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Trauma Patients without a Trauma Diagnosis: The Data Gap

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Abstract

Background—Trauma registries may contain records without a codable trauma diagnosis, creating a “data gap” that multiplies the number of invalid registry data fields. We designed an investigation intended to determine the incidence of registry records with non-codable trauma diagnoses, characterize those records, and determine the reasons for inadequate diagnosis data.

Methods—We utilized a retrospective cohort design. A query of trauma registry records spanning a five-year period yielded 129 records with no injury severity score. Each patient’s medical record was reviewed, sources of diagnostic information were noted and diagnoses were categorized.

Results—In 57% of cases, we found documentation that the patient had sustained an injury, but the injury was inadequately documented in the discharge summary. In 19% of cases, although the registry record was valid, the diagnosis was not codable as trauma. In 17% of cases, clinical documentation was adequate, but the diagnosis was inadequately recorded in the trauma registry. In 13% of cases, no traumatic injury was sustained, although the registry record was valid. In 2% of cases, the trauma registry record itself was invalid. In 1% of cases, a coding error occurred.

Conclusions—Particularly prominent among records with inadequate discharge documentation were cases of head and spine injury for which there was no radiographic evidence. The incidence of records with uncodable diagnoses might best be reduced through improved physician documentation, revision of trauma registry inclusion criteria, increased attention by trauma registrars to key sources of documentation, and direct communication with the attending physician when necessary.

Keywords

Registries; Injuries; Diagnosis

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Introduction

A trauma registry must be subjected to continuous data validation if it is to reliably inform performance improvement, education, and research activities. The trauma diagnosis is a crucial registry data field that is frequently required for registry reports. Abbreviated Injury Scale (AIS) codes that are tied to the diagnosis are required for the generation of derivative metrics such as Injury Severity Score (ISS), Trauma Injury Severity Score (TRISS) and Survival Probability Score. If a significant number of registry records lack diagnoses and associated diagnosis codes, the resultant “data gap” may adversely affect the overall validity of the registry, and may also adversely impact upon the validity of any state or national database to which registry data is subsequently contributed. The issue of inadequate trauma registry diagnostic data has not been specifically addressed in the literature.

Trauma registry records maintained in our Level One Trauma Center sometimes contain no codable trauma diagnosis. The lack of a codable diagnosis may result from human error, computer error, or inappropriate data entry criteria. Because the occurrence of a registry record without a codable diagnosis has the effect of multiplying the number of invalid fields in the database, it is desirable to minimize the number of records without a codable diagnosis. We designed an investigation intended to determine the incidence of registry records with non-codable trauma diagnoses, categorize those records, determine the reasons for abstraction of non-codable diagnosis data, and to inform strategies for minimizing the incidence of such problematic records.

Materials and Methods

Our trauma registry utilizes *Collector 3.32* (Digital Innovations, Forest Hill, MD). In each trauma registry record, free text that describes the patient’s injury or injuries is entered into the “Trauma Diagnosis” data field, one injury per line. When prompted, *Tri-Code*, *Collector’s* integrated coding software, automatically generates AIS codes and International Classification of Diseases, 9th Revision (ICD-9) diagnosis codes for each line of text entered. In turn, ISS and TRISS are auto-calculated based upon the collective AIS codes. (1) If any line of text is not recognized by *Tri-Code* as a trauma diagnosis, no AIS code is generated, and no ISS is calculated. Similarly, if no text at all is entered in the diagnosis field, no codes are generated. In some cases, the text generates an ICD-9 code and an AIS score, but the seventh digit is a “9”, which indicates that the severity of injury is unknown. In these cases as well, no ISS is generated. The AIS coding convention programmed into *Collector 3.32* during the time of this study was *AIS 1990*, with 1995 modification.

We conducted a retrospective cohort study to generate descriptive statistics. The design of this study was submitted for expedited review and was approved by The Committee for the Protection of Human Subjects, Dartmouth Medical School. We queried the trauma registry of our rural Level One trauma center for records with no ISS. Out of a total of 5,515 records spanning a five-year period (01/01/2002 – 12/31/2006), 129 records met our query criteria. The electronic medical record for each case was reviewed for documentation of trauma diagnosis information. For all cases in which they were available, the following documents in the patient’s electronic medical record were reviewed for diagnostic information: *Admission History and Physical Examination*, *Emergency Department Physician’s Note*, *Surgeon’s Primary Survey*, *Radiologist’s Report*, *Operative Report*, and *Discharge Summary*. For those cases in which the electronic medical record contained no diagnostic information of any kind, the paper chart was ordered and reviewed. Following review of the medical records, the cases were categorized as follows:

1. Trauma diagnosis text correctly entered in registry, but coded as non-traumatic problem

2. No traumatic injury sustained; invalid registry record
3. Valid registry record, but no traumatic injury sustained
4. Documentation in discharge summary sufficient to generate a codable trauma diagnosis, but diagnosis inadequately recorded in trauma registry
5. Diagnosis recorded in valid trauma registry record, but diagnosis not codable as trauma
6. Traumatic injury sustained, but diagnosis inadequately documented in discharge summary

Results

Our query of the trauma registry for records with no ISS yielded 129 records (2.3% of all traumas). The trauma diagnosis field in these records contained no text recognizable by our registry software as a trauma diagnosis capable of generating an ISS. We assigned each case to one or more of the six categories defined above. The results are tabulated in Table 1. The sum of the counts for all six categories is greater than 129, because some records were assigned to more than one category.

Category 4, 5 and 6 records were also sub-categorized by AIS 2005 Body Region. (2) If our review of the medical record revealed documentation of a traumatic injury, that injury was assigned to an AIS body region. If more than one injury was found per case, then the body region was assigned to the most severe injury. The sub-categorizations of category 4, 5 and 6 records may be viewed in Tables 2, 3 and 4, respectively. In addition, Category 6 records were sub-categorized by the location in the medical record in which we found diagnostic information that had not been noted in the discharge summary; this sub-categorization may be viewed in Table 5.

In fourteen cases the patient presented with objective and subjective evidence suggestive of cord injury, but no specific trauma diagnosis was made. We reviewed the medical record, both paper and electronic, for all fourteen cases. Table 6 shows the discharge diagnosis for the fourteen cases, the new diagnosis that we assigned retrospectively, and the corresponding new ICD-9 and AIS codes.

Discussion

Validation of trauma registry data is essential for ensuring the reliability of the information the registry is expected to supply. A trauma registry serves its purposes only to the extent that the data that it contains is complete, accurate, and adherent to case inclusion criteria and individual data field definitions. Periodic data audits are feasible and effective for maintaining data quality. (3,4) In their paper on trauma registry data validation, Hlaing et al identified and studied seven types of registry errors. They found that the error types with the highest incidence were false negative coding errors, and errors of commission and omission. (4) Those same types of errors figured heavily in our own findings. False negative coding errors have been reported to be particularly common in cases of trauma death without autopsy, (5) and in state and regional trauma registries which fail to include information on patients who died at the scene or in transit. (6) Errors of omission are the easiest type of error to identify, and many validation efforts concentrate on completeness as an important measure of validity. (7) Errors of commission can be more difficult to identify via visual inspection, but may be uncovered by software scripting in internal data check features that are designed to uncover common errors such as coding incongruence or out of range time values.

In our trauma center we have instituted a three-part data validation process. The first component consists of the use of the registry software's "check" feature which alerts the user to missing or inappropriate data in certain key fields of each registry record. The second component is the generation of a monthly report of selected key data fields, predominantly patient identifiers and data elements included in the National Trauma Data Standard, which are scanned for errors of omission. The third component is an inter-registrar validation exercise that consists of a weekly "chart swap" in which each of two trauma registrars completely review a randomly selected registry record completed by their counterpart, making note of any errors. All errors of omission and commission, identified via any of the three process components, are corrected and the records are closed. This process is intended to comply with recommendations for trauma registry data validation made by the American College of Surgeons Committee on Trauma. (8) We were prompted to initiate the current study when data validation activities revealed the appearance of a significant number of registry records without ISS scores. In an effort to determine the reason or reasons behind the lack of codable trauma diagnoses, we categorized each of the 129 cases without ISS scores.

Category 1 (*Trauma diagnosis text correctly entered in registry, but coded as non-traumatic problem*) represents a false negative coding error. Only one record was included in this category. This record was likely transferred from our previous registry database, where a text diagnosis of *subarachnoid hemorrhage* was apparently coded as a non traumatic hemorrhage. Category 1 likely represents a computer error. We found no errors of this type in records that were coded by *Tricode*.

Category 2 (*No traumatic injury sustained; invalid registry record*) represents a false positive error. We found three registry records that failed to meet our registry inclusion criteria. Category 2 represents a false positive error because the number of trauma cases was falsely increased by the inclusion of cases that were not traumas. These were not false positive coding errors. No trauma codes were generated because no traumatic injuries were sustained in these cases. Category 2 cases represent trauma registrar error, and can be prevented through careful adherence to trauma registry inclusion criteria.

Category 3 (*Valid registry record, but no traumatic injury sustained*) highlights a system issue: a peculiarity of our registry inclusion criteria that allows for patients with no traumatic injury to be correctly included in the trauma registry. For performance improvement purposes, it is our policy to include in the registry all traumas for which a trauma team activation was paged in the emergency department. Occasionally, patients without injuries are overtriaged or misidentified as traumas, and a trauma team activation is paged. These patients meet our inclusion criteria, but no injury can be recorded in their registry records. The data gap in Category 3 records is therefore an expected result of our inclusion criteria, given that trauma overtriage is an expected and not altogether undesirable occurrence. (8) The principal disadvantage associated with Category 3 records is that NTDB submission will transmit the data gap to the national database.

Category 4 (*Documentation in discharge summary sufficient to generate a codable trauma diagnosis, but diagnosis inadequately recorded in trauma registry*) represents error of omission on the part of the trauma registrar. In 50% of these cases, the omitted diagnosis was a head injury (*See Table 2*). Category 4 errors can be prevented through careful scrutiny by the trauma registrar of the entire discharge summary.

Category 5 records (*Diagnosis recorded in valid trauma registry record, but diagnosis not codable as trauma*) were the second most common type of records without an ISS. As in category 6, the AIS regions, "External thermal & other" "head", and "spine" were heavily

represented in category 5, accounting for 80% of records (See Table 3). Category 5 represents a trauma program system issue with two different aspects:

- a. Diagnosis documentation that lacks the specific verbiage required for coding certain types of injuries with *Tricode*
- b. Trauma registry inclusion criteria that allow conditions that are not codable as trauma

In the year 2000, prompted in part by the positive experience of others, (9) we began to download case-specific ICD-9 diagnosis codes from the hospital information database into our trauma registry. For several years the downloads served as the sole source of diagnosis data in our trauma registry, and proved to be a significant time-saving measure during a period when the trauma program was understaffed. However, the quality of trauma diagnosis data ultimately proved to be suboptimal, and we returned to manual transcription of diagnoses from the individual patient medical records, with automated trauma coding generated by *Tricode*.

Beginning in the early 1990s, trauma scoring software was developed to meet the evolving needs of trauma registries for accurate and efficient coding of injuries. (10) Our trauma registry software, *Collector 3.32*, utilizes *Tri-Code*, coding software that automatically generates AIS and ICD-9 codes for each line of text entered. Collector also features a manual coding function that allows the registrar to bypass *Tricode* and manually enter ICD-9 and AIS codes. We chose to utilize *Tricode* exclusively, and not to manually code, in the interest of maintaining congruence with the medical record as well as the specificity of the textual diagnosis description. In accordance with AIS coding guidelines, we also refrained from modifying the documented diagnosis in order to render it codable. (2) This approach created a coding data gap in some records, particularly for minor and superficial injuries, and certain types of spine and head injuries. For example, “closed head injury” is not completely codable as a trauma diagnosis. “Closed head injury” is coded by *Tricode* as ICD-9 code 854.0, and as AIS code 115099.9. In AIS coding, the digit following the decimal denotes severity. A severity code of 9 means that severity is indeterminate, which is appropriate in this example because a diagnosis of “closed head injury” provides no information with regard to severity. Due to lack of a specific severity code, an ISS and other derivative scores cannot be generated from AIS code 11509.9, and the result is a data gap.

In the course of reviewing the medical record of a patient with a closed head injury, the trauma registrar might note that the patient sustained a blow to the head, had a loss of consciousness witnessed by EMS, and underwent a computed tomography (CT) scan of the head which was read as essentially normal. In such a case, the trauma registrar might be tempted to read between the lines and fill in the gap by entering “closed head injury with concussion”. Such an entry would yield the same ICD-9 code of 850.9, but would generate AIS code 161000.2. The severity code of 2 (moderate severity) would allow generation of an ISS, and one might argue, a more complete and valid trauma registry record. Completeness however is only one measure of the validity of a trauma registry record. Congruence with the medical record is another, and in our view, a more important measure of validity than completeness. A dataset that is faithful to the medical record is a relevant dataset; it should as much as possible, accurately reflect the quantity and quality of information contained in the medical record. Empowering the trauma registrar to embellish the diagnosis sets a precedent with potential for *errors of commission*: i.e. entry of inaccurate information. On the other hand, the disadvantage of our adopted approach is the data gap caused by the missing ISS and other derivative scores. We expect that some coding issues of this nature are becoming moot because certain diagnoses that have been uncodable with AIS 1990 are now codable with the recently released AIS 2005, although in aggregate the effect of the upgrade may not be significant: Skaga et al reported no significant change in mean ISS as a result of switching from AIS 90 to AIS 98. (11)

A trauma registry inclusion criterion that allows a condition not codable as trauma constitutes another etiology of Category 5 cases. Drowning and rhabdomyolysis are two examples of conditions specified as inclusion criteria for our registry that are not codable as trauma. This problem can be prevented by adoption of trauma registry inclusion criteria consistent with the range of conditions codable as traumatic injuries. If the informed choice is made to include such conditions, then the generation of data gaps should be expected.

Category 6 (*Traumatic injury sustained, but diagnosis inadequately documented in discharge summary*) represents errors of omission. Category 6 records comprised more than half of all cases in which the trauma registry record lacked a codable trauma diagnosis. In these cases the discharge summary contained no diagnosis information, or diagnosis information inadequate for trauma coding. Although no codable trauma diagnosis could be found in the discharge summary for these cases, our review of other components of the medical record revealed sufficient documentation to support assignment of a codable trauma diagnosis. Table 5 shows that the most common sources of additional diagnosis information were the diagnostic imaging (38%), primary survey by the trauma service (32%), and ED physician's note (26%). In the absence of any note that rules out injuries previously documented elsewhere, we can only speculate on the reasons why the information was not included in the discharge summary. Given the premise that the discharge summary should describe all injuries sustained by a patient admitted to the hospital for trauma, the problem represented by this category may be ascribed primarily to physician error. However, if it is considered the responsibility of the trauma registrar to scour all possible sources of diagnosis information in the medical record, then the error in these cases must also be shared by the registrar. The discharge summary is considered to have low reliability, as compared with most other components of the medical record. (12) However, particularly in complex cases with lengthy hospital stays, it can be difficult to determine retrospectively whether an injury description found early in the medical record but not in discharge summary constituted an error, or whether the physician composing the discharge summary erred by omitting a valid diagnosis.

When the trauma diagnosis documented in the discharge summary is absent or appears to be inadequate, we recommend that the trauma registrar thoroughly review the medical record, including radiology reports and physician's initial evaluation notes. If upon review, the diagnosis documentation still appears to be inadequate, the registrar should contact the attending physician of record for clarification. Finally, we recommend that the physician amend the record to include any diagnostic information that was omitted in the discharge summary.

Table 4 shows that the AIS region "External, thermal and other" was prominently represented in Category 6, as were head and spine injuries. Falling under the AIS region "External, thermal and other" were numerous cases in which the only injuries sustained by the patient were superficial soft tissue injuries such as minor contusions, abrasions and/or lacerations. Many of these patients were discharged from the ED. In most cases, patients discharged from the ED do not meet our criteria for trauma registry inclusion, but all ED arrivals paged as a trauma team activation are mandated for inclusion in the registry, regardless of ED disposition. In these cases therefore, as in Category 3 cases (in which no injury occurred), a data gap is generated if minor injury occurs but is not documented.

Also prominent in Category 6 was inadequate discharge documentation of head and spine injuries, particularly injuries for which there was no radiographic evidence. As alluded to in our discussion of Category 5 cases, cerebral concussion may be underdiagnosed in our trauma center. A witnessed blow to the head with loss of consciousness and a normal head CT is sufficient basis to make a clinical diagnosis of concussion, particularly if the patient has subjective complaints suggestive of head injury. (13) In many cases, however, such patients

were discharged with a diagnosis of “closed head injury”, no injury, or “possible concussion”, none of which are fully codable.

Soft tissue injuries of the spine also appear to be underdiagnosed. In many cases, patients with a history of significant trauma mechanism, spinal complaints, and negative imaging are discharged from the ED with an assessment of “no injuries identified”, “back tenderness”, “neck pain”, etc. We suspect that a clinical diagnosis of lumbar or cervical strain might have been appropriate in these cases. (14)

Of particular interest to us were the fourteen cases (nearly 11% of the total) in which the patient presented with objective and subjective evidence suggestive of cord injury, but no specific trauma diagnosis was made. Our review of the entire medical record in these cases revealed that in eight cases a diagnosis of spinal cord injury NOS was justified; in two additional cases it was possible to identify a specific neurologic level of cord injury. One case was identified as a lumbosacral nerve root injury; the remaining three cases showed evidence of neurologic injury of indeterminate nature. In summary, 57% of the fourteen cases were found to be partially codable as non-specific neurologic or cord injuries, and an additional 21% were found to be fully codable – two as cord injuries and one as a nerve root injury.

Previously, for patients with evidence of cord injury in the absence of fracture or dislocation, a diagnosis of “spinal cord injury without radiographic abnormality” (SCIWORA) might be applied. Since the term SCIWORA was first used by Pang and Wilberger in 1982 to describe certain pediatric cord injuries, (15) the phrase, “without radiographic abnormality” has been used to refer essentially to plain film radiography and CT. The term SCIWORA is still in use, but now that magnetic resonance imaging (MRI) is more readily available for detection of cord injuries, a diagnosis of SCIWORA ideally should be interpreted in light of the imaging technology that is available and utilized. However, clear guidelines in this area are non-existent.

Two of the fourteen patients had been assigned a diagnosis of “central cord syndrome”. Strictly speaking, such a diagnosis is incomplete from a trauma perspective. Central cord syndrome, anterior cord syndrome, neuropraxia, and similar descriptions of neurologic deficit may all have non-traumatic causes, and do not constitute a complete trauma diagnosis unless accompanied by a description of the causative anatomic injury, preferably with identification of the specific neurologic level of injury. Examples of specific cord injuries include laceration, contusion, hemorrhage and concussion. There appears to be some variation in how spinal cord injuries without radiographic abnormality are identified, if they are identified at all. Improved definitions and guidelines for the diagnosis of such injuries are needed.

In conclusion, in 57% of cases in this series, the injury was inadequately documented in the discharge summary. In 19% of cases, although the registry record was valid, the diagnosis was not codable as trauma. In 17% of cases, clinical documentation was adequate, but the diagnosis was inadequately recorded in the trauma registry. In 13% of cases, no traumatic injury was sustained, although the registry record was valid. In 2% of cases, the trauma registry record itself was invalid. In 1% of cases, a coding error occurred. The incidence of records with uncodable diagnoses might best be reduced through:

1. Increased attention by physicians to documentation of specific anatomic injury diagnoses, particularly head and spine injuries for which there is no radiographic evidence.
2. Increased attention by trauma registrars to diagnosis documentation.
3. Direct communication with the attending physician of record in situations where a trauma diagnosis cannot be gleaned from the record.

4. Development of trauma registry inclusion criteria consistent with the trauma coding capabilities of registry software.

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Table 1

Category	n, (%)
1) Trauma diagnosis text correctly entered in registry, but coded as non-traumatic problem	1, (1%)
2) No traumatic injury sustained; invalid registry record	3, (2%)
3) Valid registry record, but no traumatic injury sustained	17, (13%)
4) Documentation in discharge summary sufficient to generate a codable trauma diagnosis, but diagnosis inadequately recorded in trauma registry	22, (17%)
5) Diagnosis recorded in valid trauma registry record, but diagnosis not codable as trauma	25, (19%)
6) Traumatic injury sustained, but diagnosis inadequately documented in discharge summary	74, (57%)

Category 4: Documentation in discharge summary sufficient to generate a codable trauma diagnosis, but diagnosis inadequately recorded in trauma registry

Table 2

AIS Region	n
Head	11
External, Thermal, Other	5
Spine	3
Lower Extremity	2
Face	1

Table 3

Category 5: Diagnosis recorded in valid trauma registry record, but diagnosis not codable as trauma

AIS Body Region	n
External, Thermal, Other	11
Spine	6
Head	3
Thorax	2
Abdomen	2
Lower Extremity	1

Table 4

Category 6: Traumatic injury sustained, but diagnosis inadequately documented in discharge summary

AIS Body Region	n
External, Thermal, Other	24
Spine	19
Head	19
Thorax	7
Lower Extremity	3
Abdomen	3
Face	1

Table 5

Sources of Additional Diagnostic Information

Location in Medical Record	n
Diagnostic Imaging *	28
Initial Trauma Evaluation	24
Emergency Physician's Note	19
Paper Chart	10
Admission History & Physical	5
Operative Report	2

* Diagnostic imaging information was drawn from reports on radiological exams performed on the day of admission, as well as any exams performed during the patient's hospital stay that were not repeats of exams performed earlier in the admission.

Table 6

Spinal Cord Injuries

Diagnosis Assigned Following Review	Discharge Diagnosis ICD-9	Discharge Diagnosis AIS	New Diagnosis Assigned Following Review	New ICD-9	New AIS
Cervical spine stenosis, cervical spondylotic myelopathy	723.0, 721.1	none	C2-3 Cord Injury with Central Cord Syndrome	952.03	640210.4
None	none	none	Spinal Cord Injury NOS	952.9	999999.9
None	none	none	Spinal Cord Injury NOS	952.9	999999.9
Traumatic central cord pattern weakness	none	none	C5-6 Cord Injury with Central Cord Syndrome	952.08	640210.4
None	none	none	Lumbosacral nerve root injury	953.5	630699.2
SCIWORA, central cord syndrome	none	none	Spinal Cord Injury NOS with Central Cord Syndrome	952.9	999999.9
None	none	none	Neurologic injury NFS	none	none
None	none	none	Spinal Cord Injury NOS	952.9	999999.9
None	none	none	Spinal Cord Injury NOS with Central Cord Syndrome	952.9	999999.9
None	none	none	Neurologic injury NFS	none	none
None	none	none	Neurologic injury NFS	none	none
None	none	none	Spinal Cord Injury NOS	952.9	999999.9
L leg sensory and motor deficits	none	none	Spinal Cord Injury NOS	952.9	999999.9
Paraspinal cervical tenderness	none	none	Spinal Cord Injury NOS	952.9	999999.9