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Mapping Abbreviated Injury Scale data from 1990 to 1998 versions: A stepping-stone in the contemporary evaluation of trauma

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ABSTRACT

Introduction: Many trauma registries have used the 1990 revision of the Abbreviated Injury Scale (AIS; AIS90) to code injuries sustained by trauma patients. Due to changes made to the AIS codeset since its release, AIS90-coded data lacks currency in the assessment of injury severity. The ability to map between the 1998 revision of AIS (AIS98) and the current (2008) AIS version (AIS08) already exists. The development of a map for transforming AIS90-coded data into AIS98 would therefore enable contemporary injury severity estimates to be derived from AIS90-coded data.
Methods: Differences between the AIS90 and AIS98 codesets were identified, and AIS98 maps were generated for AIS90 codes which changed or were not present in AIS98. The effectiveness of this map in describing the severity of trauma using AIS90 and AIS98 was evaluated using a large state registry dataset, which coded injury data using AIS90 over several years. Changes in Injury Severity Scores (ISS) calculated using AIS90 and mapped AIS98 codesets were assessed using three distinct methods.
Results: Forty-nine codes (out of 1312) from the AIS90 codeset changed or were not present in AIS98. Twenty-four codes required the assignment of maps to AIS98 equivalents. AIS90-coded data from 78,075 trauma cases were used to evaluate the map. Agreement in calculated ISS between coded AIS90 data and mapped AIS98 data was very high (kappa = 0.971). The ISS changed in 1902 cases (2.4%), and the mean difference in ISS across all cases was 0.006 points. The number of cases classified as major trauma using AIS98 decreased by 0.8% compared with AIS90. A total of 3102 cases (4.0%) sustained at least one AIS90 injury which required mapping to AIS98.
Conclusions: This study identified the differences between the AIS90 and AIS98 codesets, and generated maps for the conversion process. In practice, the differences between AIS90- and AIS98-coded data were very small. As a result, AIS90-coded data can be mapped to the current AIS version (AIS08) via AIS98, with little apparent impact on the functional accuracy of the mapped dataset produced.

Introduction

The value of trauma registries is largely dependent on the utility of the data which they contain. The Abbreviated Injury Scale (AIS)[1–3] has served as the foundation of trauma registries worldwide for decades. The AIS allows meaningful comparison of injuries of different types and severity, and forms the basis of summary injury scores such as the Injury Severity Score (ISS)[4] and the Trauma and Injury Severity Score (TRISS).[5] Such scores can be used in benchmarking, outcome prediction and evaluation of the quality of care of trauma patients.[4,6]

Since the initial publication of the AIS, nine revisions and updates have incrementally expanded the type and detail of injuries which the AIS can describe. The assigned severity levels for many injuries have also changed over time, to reflect concurrent improvements in the diagnosis, treatment, and prognosis of these injuries. This may affect the monitoring of trends in injury severity over extended periods of time, or in benchmarking between systems using different AIS versions.

The 1990 revision of the AIS[1] was adopted by a large number of trauma registries. An updated codeset was released in 1998,[2] providing a number of revisions to the AIS90 codeset. Differences between AIS90 and AIS98 have been assessed by only one previous study.[7] Although differences between the AIS90 and AIS98

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codesets were comparatively small, the ISS changed for 23% of patients in the sample.[7] In part, this was due to changes in ISS coding rules for external injuries, which were simplified in AIS98. However, it was not clear whether injuries to particular structures or body regions disproportionally contributed to ISS differences, as has been noted with other AIS version changes.[8–10] It was also unclear whether ISS changes between AIS90 and AIS98 would affect the number of patients classified as 'major trauma', which is commonly defined using an ISS greater than 15.[5]

The most current revision of the AIS is the 2008 update to the 2005 edition (AIS08).[3] The AIS08 dictionary contains a map to transform AIS98-coded injuries to the much larger and more complex AIS08. This map is incomplete,[11] although supplementary mapping tools capable of completing this process have since been developed.[12,13] As a result, if the comparatively small differences between AIS90 and AIS98 could be completely identified, and appropriate AIS98 equivalents identified for AIS90 codes, it would be possible to map AIS90-coded injury data to AIS08. In other words, the development of an AIS90 to AIS98 map would serve as a small 'stepping-stone' to allow transformation of AIS90-coded data to the current AIS08. Given the size and complexity of the AIS98 to AIS08 map, the 'stepping-stone' approach is felt to be preferable to the development of a direct AIS90 to AIS08 map, as the majority of the differences between AIS90 and AIS08 are likely to already be contained within the existing AIS98 to AIS08 mapping tools. However, there is currently no map for transforming AIS90-coded data to any more recent AIS version.

The aims of this study were to develop a map capable of transforming an AIS90-coded dataset into an AIS98-based (mapped) dataset, and to describe and assess differences in ISS between an AIS90-coded dataset, and the AIS98-mapped dataset generated using this map.

Materials and methods

Development of an AIS90 to AIS98 map

The differences between the AIS90 and AIS98 codesets were identified, through manual review of the AIS90 and AIS98 dictionaries. The AIS90 dictionary used was copyrighted in that year, while the AIS98 dictionary used was re-copyrighted in 2001. Comparisons were performed independently by two authors (CSP and JL). Following this, discussions were held between these authors to ensure that the list of identified differences was complete. Both authors had a statistical and epidemiological background, had completed a number of AIS scaling courses, and had both practical and research experience in using AIS data.

The AIS98 equivalents were assigned for each AIS90 code which changed or had been removed in AIS98, depending on the nature of the changes made to each code. The same authors who identified differences between the AIS90 and AIS98 codesets also assigned these equivalent codes, both independently and during subsequent discussion. As with a previous study where AIS maps were developed,[12] the selection of plausible AIS98 maps was governed by established AIS coding guidelines.[2]

Comparison between AIS90-coded and AIS98-mapped datasets

Established in 1998, the Queensland Trauma Registry (QTR) collected data on seriously injured people in the state of Queensland. Queensland contains a population of approximately 4.5 million people, living in the north-east of Australia. In 2003, 15 hospitals participated in the QTR, with one additional hospital commencing during the study period. These hospitals are estimated to account for more than 90% of seriously injured patients admitted to Queensland public hospitals.[14] Data were manually entered onto the registry by QTR employees based at each hospital. All coders had a background in either nursing or health information management, and were trained using AIS scaling courses.

With some exclusions, patient cases were included on the QTR if they were admitted to a participating hospital for 24 h or more for the acute treatment of injury, or died after ED presentation (regardless of length of admission), and were coded to an injury-related category in ICD-10-AM (the Australian modification of the International Statistical Classification of Diseases).[14]

All cases meeting QTR inclusion criteria between January 2003 and December 2008 were included in the current study. De-identified data were retrieved from the QTR for each case, including all AIS90 injury codes and descriptors along with the assigned ISS body region. The developed AIS90 to AIS98 map was applied to this dataset to generate AIS98 mapped codes for all AIS90 codes. The ISS was then calculated for all cases using both AIS90-coded and AIS98-mapped data.

Data analysis and statistical methods

For the development of the AIS90 to AIS98 map, the observed differences between AIS90 and AIS98, and features of the mapping tool developed as a result, were summarised.

Differences in ISS calculated from the AIS90-coded and AIS98-mapped datasets were assessed in two ways. Firstly, because of the ordinal, irregular nature of the ISS[2,15–17] a summary table was produced to illustrate the spread of agreement between AIS90- and AIS98-based ISS. This was evaluated using a kappa score, and comparison of the mean ISS difference between the datasets. A quadratic weighted kappa was also calculated, as this is equivalent to the intra-class correlation coefficient for ordinal data.[18] Secondly, the change in the number of cases classified as major trauma between AIS90 and AIS98 was assessed, using percentage changes and kappa scores.

A p-value of 0.05 was taken as indicative of statistical significance, and 95% confidence intervals (CI) were calculated for proportions and kappa values. Ethics approval for this study was given by the Queensland Health Department, The University of Queensland and Monash University.

Results

Evaluation of AIS90 and AIS98 codesets and map generation

Table 1 summarises the differences identified between the AIS90 and AIS98 codesets. There were 23 AIS90 codes that were not present in AIS98, and 52 new codes were added. The size of the codeset consequently increased from 1312 codes in AIS90 to 1341 codes in AIS98. The identified changes equated to 3.7% of the AIS90 codeset (49 of 1312 codes), and 5.8% of the AIS98 codeset (78 of 1341 codes). Where both the localising (pre-dot) and severity component of the AIS code remained unchanged between the two versions, in all but one instance it was judged that a given injury would have been assigned the same AIS code in both AIS90 and AIS98 had double-coding taken place.

The 49 AIS90 codes which changed or were not included in AIS98 fell into two categories – those requiring map assignment, and those which did not. Twenty-six codes had a simple change in localising or severity component between AIS90 and AIS98 (Table 1); 25 of these codes had unchanged injury descriptors, and did not require a map (listed in Table 2). The remaining code had a changed injury descriptor and required a map.

In total, 24 AIS90 codes required mapping to AIS98; these codes are listed in Table 3. In the majority of instances where an AIS90 code was not present in AIS98, the AIS90 code reflected anatomical or age-related specificity that was removed in AIS98. An AIS98