

THE DEVELOPMENT OF A SOFTWARE TOOL FOR CLASSIFICATION OF INJURIES IN THE ABBREVIATED INJURY SCALE.

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ABSTRACT

This paper describes the implementation of AIS Reporter: a software tool designed to assist in the preparation of injury reports using the most recent revision of the Abbreviated Injury Scale (AIS) dictionary. The program is intended for both biomechanical researchers and hospital staff. To facilitate the interaction process a 3D human model is used to represent injury, and XML is applied for injury data storage. Since AIS Reporter was created in JAVA it can be launched on several computer environments. The program also enables the calculation of multiple-injury scores according to different systems, such as NISS, ISS or MAIS.

Keywords: COMPUTER PROGRAMS, THREE DIMENSIONAL, INJURY SEVERITY, TATISTICS

Injuries together with circulatory system diseases and cancers are the three biggest problems faced by medicine today. In Poland, for instance, injuries are the main causes of death among children and adults up to 44 years of age. Trauma care is a continuous process which starts at the place of accident and continues during the transportation to the hospital, before proceeding to the emergency department and finally ending in a specialized hospital ward. The key period of time in this process, considering health and survival, is the so called "Golden hour", which starts from the moment of occurrence of injury and ends with the provision of medical care (or in some cases medical operation) (Ząbek,2007). The speed and efficiency of the actions taken during this period have a major effect on the health, potential disability and quality of life of the patient.

The main objective of this study was to create an application that would allow quick injury assessment as well as the formulation of an injury report in a standardized format. The AIS dictionary has been used as a source of injury data. The Abbreviated Injury Scale (AIS) is the only dictionary specifically designed as a system to define the severity of injuries throughout the body.

AIS

The AIS is an anatomically-based scale which provides criteria for the classification of single time-independent injuries according to their severity. The parent organization of the AIS is the International Injury Scaling Committee, which was founded by the Association for the Advancement of Automotive Medicine (AAAM). In 1969 a group of 50 injury specialists hosted jointly by the AAAM, the American Medical Association and the Society of Automotive Engineers was given the task of creating a research tool for collecting injury data to be used by everyone studying injuries and their severity. Two years later the first revision of the AIS was presented. It contained approximately 75 injuries, mostly resulting from vehicular collisions. The most recent revision is called the „AIS 2005” and is divided into 9 chapters, each of which represents a different region of the body. The AIS directly contributes to two dimensions of injury: threat to life and tissue damage. It was not designed solely as a measure of mortality, and considering (Gennarelli, 2005) this goal has been achieved.

MULTIPLE INJURY SCALES

The AIS describes single injuries that are coded separately. Most injured people sustain more than one injury in an accident. Therefore, it is necessary to be able to assess the overall severity of all those injuries. The MAIS and ISS were the earliest schemes to do this. MAIS is the highest AIS score in the case of all the injuries sustained by a particular patient. The Injury Severity Score is somewhat more complicated. It is the sum of the squares of the three most serious injuries in three different ISS body regions. While the AIS is divided into 9 body chapters, the ISS assigns all of the AIS injury descriptions to 6 body regions in order to calculate its final value. Thus, all individual injuries have to

be assigned to new body regions before calculating the ISS score. The NISS was proposed as a more effective measure to predict the probability of survival, particularly in patients with injuries in a single body region. NISS is the sum of the three most serious injuries regardless of their location in the human body. The AIS Reporter has the ability to calculate the above mentioned (MAIS, NISS, ISS) multiple injury scores.

RESEARCH QUESTION/OBJECTIVE

The main objective of the AIS Reporter was to provide a cross-platform application used to create brief reports of the injury status of patients. The main features of this application are simplicity, speed of injury coding and the ability to calculate multiple injury scores such as MAIS, NISS and ISS. To this author's knowledge this is the first injury reporting program, based on the AIS 2005, using a 3D human model.

METHODOLOGY

The AIS Reporter has been developed using the Java programming language. It has been chosen due to the amount of libraries it offers in the standard version. It is open source and provides tools for managing XML files as well as 3D objects. Eclipse has been used as a programming platform as it is free of charge and provides several tools that accelerate and simplify the development process.

The graphical user interface was created using the “Swing” library embedded in the Java SE platform.

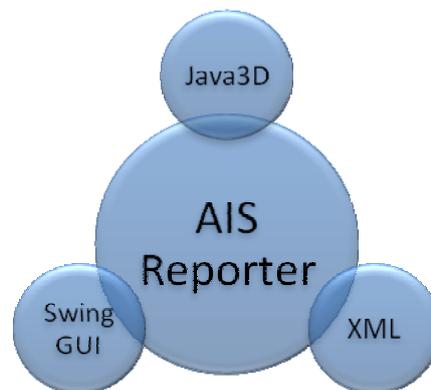


Fig. 1 – AIS Reporter Model

“AIS Reporter” program uses a 3D human model to select and represent injuries (as described in detail below) and XML for injury data storage. The 3D model has been created in third-party 3D-modelling software and then imported into the AIS Reporter as an “object” file and further maintained by the Java3D libraries.

It is designed to be compatible with all of the principal operating systems, such as Windows, Linux and MacOS. The AIS Reporter employs a so called “Swing” Java library to create Graphical User Interface (GUI). The application permits the storage of patients’ demographic data and the selection of the type of accident.

The initial injury assessment can be performed in three different ways: using the 3D human model, using the AIS catalogue nomenclature or by entering the injury code manually. The injury can be identified by selecting firstly the required „field of injury” on the 3D model (Fig.2a), and then the precise injury from the catalogue (Fig 2b). Each colour represents a different type of injury (i.e. blue for skeletal, red for neural injuries, etc.). In case of multiple injuries the colour is automatically selected to determine the injury with the highest AIS severity score.

The AIS Reporter was designed to be scalable, meaning its adaptation to potential future changes in the 3D human model or updates in the AIS catalogue is feasible.



Fig. 2a – Selecting field and type of injury on a human 3D model (in this case neural thorax injury, vascular arm injury, joint forearm injury and skeletal hand injury)

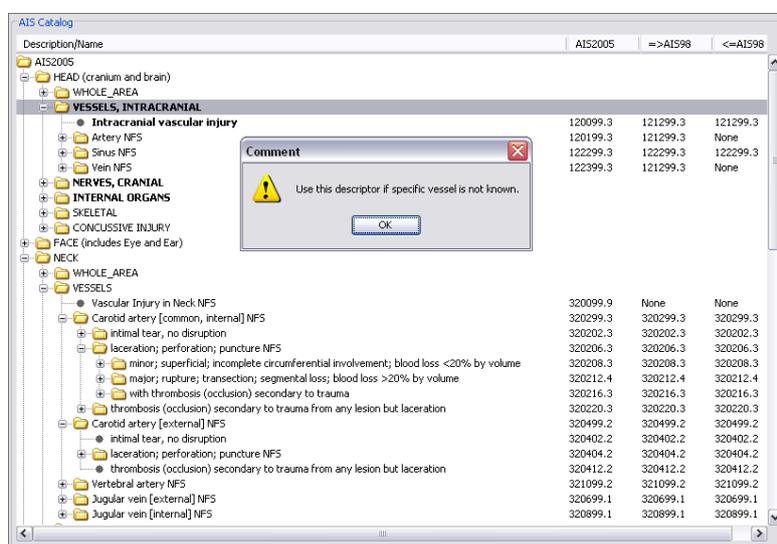


Fig. 2b – Selecting type of injury from the AIS Catalogue

SOURCE OF DATA

The AIS Reporter is based on the most recent edition of the Abbreviated Injury Scale (AIS) dictionary (AIS 2005, 2007 update), which is a numerical means of ranking injuries. During the development of the AIS Reporter, data collected in the paper version of AIS 2005 was converted into XML format, resulting in 12.5k lines of code.

A part of the XML version of the AIS catalogue is presented below:

```
<Injury>
  <Description>laceration NFS</Description>
  <AIS2005>110600.1</AIS2005>
  <TO_AIS98>110600.1</TO_AIS98>
  <FROM_AIS98>110600.1</FROM_AIS98>
  <PreciseInjury>
    <Description>minor; superficial</Description>
    <AIS2005>110602.1</AIS2005>
    <TO_AIS98>110602.1</TO_AIS98>
    <FROM_AIS98>110602.1</FROM_AIS98>
  </PreciseInjury>
</Injury>
```

It describes two injuries in a parent-to-child relation. The parent injury is called ‘laceration NFS (Not Further Specified)’. This information is stored in the ‘Description’ node. We then have three nodes that describe the codes (6 digit pre-dot code and severity), which in turn are followed by the child node called the ‘PreciseInjury’, which contains more specific data relating to its parent injury. In that case it is ‘minor, superficial’ laceration. In this hierarchical manner all of the injuries are located in the XML file.

As for the application itself, it uses the Java standard libraries and the Java3D plug-in. The latter was used to incorporate the 3D human model into the program.

RESULTS

The final product, “AIS Reporter” is a tool that allows a rapid assessment of the degree of injury and the calculation of multiple injury scores for a given patient. The attending doctor/medic is able to directly summarize the established injuries into a simple tabular, standardized format. The AIS Reporter is able to create a report that can be printed or stored for further purposes.

DISCUSSION

To this author's knowledge, AIS Reporter is the first computer program, based on the AIS 2005, that employs a 3D human model for the assessment of multiple injuries. There have been some other attempts at computerizing injury scaling (Osler,1990), but these were aimed at achieving different goals. Injuries were previously recorded using the paper version of the AIS catalogue. Yet this program allows for quicker registration of injuries, which is certainly an advantage in an emergency setting. Furthermore, by applying international injury scores, it provides a standardized platform for injury classification. Finally, it also serves as a means of data collection and longitudinal statistical analysis.

LIMITATIONS OF THIS STUDY AND POSSIBLE IMPROVEMENTS

A useful extension of the program would be its adaptation to portable devices such as PDA's or advanced cell phones implemented with Java Micro Edition (Java ME). This would make the injury reporting even faster. For example, a brief report could be generated by a medic inside the ambulance. Moreover, PDA devices are more convenient, and the development of a mini version of AIS Reporter could open other novel possibilities. Unfortunately, however, the conciseness of the injury assessment is linked with a certain simplification of the human model which, in turn, entails a degree of bias concerning the interpretation of injuries. Another improvement would be the addition to the package of a database, i.e. to create a module that would allow the storage of all information on injured patients in a standalone database and possibly to restructure the program so that it could fit comfortably into a medical rescue system.

A potential caveat of the AIS Reporter application is a certain simplification of the human anatomy and the use of a universal model for both genders and for children and adults. A more complex hierarchical anatomy model that allows the user to switch layers which would represent different injury fields such as skeletal or nerve injuries, would be a further improvement. Indexing all the injuries in the AIS catalogue would help with and speed up the addition of injuries without selecting the required parts of the human model. This could be done automatically.

CONCLUSIONS

The AIS Reporter is a software tool for rapid assessment of multiple injuries based on a 3D human model. It employs a novel graphical user interface, which enables immediate selection of specific injury. It is derived from the most recent edition of the AIS catalogue which is currently the international standard in injury scoring, incorporating thousands of injury codes. At present, the AIS Reporter is designed to work on a personal computer. A future extension of this application to portable devices, such as PDAs, is feasible. Furthermore, a differentiation of the 3D human model depending on patients' gender and age is under way.

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