Overview of Trauma Registries in the United States

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Overview of Trauma Registries

How many trauma registries are there in the US? This is a tough question to answer. According to a survey conducted by members of the Emergency Nurses' Association (ENA), the number of clients reported by trauma registry software companies exceed 1850 organizations (including some in other countries).[1] To this number we need to add users of custom-designed software packages for states, hospitals, or researchers. However, it is not known how many of these organizations are actually creating or using a trauma registry (or what type of trauma registry).

A directory prepared by the American Trauma Society (ATS) and John C. Lincoln Hospital lists 655 trauma centers (including self-, state-, and ACS-designated centers). Of these, about 76 percent reported that they had a trauma registry of some kind.

The American College of Surgeons (ACS) requires that all Level I, II, III, and IV Trauma Centers that it certifies have a trauma registry. A common reason for a hospital's unsuccessful peer review as a trauma center by the ACS is that it did not have a functioning trauma registry. [2]

In addition to individual hospitals or trauma centers, there are state and regional (multi-hospital) registries. The ATS is in the process of surveying state and system trauma registries in the US. The ATS Trauma Registrar Group-State/Regional Issues is conducting the survey, which should be completed by mid-1997.

Information collected by a trauma registry can be used for a variety of purposes, including counting and tracking the outcome of serious trauma patients treated at a hospital or trauma center. More sophisticated registries go beyond the basics and are used to monitor quality, design prevention programs, and conduct research.

Population-based trauma registries (such as a statewide registry) can be the most useful for analyses, because, if designed properly, they reflect the injury experience for an entire population. Nonpopulation-based registries can provide valuable information for an organization's internal use and analysis, but do not necessarily represent the overall trauma experience of a particular community or state. Basically, these registries see "what comes in the door," and contain neither statistical samples nor census data.

According to the ACS, "the goal of the trauma registry is to provide detailed, reliable, and readily accessible information on the injured patient. These data will allow the quality of care to be assessed, problems to be identified, and analysis to be supported by nonclinical information." [3]

The information trauma registries collect around the country has not been standardized. And although there are a number of statewide trauma registries, there is not a national trauma registry. There is considerable variation in the number and type of data elements trauma registries collect. The following are examples of the various data elements that registries collect: [4]

- Demographic
- Injury information (time, place, date)
- Pre-hospital information (EMS provider, amount of time at scene of injury)
- Referring hospital (if applicable)
- Emergency department admission information (mode of transport, time of arrival, chief complaint)
- Emergency department treatment
- Hospital diagnoses and procedures
- Severity measurements (Glasgow Coma Scale [GCS], Abbreviated Injury Scale [AIS], Injury Severity Score [ISS])

- Probability of survival
- Quality assurance indicators (delay in treatment, missed diagnosis)
- Complications (infections, medical problems)
- Outcome (disposition, days in hospital, days in ICU, hospital charges)

Data Collection and Quality Issues

Data collection issues abound. Since there is not a uniform method for collecting trauma data, organizations often must decide the "who, how, what, where, why, when" of collecting data on their own. Most trauma registry software answers only a few of these questions. For example, when data are collected can vary dramatically: upon admission, upon discharge (or autopsy). The amount of detail available at these different points in time varies too. Who collects the data can affect how reliable, detailed or comprehensive it is; some registries use untrained coders while others may use trained coders, nurses, HIM department personnel, or physicians. [5]

Data quality issues are important for trauma registries to address. It is vital that procedures be established to check data inputs and follow-up and correct problems. The ATS sponsors a trauma register course that trains new trauma registrars in the skills of operating a trauma registry.

The Abbreviated Injury Scale (AIS) is the most commonly used anatomic injury severity scaling system in the world, and it is used by many trauma registries. [6] However, a relatively small proportion of trauma registry personnel has attended the Association for the Advancement of Automotive Medicine's (AAAM) Injury Scaling Course. This brings into question the uniformity and quality of AIS coding around the country. Improper AIS and ISS coding can result in over- or underestimates of injury severity and affect analyses or comparisons of outcomes. The AAAM's course teaches the proper use of the current Abbreviated Injury Scale and ISS. Because of major changes in AIS over the years, training would be valuable even for users of earlier editions. [7]

Data compatibility issues occur when centralizing, sharing, or comparing trauma registry data. The classic data warning exists-be sure you are comparing apples to apples.

Some registries use AIS-85 coded data, while others use AIS-90. There are major differences between these coding systems. Some codes have been added, deleted, upgraded, or downgraded. Generally, AIS-85 is a "more severe" classification system than AIS-90, with a higher proportion of AIS-3 and above codes available for use. Injury severity data coded in AIS-85 should not be mixed or compared with data coded in AIS-90. Without adjustment between these systems, analysis of mixed data can yield misleading or inaccurate results. [8] For example, a 10-year-old patient with a femur fracture would be coded in each system as follows in Table 1.

Table 1—AIS-85 and AIS-90 Code Comparison		
Injury Description	AIS-85	AIS-90
Femur Fracture, NFS <12 years old	92601.3	851802.2
MAIS (Maximum AIS)	AIS-3	AIS-2
ISS	9	4

Some registries use mapped AIS codes instead of hand-coded AIS-85 or AIS-90 codes. Mapping from ICD-9-CM gives less detail than hand-coded data. Mapped AIS and ISS values will generally be lower, more conservative than hand-coded data. [9] Counts of cases with higher AIS or ISS values (e.g., AIS >3 or ISS>10) are likely to be lower when using mapped data than when using hand-coded data. The following example (See Table 2)compares hand-coded and mapped AIS-90 codes for the same trauma patient:

As shown in this case, manually coded injury severity data can be more detailed (identifying 21 versus 11 injuries) than mapped injury severity data and also results in a higher ISS:

ISS for manually coded AIS-90: $4^2 + 2^2 + 3^2 = 29$, captures 21 AIS-90 codes

ISS for mapped AIS-90 codes: $3^2 + 2^2 + 3^2 = 22$, captures 11 AIS-90 codes

As the case in Table 2 illustrates, the mapped ISS underestimates the actual severity of this patient by seven points.

Table 2—Comparison of Hand-coded and Mapped AIS-90 Codes*

Hand-coded AIS/ISS (Results in 21 AIS-90 codes)

Chest
2-3 rib fractures with pneumothorax, 450222.3 (right)
Bilateral lung contusion, 441410.4
Abdomen and Pelvic Contents
Liver (minor) laceration, 541822.2
Spleen (minor) laceration, 544222.2
Lumbar (L-1) spine fracture, transverse process, 650620.2
Lumbar (L-2) spine fracture, transverse process, 650620.2

Extremities and Pelvic Girdle
Supracondylar femur fracture, 851822.3 (right)
Tibia fx, open/displaced/comminuted (medial malleolus), 853414.2 (right)
Tibial tendon laceration (and other leg tendons), 840804.2 (right)
Other lower extremity arteries, major laceration, 821008.3
Femoral/tibial nerve contusion, 830602.2
Tibia plateau fracture (proximal), 853406.2 (left)
Talus fracture, 853200.2Calcaneus fracture, 851400.2 (right)
Muscle tear, 840600.2
Lower extremity, skin laceration, minor, 810602.1
Lower extremity, skin abrasion, 810202.1
Radius fracture, open/displaced/comminuted, 752804.3 (left)
Ulna fracture, open/displaced/comminuted, 753204.3 (left)
Upper extremity, skin abrasion, 710202.1

External/Burns/Other
Face, skin abrasion, 210202.1
ISS = $4^2 + 2^2 + 3^2 = 29$

Mapped AIS/ISS for the same patient (Results in 11 AIS-90 codes)

ICD-9-CM Codes	AIS-90 Codes
821.23 Femur fracture	851822.3
860.4 Hemo/pneumothorax**	442202.3
805.4 Lumbar spine fracture	650616.2
864.02 Liver laceration	541822.2
865.02 Spleen laceration	544222.2
825.31 Talus fracture	853200.2
813.83 Radius and ulna fracture	752802.2 and 753202.2
825.1 Calcaneus fracture	851400.2
823.00 Tibia fracture	853406.2
891.0 Lower extremity skin laceration	810600.1

ISS for mapped AIS-90 codes = $3^2 + 2^2 + 3^2 = 22$

*For complete descriptions of AIS-90 and ICD-9-CM codes, see respective manuals.
**The rib fractures and lung contusions were not assigned ICD-9-CM codes.

Therefore, if a trauma center counted the number of severely injured patients (e.g., ISS >12) it treated in a year, it would likely find that the number would be higher using manually coded rather than mapped AIS data.

A uniform definition of injury does not exist for trauma registries. Trauma registries can define injuries differently. For example, they may use the ICD-9-CM Nature of Injury codes: 800-959.9 or AIS-85 or AIS-90 codes. When comparing AIS and ISS data, it is important to know how injuries were defined in the trauma registry database. For example, the AIS-90 lists five accidental hypothermia codes as "Other Trauma" ranging from AIS-1 (34 degrees Celsius) to AIS-5 (less than or equal to 27 degrees Celsius). (The AIS-85 does not include these codes.) Some trauma registries do not collect hypothermia information, despite the fact that AIS-90 considers it a valid injury. A trauma registry that does not record hypothermia as an injury will have different AIS codes (and potentially different ISS scores) than a trauma registry that does.

The difference just described is due solely to the definition of trauma rather than actual patient severity. You may ask, why would anyone be interested in recording hypothermia in a trauma registry? In colder climates, multi-injured patients may arrive at trauma centers with hypothermia after prolonged extrications from crashed cars. Although a trauma patient with hypothermia may recover as well as one who didn't, some articles suggest that hypothermia may have a negative impact on patient outcome. [10]

Differences exist in the manner in which the score for overall severity is calculated. Trauma registries commonly use the ISS to represent overall severity in patients with multiple injuries. The ISS is the sum of the squares of the highest AIS code in each of the three most severely injured ISS body regions. As a member of the national faculty for the AAAM's Injury Scaling Course, the author has seen confusion among course participants about the proper way to calculate the ISS. The author has also used a variety of trauma registry software programs and has noted that these software programs do not always calculate ISS in the same manner. The particular areas of confusion are as follows:

- Definition of ISS body regions: the six ISS body regions (Head or Neck, Face, Chest, Abdominal or pelvic contents, Extremities or pelvic girdle, and External) are different from the nine chapters in the AIS-90 coding manual (Head, Face, Neck, Thorax, Abdomen/Pelvic Contents, Spine, Upper Extremity, Lower Extremity, and External [Skin, Burns and Other Trauma]).
- Calculating the ISS scores when external injuries are present: in AIS-85, minor and moderate (AIS 1-2) injuries to the skin and penetrating injuries are coded under the External section and assigned to the External body region for calculating ISS. In AIS-90, these injuries are dispersed across body regions to help in locating them and are marked with asterisks in the AIS-90 manual (see page 11 of the manual for further information about proper ISS scoring for External injuries).

Mistakes in interpreting the rules for calculating ISS can result in artificially low or high ISS scores. Coders or software programmers who have not taken the AAAM's Injury Scaling Course and therefore are not familiar with the AAAM's AIS and ISS coding rules can easily assign the wrong ISS scores.

The Glasgow Coma Scale (GCS) is a widely used index that reliably assesses the degree of coma in patients with craniocerebral injuries. [11] It is based on three behavioral responses: eye opening, best verbal response, and best motor response. Because factors other than head injury can influence the measurement of the Glasgow Coma Score, some trauma registries have added information to supplement it. For example, a trauma registry may record that a previously alert trauma patient was paralyzed and intubated as a precaution to protect his/her airway. This assists interpretations of GCS as well as other severity information. Trauma registries that have not noted that their GCS scores are affected by other factors may have difficulty interpreting their data or comparing their data to others.

Impact of Computerization: Links to Computer-based Patient Records

Computer-based patient records are still in a relatively early stage of development. A small percentage of hospitals in the US have fully computerized patient records. As a result, automatic linking of trauma registries to computer-based records is still in its infancy. However, an exciting opportunity exists to develop these linkages over the next few years.

The state-of-the-art situation is still a few steps back. In fact, many trauma registries actually re-input demographic information for each case instead of downloading data from a hospital mainframe. This occurs due to software incompatibility or lack of resources to write a downloading or linking program. Trauma registries that re-input basic information should explore linkages

with their hospital mainframe computer system as soon as possible. The resources expended on data entry can then be redirected to analysis and quality improvement activities.

Who Uses Trauma Data and For What Purposes

Healthcare facilities use trauma data for a variety of purposes, including:

- Performing internal QI
- Identifying cases with unexpected (good or bad) outcomes to review
- Meeting state requirements
- Meeting national certification requirements
- Performing case management
- Identifying trends by severity, by LOS, by cost, by outcome
- Identifying priorities for community injury prevention programs and monitoring their success
- Providing data for research (required by ACS for Level I Trauma Centers)

States use trauma data for a variety of purposes, including:

- Performing certification or designation
- Making site visits or selecting charts

    -Reviewing unexpected outcomes

- Evaluating trauma system

    -Are severely injured patients being treated at trauma centers with appropriate resources to care for them?

E Codes

Many trauma registries use External cause of injury codes (E codes) in the International Classification of Diseases, 9th revision, Clinical Modification, to classify the environmental events, circumstances, and conditions as the cause of injury. E codes are intended for use in addition to code(s) from one of the main chapters of the ICD-9-CM, indicating the nature of injury.

An example of a commonly used E code is E814.0-motor vehicle traffic accident involving collision with other vehicle, driver of motor vehicle other than motorcycle. E codes are not a standard data element; however, many organizations consider them to be valuable and are beginning to routinely collect them. Some states do require the assignment of E codes.

The Centers for Disease Control and Prevention (CDC) has proposed standard definitions of categories of E codes (motor vehicle accidents, falls, firearm, etc.). They can be downloaded from the CDC Web site. [12] Analyses of particular types of trauma patients, such as those with motor vehicle crash-related injuries, are facilitated by the use of E codes. Some trauma registries also collect information on restraint availability and use for car occupants.

Trauma registries collecting E codes can compare specific injuries from their database to population-based data such as motor vehicle crash (MVC) injuries in the National Accident Sampling System, Crashworthiness Data System (NASS/CDS), and Fatal Accident Reporting System (FARS). NASS/CDS uses the Occupant Injury Classification (OIC), which is similar to the AIS, to describe injuries and severity levels (however, a conversion is required to compare NASS OIC codes and severity with hospital AIS-85 or AIS-90 data). [13]

Resources

Association for the Advancement of Automotive Medicine: for information on the Injury Scaling Course and AIS manual, call (847) 390-8927

American Trauma Society: for information on the Trauma Registry survey and the Trauma Register course, call (301) 420-4189

Notes

1. Eckelberry, Lynn, and J. Rachael White. Trauma Registry Vendor Comparison, 1997. Unpublished survey available through Akron General Medical Center, Akron, OH, p. 1.

2. Mitchell, F., E. Thai, and C. Wolferth. "American College of Surgeons Verification/Consultation Program: Analysis of Unsuccessful Verification Reviews." *Journal of Trauma* 37, no. 4 (1994): 557-564.

3. American College of Surgeons, Committee on Trauma. *Resources for Optimal Care of the Injured Patient.* Chicago, IL: American College of Surgeons, 1993, p. 98.

4. Ibid., pp. 100-101.

5. MacKenzie, E., S. Shapiro, and J. Eastham. "The Abbreviated Injury Scale and the Injury Severity Score: Levels of Inter- and Intra-Rater Reliability. *Medical Care* 23 (1985): 823-835.

6. Association for the Advancement of Automotive Medicine. *Abbreviated Injury Scale, 1985 Revision.* Des Plaines, IL: AAAM, 1985.

   Association for the Advancement of Automotive Medicine. *Abbreviated Injury Scale, 1990 Revision.* Des Plaines, IL: AAAM, 1990.

7. Garthe, E. Comparison of the AIS-85 and AIS-90 with NASS-93. 1996 Society of Automotive Engineers (SAE) Technical Paper No. 95MJA242. Paper presented at the February 1996 Annual Congress of SAE.

8. Garthe, E., and N. Mango. A Method of Mapping Pre & Post NASS-93 Injury Descriptions to Enable Multi-Year Data Comparisons. Paper presented at the February 1997 Annual Congress of SAE.

9. Garthe, E. "The Compatibility Between the Abbreviated Injury Scale (AIS-80) and the International Classification of Diseases (ICD-9-CM)." Presented at the Annual Meeting of the American Association of Automotive Medicine, San Francisco, CA, 1981. Published in the quarterly *Journal of the AAAM,* March 1982. Recipient of the Dr. John States Award.

   MacKenzie, E., M.D. Steinwachs, and B. Shankar. "Classifying Trauma Severity Based on Hospital Discharge Diagnoses: Validation of an ICD-9-CM to AIS-85 Conversion Table." *Medical Care* 27 (1989): 412.

10. Frank, Steven et al. "Perioperative Maintenance of Normothermia Reduces the Incidence of Morbid Cardiac Events." *Journal of the American Medical Association* 277, no. 14 (April 1997): 1127-1134.

11. Jennett, B., B. Teasdale, R. Braakman, J. Miderhoud, R. Knill-Jones. "Predicting Outcome in Individual Patients after Severe Head Injury." *The Lancet* May 15, 1976: 1031-1034.

12. Centers for Disease Control and Prevention. "Proposed matrix of e-code groupings for presenting injury mortality and morbidity data" (April 1, 1997); downloaded from CDC web site: http://www.cdc.gov/ncipc/whatsnew/matrix.htm

13. Garthe, E., and N. Mango. Linking the NASS 93 Crash Injury Data Base with Hospital Motor Vehicle Trauma Data. Manuscript for presentation at the 1997 Association for the Advancement of Automotive Medicine's annual conference.

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