data averaged 2.8%, with no state attaining a level greater than 6.5 percent. Refer to Table 28 in Appendix D and Figure 28 in Appendix E for details on state-specific information by mechanism for unintentional injuries for the SASD.

The distribution of *intentional* injuries in the HCUP ambulatory surgery data was different than the HCUP inpatient data; most of the intentional injuries were from assault, as demonstrated below:

- *Assaults* accounted for an average of 86.8% of the intentional injuries in the SASD and 33.9% of the SID intentional injuries.
- *Self-inflicted injuries* accounted for an average of 11.6% of the intentional injuries in the SASD and 65.5% of the SID intentional injuries.
- *Other causes of violence* accounted for an average of 1.6% of the intentional injuries in the SASD and 0.6% of the SID intentional injuries.

See Table 29 in Appendix D and Figure 29 in Appendix E for details on state-specific SASD information by mechanism for intentional injuries. Table 7 and Figure 7 present the information for the SID.

E Code Reporting on Ambulatory Surgery Injury Records in Comparable Data Sets

No national data set comparable to the HCUP ambulatory surgery databases exists. The National Hospital Ambulatory Care Survey (NHAMCS) includes visits to the outpatient department. This setting is much broader than the HCUP SASD, which includes only ambulatory surgery encounters; thus, it would not be an appropriate comparative database. No state-specific studies on injuries in the ambulatory surgery setting were found in the literature search.

Variation in HCUP State-Specific E Code Completeness on Ambulatory Surgery Injury Records with Respect to State Policies and Procedures for E Code Reporting and Edit Checking

For the 18 states that provide hospital-based ambulatory surgery department data to HCUP, the percentage of injury records with E codes reported varied greatly across states, from 8.2% to 99.5 percent. Twelve of the 18 states reported E codes on more than 89% of the injury-related ambulatory surgery records. The remaining six states reported E codes on 8.2% to 79.6% of their injury records. There was no identified reason for the variation.

Number of Diagnoses Coded

For the HCUP inpatient and emergency department data, states that coded more diagnoses appeared to have better E code completeness. In the ambulatory surgery data, the relationship was not as clear. Three of the six states with low E code completeness coded no more than nine diagnoses; the other three states coded a maximum of 10 diagnoses. In contrast, there were five additional states that coded a maximum of 10 diagnoses and reported E codes on more than 95% of injuries. See Table 30 in Appendix D for state-specific information. Figure 30 in Appendix E graphs the percent of E code completeness by the maximum number of diagnoses coded.

Mandates and Enforcement

For the HCUP inpatient and emergency department data, states with mandates for the collection of E code data had better E code completeness. This pattern was not the rule in the 18 states that provided ambulatory surgery data. Of the 12 states with complete E code reporting on the ambulatory surgery data (i.e., more than 89% completeness), two states, Colorado and North Carolina, did not have mandates. Furthermore, North Carolina does not encourage the submission of E codes. Three states with a low percentage of E code completeness (i.e., less than 55% completeness) mandate collection of E codes. This inconsistency may be caused by mandates that do not specifically mention the collection of E codes in ambulatory surgery data. See Table 31 in Appendix D and Figure 31 for state-specific information.

Verify with Edit Checks

Whether states use edit checks to verify E codes on injury records seems unrelated to actual E code completeness. Four of the six states with low E code completeness edit check or verify their E codes. See Table 32 in Appendix D and Figure 32 for state-specific information.

E Code Evaluation: Medical Misadventures/Adverse Reaction Records

Based on the HCUP NIS, medical misadventure/adverse reaction discharges (defined using the principal diagnosis), account for approximately 2.3% of all U.S. discharges. Across the 33 states in the SID, the percent of medical misadventure/adverse reaction records based on the principal diagnosis was similar to the nation overall and averaged 2.4 percent. Even when all listed diagnoses were used to define medical misadventure/adverse reaction records, the NIS national percentage of 5.6% for all U.S. discharges is comparable to the average of 5.9% for the SID. See Table 33 in Appendix D for details and Figure 33 in Appendix E for results by principal and all listed diagnoses.

In contrast, the percentage of all discharges that have a principal diagnosis indicating a medical misadventure/adverse reaction was lower in the HCUP emergency department and ambulatory surgery data, as demonstrated below:

- Across the nine states in the SEDD, the average percentage of discharges with a principal diagnosis of medical misadventure/adverse reaction was 0.6 percent.
- Across the 18 states with hospital-based SASD data, the average percentage of discharges with a principal diagnosis of medical misadventure/adverse reaction was 1.8 percent.
- Across the nine states with freestanding SASD data, the average percentage of discharges with a principal diagnosis of medical misadventure/adverse reaction was 0.6 percent.

Refer to Tables 34 and 35 in Appendix D for state-specific details for the SEDD and SASD, respectively. Figure 34 in Appendix E presents the SEDD results by principal and secondary diagnoses. Figure 35 in Appendix E describes the SASD results for hospital-based and freestanding facilities.

For a comparison of the medical misadventure rate, based on principal diagnosis, refer to Table 36 in Appendix D and Figure 36 in Appendix E. Findings are presented across health care settings: inpatient, emergency department, and ambulatory surgery.

E Code Completeness of Medical Misadventure/Adverse Reaction Records in the HCUP Data

Percentage Calculation

The percentage of medical misadventure/adverse reaction records (based on the principal diagnosis), with a medical misadventure/adverse reaction E code in one of the secondary diagnoses, was 39.2% using the HCUP NIS and an average of 40.2% across the 33 SID states. Only two states reported E codes on more than 90% of their medical misadventure/adverse reaction discharges. In contrast, 19 of the 33 states reported E codes on more than 90% of their injury records. Across the 33 states, E code completeness averaged 87.2% on inpatient injury records, which is considerably higher than the average of 40.2% for medical misadventures. For state-specific information on E code completeness in inpatient injuries and medical misadventures, refer to Table 37 in Appendix D and Figure 37 in Appendix E.

Lower E code reporting on medical misadventure/adverse reaction records (an average of 57.6% completeness) versus injury records (an average of 92.5% completeness) was also apparent in the nine emergency department states. For state-specific information on E code completeness in emergency department injuries and medical misadventures, refer to Table 38 in Appendix D and Figure 38 in Appendix E.

The trend toward lower E code reporting on medical misadventure/adverse reaction records (an average of 42.8%) as compared with injury records (an average of 80.1%) was also demonstrated in the HCUP ambulatory surgery data. For state-specific information on E code completeness in ambulatory surgery injuries and medical misadventures, refer to Table 39 in Appendix D and Figure 39 in Appendix E.

Within a state, E code completeness for medical misadventures remained relatively constant across health care settings – inpatient, emergency department, and ambulatory surgery. Refer to Table 40 in Appendix D and Figure 40 in Appendix E for state-specific details.

Mechanism by Intent Matrix

The Mechanism by Intent Matrix that categorizes injuries using E codes includes a classification of adverse effects of medical treatment. More adverse effects were seen in the inpatient injuries as compared with injuries in the emergency and ambulatory surgery setting. Specific findings are demonstrated below:

- In the NIS, adverse effects of medical treatment account for 2.1% of U.S. injuries.
- Across the SID, adverse effects of medical treatment accounted for an average of 2.2% of the injuries.
- Across the SEDD, adverse effects of medical treatment accounted for an average of 0.1% of the injuries.
- Across the SASD, adverse effects of medical treatment accounted for an average of 0.2% of the injuries.

E Code Reporting of Medical Misadventure/Adverse Reaction Records in Comparable Data Sets

NHDS Comparison

The NHDS estimates that the percentage of U.S. inpatient discharges that were medical misadventure/adverse reactions was slightly lower than the percentage estimated using the NIS:

- Based on principal diagnosis, medical misadventure/adverse reactions account for 2.1% of inpatient discharges using the NHDS, as compared with 2.3% of inpatient discharges using the NIS.
- Based on all listed diagnoses, medical misadventure/adverse reactions account for 4.9% of inpatient discharges using the NHDS, as compared with 5.6% of inpatient discharges using the NIS.

See Table 33 in Appendix D and Figure 33 in Appendix E for a comparison of the NHDS to the NIS and SID.

In terms of E code reporting, the medical misadventure/adverse reaction records in the NHDS records were more complete. Medical misadventure/adverse reaction records in the NHDS include E codes on 67.9% of the records, in contrast to only 39.2% of the medical misadventure/adverse reaction records in the NIS. See Table 37 in Appendix D and Figure 37 in Appendix E for a comparison of the NHDS in relation to the NIS and SID.

Using the Mechanism by Intent Matrix to identify adverse effects of medical treatment for injury records, more adverse effects were seen in the NHDS injuries (3.0% of all injuries) as compared with the NIS (2.1% of all injuries). Refer to Table 41 in Appendix D for a comparison of the NHDS to the NIS.

NHAMCS Comparison

In the emergency department data, more adverse effects of medical care were seen in the NHAMCS injury-related records (3.7% of the injuries) than the HCUP SEDD (an average of 0.1% of the injuries). Refer to Table 41 in Appendix D for a comparison of the NHAMCS to the SEDD.

Utah Comparative Study

A study conducted by the Utah Health Data Committee examined adverse events in hospital discharge abstracts in Utah (Utah Health Data Committee, 2001). The study calculated the percentages by dividing the number of adverse events from 1995 to 1999 by the total number of discharges. They discovered the following:

- Misadventures of surgical and medical care (any occurrence of 998.2, 998.2, 998.7, or E870-E876) were 0.4% of discharges.
- Complications of surgical or medical procedures (any occurrence of 996-999, not specified above, or E878-E879) were 6.0% of discharges.
- Complications of medications (any occurrence of 960-979, excluding 965.01, E930-E949, or E850-E858, excluding E850.1 and E854.1) were 2.5% of discharges.

The study evaluated all listed diagnoses to identify adverse events and allowed multiple adverse events to be counted for one discharge. In the Utah SID, 6.5% of the discharges were identified as medical misadventures/adverse reaction discharges using all diagnoses listed. Compared to the Utah study, the identification of medical misadventures in the SID was based on a more limited range of ICD-9-CM codes (996-999, 909.3 and 909.5) and did not include E codes. The Utah study reported that their 1994-1999 hospital discharge data had E code completeness of 90 percent. The 2001 Utah SID showed 92.3% of the injury records with an E code and 51.7% of medical misadventure/adverse reaction discharges with an E code.

Variation in HCUP State-Specific E Code Completeness on Medical Misadventure/Adverse Reaction Records with Respect to State Policies and Procedures for E Code Reporting and Edit Checking

E code reporting on medical misadventure/adverse reaction records varies dramatically across states:

- Across the 33 states in the SID, E code completeness ranges from 9.4% to 98.4 percent.
- Across the 9 states in the SEDD, E code completeness ranges from 22.9% to 81.9 percent.

- Across the 18 states in the SASD, E code completeness ranges from 8.9% to 88.7 percent.

Mandates and Enforcements

Of the 22 states with mandates for the collection of E codes on injury-related records, only nine have mandates that specifically mention E code submission for medical misadventures. The average E code completeness for these nine states was 64.3%, with a range of 34.6% to 98.4 percent. In contrast, the five states that have a policy to encourage E code submission for medical misadventures have an average E code completeness of 30.9 percent. This finding was similar to the 30.2% E code completeness in the 17 states with neither a mandate nor a policy for the submission of E codes. Two states, Georgia and South Carolina, specifically prohibit the submission or reporting of E codes for medical misadventure/adverse reaction events. See Table 42 in Appendix D and Figure 42 in Appendix E for state-specific information.

Verify with Edit Checks

It was unclear if verifying the presence of E codes on medical misadventure/adverse reaction records affected the E code completeness. In the seven states that verify E codes on medical misadventure records, the average E code completeness was 48.3%, as opposed to the 37.9% completeness for the remaining states. Five of the seven states that verify E codes also have mandates for the collection of this information; thus, it was unclear whether the mandate for the collection or the editing for the information has the greatest effect on the E code completeness rate. See Table 43 in Appendix D and Figure 43 in Appendix E for details on the states that do and do not perform edit checks on the use of E codes on medical misadventure/adverse reactions.

CONCLUSION

E Coding on Injury-Related Records in the HCUP Databases

The reporting of E codes for injury-related records was relatively complete in the HCUP databases, as demonstrated below:

- Across the 33 states that provide inpatient data to HCUP, E code completeness on injury records averaged 87.2 percent. Almost 60% of the states reported E codes on at least 90% of their injury records.
- Across the nine states that provide emergency department data to HCUP, E code completeness on injury records averaged 92.5 percent. Nearly 80% of the states reported E codes on at least 90% of their injury records.
- Across the 18 states that provide hospital-based ambulatory surgery data to HCUP, E code completeness on injury records averaged 80.1 percent. Close to 60% of the states reported E codes on at least 90% of their injury records.

E code completeness on injury records in the HCUP databases was higher than in other publicly available databases, as detailed below:

- E code completeness on injury records in the NIS was 85.7%, compared to 68.0% completeness in the NHDS.
- E code completeness on injury records across the nine SEDD states averaged 92.5%, compared to 80.8% completeness in the NHAMCS.

E Coding on Medical Misadventure/Adverse Reaction Records in the HCUP Databases

The reporting of E codes for medical misadventure/adverse reaction records in the HCUP databases was not as complete as the reporting of E codes for injuries, as detailed below:

- For the NIS, E code completeness was 39.2% for medical misadventures, as compared with 85.7% for injuries.
- Across the 33 states that provide inpatient data to HCUP, E code completeness averaged 40.2% for medical misadventures, as compared with 87.2% for injuries.
- Across the 9 states that provide emergency department data to HCUP, E code completeness averaged 57.6% for medical misadventures, as compared with 92.5% for injuries.
- Across the 18 states that provide hospital-based ambulatory surgery data to HCUP, E code completeness averaged 42.8% for medical misadventures, as compared with 80.1% for injuries.

E code completeness on medical misadventure/adverse reaction records in the HCUP databases was lower than other publicly available databases, as detailed below:

- E code completeness on medical misadventure records in the NIS was 39.2%, compared to 67.9% completeness in the NHDS.

Improving E Code Completeness

Although the reporting of E codes in the HCUP databases was relatively complete, variation existed across states. States with mandates requiring E codes submission on injury records had higher E code completeness, as demonstrated in the HCUP emergency department data:

- States with mandates reported E codes on at least 94% of their emergency department injuries.
- States without mandates reported E codes on 71.9% to 80.1% of their emergency department injuries.

If mandates were either formally or informally enforced by the statewide data organization, then the E code completeness was even higher, as demonstrated in the HCUP inpatient data:

- In the 8 states that enforce their mandates or regulations for the collection of E codes in their inpatient data, the E code completeness averaged 97.0 percent.
- In the 14 states that have mandates but no mechanism to enforce those mandates, the E code completeness averaged 89.4 percent.
- In the remaining 10 states with no mandates, the E code completeness averaged 79.4 percent.

The effect of mandates on the collection of E codes was also demonstrated in a study of injuries in Missouri (Muelleman et al., 1997). Missouri enacted legislation in 1993 requiring E code reporting. Prior to this legislation, 84% of Missouri's hospital and emergency department injury-related records reported E codes. After the legislation took effect in 1994, E code completeness increased to 94% of injury-related hospitalizations and 91% of injury-related emergency department records.

The number of diagnosis fields available to report E codes also affected completeness, as demonstrated in the HCUP inpatient data:

- Across the 22 states *with mandates for collection*, E code completeness was 97.8% for states that coded a maximum of 15 or more diagnoses and 89.6% for states that coded no more than 12 diagnoses.
- Across the 10 states *without mandates for collection*, E code completeness was 85.0% for states that coded a maximum of 15 or more diagnoses and 75.6% for states that coded no more than 12 diagnoses.

Two factors did not seem to affect E code completeness in any of the three clinical settings: encouraging the submission of E codes in states without mandates for collection, and verifying the presence of E codes for injury and medical misadventure records.

In conclusion, E code reporting for injuries was relatively complete in the HCUP databases. E codes were reported on the most injuries (90%) in almost 80% of the SEDD and approximately 60% of the SID and SASD. For medical misadventures, the HCUP databases were generally less complete, except for a few states that have focused on the collection of this information.

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Appendix A
HCUP Partners

APPENDIX A: HCUP PARTNERS

State	Data Source
Arizona	Arizona Department of Health Services
California	Office of Statewide Health Planning and Development
Colorado	Colorado Health & Hospital Association
Connecticut	Chime, Inc.
Florida	Florida Agency for Health Care Administration
Georgia	GHA: An Association of Hospitals & Health Systems
Hawaii	Hawaii Health Information Corporation
Illinois	Illinois Department of Public Health
Iowa	Iowa Hospital Association
Kansas	Kansas Hospital Association
Kentucky	Kentucky Department for Public Health
Maine	Maine Health Data Organization
Maryland	Health Services Cost Review Commission
Massachusetts	Division of Health Care Finance and Policy
Michigan	Michigan Health & Hospital Association
Minnesota	Minnesota Hospital Association
Missouri	Hospital Industry Data Institute
Nebraska	Nebraska Hospital Association
New Jersey	New Jersey Department of Health & Senior Services
New York	New York State Department of Health
North Carolina	North Carolina Department of Health and Human Services
Oregon	Oregon Association of Hospitals and Health Systems
Pennsylvania	Pennsylvania Health Care Cost Containment Council
Rhode Island	Rhode Island Department of Health
South Carolina	South Carolina State Budget & Control Board
Tennessee	Tennessee Hospital Association
Texas	Texas Health Care Information Council
Utah	Utah Department of Health and Utah Bureau of Emergency Medical Services
Vermont	Vermont Association of Hospitals and Health Systems
Virginia	Virginia Health Information
Washington	Washington State Department of Health
West Virginia	West Virginia Health Care Authority
Wisconsin	Wisconsin Department of Health & Family Services

Appendix B
ICD-9-CM and E Codes Used

APPENDIX B: ICD-9-CM AND E CODES USED TO DEFINE INJURY AND MEDICAL MISADVENTURE/ADVERSE REACTION EVENTS

ICD-9-CM Codes Used to Identify Injury Events

ICD-9-CM Diagnosis Codes	Description
800-909.2, 909.4, 909.9	Fractures; dislocations; sprains and strains; intracranial injury; internal injury of thorax, abdomen, and pelvis; open wound of the head, neck, trunk, upper limb, and lower limb; injury to blood vessels; late effects of injury, poisoning, toxic effects, and other external causes, excluding those of complications of surgical and medical care and drugs, medicinal or biological substances.
910-994.9	Superficial injury; contusion; crushing injury; effects of foreign body entering through orifice; burns; injury to nerves and spinal cord; traumatic complications and unspecified injuries; poisoning and toxic effects of substances; other and unspecified effects of external causes.
995.5-995.59	Child maltreatment syndrome.
995.80-995.85	Adult maltreatment, unspecified; adult physical abuse; adult emotional/ psychological abuse; adult sexual abuse; adult neglect (nutritional); other adult abuse and neglect.

E Codes Used for Injury-Related Events

<p>First character = "E" and <u>NOT ONE</u> of the following:</p> <ul style="list-style-type: none"> • E849.0-E849.9 (place of occurrence) • E967.0-E967.9 (child and battering/maltreatment; perpetrator codes) • E869.4 (accidental poisoning by second-hand tobacco smoke) • E870-E879 (misadventures during surgical and medical care & surgical and medical procedures as the cause of abnormal reaction or later complication, without mention of misadventure at time of procedure) • E930-E949 (drugs, medicinal, and biological substances causes adverse effects in therapeutic use).
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ICD-9-CM Codes Used to Identify Medical Misadventure/Adverse Events

ICD-9-CM Diagnosis Codes	Description
996-999	Complications of surgical and medical care, not elsewhere classified.
909.3	Late effect of complications of surgical and medical care.
909.5	Late effects of adverse effects of drug, medicinal, or biological substance.

E Codes Used for Medical Misadventure/Adverse Events

First character = "E" and ONE of the following:

- E870-E879 (Misadventures during surgical and medical care; surgical and medical procedures as the cause of abnormal reaction or later complication, without mention of misadventure at time of procedure.)
- E930-E949 (Drugs, medicinal, and biological substances causing adverse effects in therapeutic use.)

Appendix C
E Code Discussion Guide

APPENDIX C: E CODE DISCUSSION GUIDE

Part 1. State-Specific Reporting of E Codes

Section 1A. For All States

The first set of questions focus on any policies or regulations that govern E code reporting in the hospital discharge abstracts submitted to your data organization.

- In your state, do specific policies mandate the submission of E codes for injury-related diagnoses?

Section 1B. For Those States Confirming E Coding Mandates

- Do specific policies mandate submission of E codes for principal injury-related diagnoses? Are there also policies for the submission of secondary injury-related diagnoses?
- Do the policies specified for E codes include the submission of E codes for medical misadventures and/or adverse reactions?
- Are there any additional or specific policies mandating submission of E codes for medical misadventures and/or adverse reactions?
- How many E codes are mandated to be submitted for each injury-related diagnosis?
- What is the maximum number of E codes that can be retained on a discharge abstract within your state?
- Are “place of occurrence” E codes required for each injury-related diagnosis?
- Does your data organization move E codes into separate fields for cause or place of injury, or are they reported separately at the hospital level?
 - If they are reported separately, are the E codes repeated within the secondary diagnoses?
 - Do hospitals report a greater number of E codes than are currently retained in your data system?
- What measures, if any, are taken to enforce existing mandates?
- Who is responsible for enforcing these mandates?
- Are any exemptions provided or allowed regarding the E code mandates?
- Can you please provide us with any written materials regarding E code mandates, E code policies, and enabling legislation on E code usage?

Section 1C. For Those States Without E Coding Mandates

- Does your state collect E codes even without a mandate in place?
- What is the maximum number of E codes that can be retained on a discharge abstract within your state?
- Do you collect “place of occurrence” E codes for each injury-related diagnosis?

- Does your data organization move E codes into separate fields for cause or place of injury, or are they reported separately at the hospital level?
 - If they are reported separately, are the E codes repeated within the secondary diagnoses?
 - Do hospitals report a greater number of E codes than are currently retained in your data system?
- Does your state have other policies, regulations, or processes (other than mandates) to encourage submission of E codes for injury-related diagnoses? These other policies may be issued by various state agencies, such as your data organization, hospital association, and/or the state health department.
- Does your state have other policies, regulations, or processes (other than mandates) to encourage submission of E codes for medical misadventures and/or adverse reactions? These other policies may be issued by various state agencies, such as your data organization, hospital association, and/or the state health department.

Part 2. State-Specific Edit Checks

Section 2A. For All States

This second set of questions pertains to the types of edit checks and quality controls that may be used by your data organization to examine the E code data collected.

- Does your organization employ processes to verify the presence of E codes on discharge records containing injury-related diagnoses?
 - If so, are these processes applied to diagnoses for medical misadventures / adverse reactions?
- Do you examine the data to identify invalid or improper E codes?
- Do you perform checks that determine whether E codes are present for non injury-related diagnoses (e.g., cardiac care, asthma, etc.)?

Section 2B. For Those States Conducting Edit/Quality Checks

- Do you share your results with hospitals?
 - If so, are hospitals expected to remedy any inadequacies and resubmit the data?
 - If so, how is this quality control process enforced?
- Can you please provide us with any written materials regarding E code edit/quality checks?

Part 3. State-Specific Evaluations of E Code Data

Section 3A. For All States

The next set of questions addresses any prior evaluations that may be performed to determine the completeness and/or quality of your state's E code data, beyond the edit checks we just discussed.

- Has your organization evaluated the completeness and/or quality of the E code data collected?
- Does your organization contract with outside vendors to perform evaluations of the completeness and/or quality of the E code data collected?
- Have other organizations, outside of your data organization, evaluated the completeness and/or quality of your state's E code data?
- If so, do you use the results of those evaluations for your own purposes?

Section 3B. For Those States Performing Evaluations

- Do you collect information on the following:
 - The percentage of hospitals in the state that submit E codes?
 - The percentage of injury-related diagnoses having valid E codes?
- Do you produce reports from these evaluations?
 - Are those reports publicly available?
- Do you share the results of your evaluations specifically with hospitals?
- Do you share the results of your evaluations with other targeted public audiences?
- Can you please provide us with any results regarding evaluations conducted on the completeness and/or quality of the state's E code data (preferably with 2001 data)?

Part 4. Injury Reports or Analyses Based on E Code Data

The last set of questions relates to any injury reports or analyses that may be based on your state's E code data. Please note that these reports do not evaluate the E code data; rather, they use E codes to define and report injury-related statistics.

- Has your organization produced any prior injury reports or analyses of injuries based upon E code data from your state?
- Are you aware of any other organizations or researchers who may have produced any prior injury reports, manuscripts, or analyses of injuries based upon E code data from your state?
- Can you please provide us with any prior reports, manuscripts, or analyses that have been produced using E code data from your state?