DOCUMENTING INJURIES IN NHTSA's CISS PROGRAM

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ABSTRACT

In 2012 the United States Congress issued a directive to the National Highway Traffic Safety Administration (NHTSA) to modernize its nationally-representative crash databases and examine the data collected in those programs. In response, NHTSA initiated the Data Modernization Project to affirm its position as the leader in motor vehicle crash data collection and analysis, by collecting quality data to keep pace with emerging technology and evolving policy needs. To ensure the needs of the highway safety community were met, NHTSA sought input from users of the data including government, academia, and industry. One of the areas the stakeholders requested upgrades was in the injury coding portion of the crash investigation-based programs. Enhancements in NHTSA's new nationally representative motor vehicle crash data collection, the Crash Investigation Sampling System (CISS), include more robust injury coding through an updated version of the Abbreviated Injury Scale (AIS), the addition of injury causation scenarios for severely injured occupants, and the use of state-of-the-art software. NHTSA has partnered with the Department of Defense (DOD) Army Research Laboratory (ARL) to use their Visual Anatomic Injury Descriptor (VisualAID) software to record injury information. The purpose of this paper is to describe the CISS injury coding process and detail the improvements users of the data can expect in the coming years.

BACKGROUND

NHTSA has operated multiple investigation-based data collection programs with detailed injury information: the National Automotive Sampling System (NASS), the NASS-Crashworthiness Data System (NASS-CDS), Special Crash Investigations (SCI), and the Crash Injury Research and Engineering Network (CIREN). Injury data from each of the programs has been critical in NHTSA's evaluation of vehicle crashworthiness countermeasures such as air bags and seat belts and identifying problem areas where improvements could be made. The focus of these data collection programs have differed somewhat, but they were intended to complement one another.

NASS (1979-1987) was NHTSA's initial nationally-representative crash data collection system and served as the forerunner to NASS-CDS. NHTSA re-evaluated its data collection programs in 1988 and elected to divide NASS into two components: NASS-CDS and NASS-General Estimates System (NASS-GES), the latter of which being a police report-based nationally-representative sample designed to collect basic statistical information in order to monitor traffic safety trends.

NASS-CDS (1988-2015) was a nationally-representative sample of towed light vehicle crashes with an emphasis on the crashworthiness of the vehicle. NASS conducted detailed investigations of the crash scene, vehicle damage, injury, and injury sourcing. The case selection algorithm was designed to give fatal and severe injury crashes a higher probability of selection. Data was collected at 24 sites across the country with a yearly average of 4,500 cases per year between 1999 and 2015. NASS-CDS case viewers are available at http://www.nhtsa.gov/NASS. The statistical data sets are located at ftp://ftp.nhtsa.dot.gov/NASS/.

SCI (1972-present) is a collection of approximately 125-150 targeted investigations each year that are used by NHTSA and the automotive safety community to understand the real-world performance of existing and emerging advanced safety systems as well as other unique safety problems occurring in the field. The SCI case data and technical reports can be accessed at http://www.nhtsa.gov/SCI.

CIREN (1997-present) is a hospital-based study operating at six centers across the country, collecting approximately 300 serious injury cases per year. The CIREN process combines comprehensive data collection with professional multidisciplinary analysis of medical and engineering evidence to determine injury causation in every crash investigation conducted. CIREN case viewers and statistical data sets are accessible at http://www.nhtsa.gov/CIREN.

Through the years, injuries in NHTSA's investigation-based programs have been described based upon the Abbreviated Injury Scale (AIS©) developed and maintained by the Association for the Advancement of Automotive Medicine (AAAM). AAAM is a professional multidisciplinary organization dedicated to limiting injuries from motor vehicle crashes. In 1973, AAAM assumed the lead role for continuing the development of a scale to classify injuries and their severity, originally begun by a joint committee of the American Medical Association (AMA), Society of Automotive Engineers (SAE), and the AAAM in 1969. The first scale was published in 1971 in the Journal of the AMA, titled: "Rating the Severity of Tissue Damage – The Abbreviated Injury Scale" [1].

The AIS is an anatomically-based, consensus-derived, global severity scoring system that classifies the severity of each injury on a 6-point ordinal scale (1=minor and 6=maximal). The AIS provides standardized terminology to describe injuries and ranks injuries by severity. Current AIS users include health organizations for clinical trauma management, outcome evaluation, and for case mix adjustment purposes; motor vehicle crash investigators to identify mechanism of injury and improve vehicle design; and researchers for epidemiological studies and systems development, all of which may influence public policy (laws and regulations) [1]. The AIS is widely considered the premier internationally-accepted tool for ranking injury severity.

The AIS has been contiuously updated since its inception to keep pace with updates in the trauma field and incorporates current medical terminology. In turn, NHTSA has adopted several versions of the AIS scheme over the years as seen in Table 1.

Table 1.
NHTSA AIS Version by Year

AIS Version	NHTSA Data Years
AIS 2015	2017-
AIS 2005 Update 2008	2010-2016
AIS 1990/1998 Update	2000-2009
AIS 1990	1993-1999
AIS 1985	1985-1992
AIS 1980	1980-1984
AIS 1976	1976-1979

Full implementation of AIS 2015 will occur in CISS, SCI, and CIREN for 2017 cases. However, CISS pilot cases from 2016 also used AIS 2015.

INTRODUCTION

In response to a congressional directive to modernize its nationally representative crash databases, the Data Modernization Project concluded that the NASS-CDS program would be retired and replaced with the Crash Investigation Sampling System (CISS). It was also decided that other NHTSA programs collecting detailed investigation-based data - SCI and CIREN - would remain largely unchanged with the exception of Information Technology (IT) infrastructure, new data collection methods, and the upgrades to injury information described later in this paper.

The new CISS program is designed to provide many improvements from its predecessor including:

- An updated sample design with new sites for more representative data and smaller statistical margins of error for key estimates,
- Better targeting of newer vehicles and more severe crashes in case selection algorithm,
- Flexibility to increase the number of sites without reselection,
- Consolidating IT infrastructure,
- Obtaining more accurate scene and vehicle measurements,
- Upgrading injury information, and

- Making it easier for end users to access the data.

Although the main focus of this paper is to discuss enhancements in CISS injury coding, it is first necessary to briefly describe other program improvements in more detail.

CISS Sample Design

To ensure accurate national estimates of passenger vehicle crashes in the country, NHTSA designed a sophisticated three-stage sample: the first stage is a sample of single counties or a group of counties called the Primary Sampling Unit (PSU); the second stage is a sample of police jurisdictions (PJs) within the PSUs; and the third stage is a sample of crash reports at the selected PJs.

The new sample design improves operational efficiency because the designers took into account the lessons learned in the previous NASS-CDS sample design. One example of this dealt with the size of the PSUs. Some PSUs in NASS-CDS covered very large geographic areas that resulted in excessive driving time for the Crash Technicians collecting field data. As part of the redesign, the goal was to sample smaller areas to reduce associated travel times and thereby provide more field data collection time and potentially an increased caseload.

Additionally, the new sample design took into account end-user requirements. End users consistently requested data on recent model year vehicles equipped with new and emerging technologies. The new sample was designed to include more recent model year vehicles (previous four model years) which are more likely to be equipped with advanced crashworthiness and crash avoidance technologies. Areas with a higher volume of severe crashes and those with more crashes involving newer vehicles had a greater likelihood to be selected as PSUs.

To further enable CISS to generate cases with newer vehicles and higher severity injuries, a greater granularity in sampling was necessary. Crash reports are now listed into categories referred to as domains (also referred to as strata): Recent Model Year (vehicles that are 4 years old or newer), Mid Model Year (vehicles that are 5-9 years old), and Older Model Vehicles (vehicles 10 years old or older). With these changes, the CISS Pilot Study revealed a higher case selection rate on newer vehicles (47% in CISS versus 33% in NASS-CDS), thereby accomplishing one of the primary objectives of the sample redesign.

There was a significant change in the priority of the police crash report domain/strata assignments in CISS as compared to NASS-CDS. In NASS-CDS, injury severity took precedence over model year when assigning domain/strata to a crash report. However, the CISS sampling flow chart prioritizes model year of vehicle before severity of injury. This was a deliberate change by NHTSA in an effort to include more new vehicles that will likely be equipped with more advanced crashworthiness and crash avoidance technologies. The priority change was accounted for when crash population estimates and the target allocations were developed.

To reduce missing data in CISS, the system has been designed to replace cases when there is NOT a reasonable expectation that the vehicle, by which the crash was assigned a domain, will be successfully inspected. Reasons for a replacement case include, but are not limited to, the following scenarios:

- The vehicle has been repaired, crushed, sold to another owner, or moved out of the area,
- An owner, insurance company, tow yard, police, or other responsible party denies permission to inspect the exterior of the vehicle, or
- After following protocols for sufficient contact attempts, the CISS Crash Technician is unable to locate the vehicle or reach those persons necessary to secure permission to inspect the exterior of the vehicle.

Early results on replacement cases have been very promising and could prove to be one of the significant upgrades from NASS-CDS, particularly at PSUs located in urban areas where cooperation has historically been more difficult to attain. The CISS sample design is described in much greater detail in a paper by Chen, et. al, “NHTSA’s Data Modernization Project” presented at the 2015 Federal Committee on Statistical Methodology (FCSM) Research Conference [2].

CISS Information Technology (IT)

A significant amount of the resources dedicated to the Data Modernization Project were used to improve the IT components of the various programs sponsored by NHTSA’s National Center for Statistics and Analysis (NCSA). One of the major concerns addressed was making the new data system compliant with Federal privacy and security requirements. The new system utilizes Max.gov, which meets stringent authentication requirements. The databases, sensitive documents, and all Personally Identifiable Information (PII) are fully encrypted.

Another goal of the project was to modernize and consolidate the IT infrastructure for multiple legacy systems. The new system was able to more efficiently use scarce resources by eliminating redundancy and utilizing a consolidated server platform in a Federal data center supported by full virtualization. The new IT system also improves flexibility to add/subtract data by using a common variable set for shared elements across programs, making changes much more efficient.

Data in the CISS, SCI, and CIREN programs is now collected in the field by Investigators or Crash Technicians using rugged tablet computers, similar to those used by military and law enforcement personnel. In the past, information was collected largely on paper and then transferred into electronic format causing inefficiencies. Information that will be available to end users in the programs is expected to be much more robust and easier to use than in the previous systems. Although the new IT system required a significant initial investment, the upgrades should make the NCSA data programs more sustainable moving forward.

CISS Vehicle and Scene Data Collection

One of the primary goals of the redesign was to increase the number of cases in CISS. If improved data collection methods could be implemented that increased efficiency, in particular data collection methods at the scene and vehicle where the majority of the time is allocated, the number of crashes investigated in the new system could increase. Secondly, many stakeholders commented that scene and vehicle documentation should be more precise and easier to use. The Data Modernization Implementation Team felt that leveraging technology would be the most effective way to address both goals. After reviewing several options, the team recommended scene and vehicle measurements be collected electronically with Nikon Total Stations in the investigation-based programs as opposed to using manual measurement techniques. Electronically measuring scenes and vehicles will make data collection more accurate, efficient, and safer for the Investigators and Crash Technicians in the investigation-based programs. Using total stations, which are the most common tool used for detailed scene documentation in crash reconstruction, will also make the data collected in the NHTSA programs much more valuable to end users since the measurements are saved in common file formats that can be used in most computer-aided design or mapping software.

Additional detail is described in ESV paper 17-0174, "Improved Field Measurements in NHTSA's CISS Program", Mynatt, Brophy.

DISCUSSION

After reviewing the Data Modernization feedback from stakeholders, it became evident that injury data was one of the areas CISS should upgrade. The majority of the injury-related comments received from various organizations including auto manufacturers, suppliers, safety advocates, the medical community, and government were similar. Increased detail in the CISS injury data was requested, many referencing the CIREN program which focuses more on injury causation than the former NASS-CDS program. To address the users' needs, NHTSA elected to make three significant improvements to injury information in the CISS program: move to the updated version of the AIS, add injury causation scenarios for seriously injured occupants, and use state-of-the-art software to enter and present injury data.

Updated Version of Abbreviated Injury Scale

In September 2016, AAAM announced the new version of its Abbreviated Injury Scale coding system, AIS 2015 [3]. The revision incorporated the needs of its users and the current status of traumatic injury diagnosis and documentation. AIS 2015 is the next step in the continual evolution of traumatic injury classification and scaling. This latest revision improves brain injury coding, spinal cord impairment coding, and enhances many code definitions by incorporating current and appropriate medical terminology. Clearer and expanded coding rules encourage improved interrater reliability to support an improved tool for both medical coders and researchers.

AIS 2015 content was derived from expert consensus and analysis of trauma data including injury diagnostics, classifications, and feedback from field use of AIS 2005 Update 2008. In the new version, 140 new AIS codes were created, nearly 400 codes underwent definition update, and the severity level was updated on more than 40 codes. Additionally, more than 140 AIS 2005 Update 2008 codes were deleted for AIS 2015. For version compatibility, AIS 2015 includes both forward and backward maps for the purpose of translating previously coded data between AIS 2005 Update 2008 and AIS 2015 [3,4].

Injury Causation Scenarios

NASS-CDS and SCI methods used to determine and document injury causation have remained relatively static over the last several decades. These methods have typically involved documenting:

- The AIS code,
- A "source" of injury, which is the vehicle component or other object/occupant believed to have caused an injury by direct contact/loading of the occupant,
- Confidence levels for injury sources,
- Whether the injury was due to "direct" or "indirect" contact or loading with/by an interior vehicle component,
- Whether the injury was a "noncontact" or inertially induced injury,
- Whether intrusion of vehicle interior components into the occupant space caused the injury, and
- Whether an injury was caused by the air bag flinging the injured body region into a vehicle interior component.

Though these methods for describing and documenting injury causation have been helpful in regulating and improving vehicle safety performance, they also have shortcomings that limit the value of crash investigations and crash investigation databases, especially as vehicle crashworthiness and restraint technologies become more complex. In particular, these methods used to analyze and document injury causation do not completely describe the set of conditions and factors under which disabling and life-threatening injuries occur [5].

To improve methods for describing injury causation in motor vehicle crashes, in 2005 NHTSA's CIREN program implemented a new method for analyzing and documenting injury causation, known as BioTab. The procedure provides thorough evidenced-based descriptions of injury causation and incorporates and uses medical details of occupant injuries. The BioTab method can be applied to other crash investigation programs in which occupant injury and crash data are available, although the quality of the analysis will depend on the amount and quality of the available data [5].

CIREN collects thirteen core data elements as part of the BioTab method to describe injury causation. In the CISS program, case volume, study design, and budget constraints make collecting that degree of injury information unrealistic. Multiple levels of engineering and medical reviews used in CIREN are also not available in CISS. However, NHTSA determined that with adequate training and close monitoring, the Injury Coding Center (ICC) in CISS and the SCI teams have enough expertise to code an abridged amount of injury causation information.

In an effort to increase injury detail to meet the needs of the agency and other users of the data, NHTSA has incorporated ten of the thirteen injury causation elements into the new CISS program and SCI. Injury causation elements that will be collected in CISS, SCI, and CIREN for AIS-3+ and clinically-significant AIS-2 injuries injuries are shown in Table 2.

Table 2.
NHTSA Injury Causation Elements

Injury Cauastion Element	Programs Collected
Body Region Injured	CISS, SCI, CIREN
Souce of Energy	CISS, SCI, CIREN
Involved Physical Component (IPC) Configuration	CISS, SCI, CIREN
IPC Area	CISS, SCI, CIREN
IPC	CISS, SCI, CIREN
IPC Confidence Level	CISS, SCI, CIREN
Body Region Contacted	CISS, SCI, CIREN
Load Path	CISS, SCI, CIREN
Contributing Factors	CISS, SCI, CIREN
Injury Causation Scenario (ICS) Confidence Level	CISS, SCI, CIREN
Injury Causation Scenario (ICS) Evidence	CIREN only
IPC Evidence	CIREN only
Body Region Injury Mechanism	CIREN only

Less severe injuries will have a lower degree of detail in all three programs with only six of the elements collected:

- Body Region Injured,
- Source of Energy,
- Injury Causation Scenario (ICS) Confidence Level,
- Involved Physical Component (IPC) Area,

- IPC, and
- IPC Confidence Level.

One of the keys to accurately coding injury causation information is the availability of detailed medical documentation. As the new CISS sites were established, emphasis was placed on obtaining a high degree of cooperation with trauma centers and other medical facilities. While CISS will not be capable of collecting medical records with the amount of detail in CIREN, based on experience from the previous NASS-CDS program, CISS should get the necessary information to code the shortened version of the injury causation scenarios. Availability of radiology would be an example; CIREN personnel, who include medical doctors, are typically able to access the individual images to assist during the injury evaluation, while CISS is more likely to rely on the radiologist's summary report.

Most of the injury causation elements will be identical to those captured in CIREN (using the BioTab since 2005) although subtle changes to the involved physical component (IPC) configuration have been implemented. An IPC is the physical component the body contacted that led to the injury. Examples of IPCs include restraints, all parts of the vehicle interior, other occupants, cargo, and any intruding structure that the occupant contacts, such as a pole or the hood of another vehicle.

There are three types of IPC configurations now available: Isolated, Tandem, and Critical, and each has unique governing rules. An Isolated IPC occurs when only one point of contact to the occupant is required to produce the injurious loading. A Tandem IPC occurs when multiple components, in series with one another, lead to a single point of contact to the occupant with simultaneous or sequential loading (thorax loading of the belt, air bag, and steering wheel). A Critical IPC configuration occurs when multiple components simultaneously load the occupant at separate and distinct locations (loading of the leg between the foot and knee). A confidence level of Certain, Probable, or Possible will be assigned to each IPC according to the specific rules by IPC configuration.

For an Injury Causation Scenario (ICS) that involves an IPC with a confidence level of Probable or Possible, a second "alternate" IPC may be coded. An example of an Isolated IPC with Alternate scenario would be a patellar fracture that probably occurred from contact with the steering column, but possibly occurred from contact with the knee bolster. The Primary IPC would be the steering column, and the Alternate IPC would be the knee bolster. Prior coding protocol could not capture such circumstances. Table 3 shows the different IPC configurations available in CISS, SCI, and CIREN and a numeric identification scheme for clarity in referencing.

Table 3.
IPC Configuration Numbering Scheme

IPC Configuration	Primary IPC	Alternate IPC
Isolated	1.1	1.2
Tandem	2.1	
	3.1	
	4.1	
Critical	5.1	5.2
	6.1	6.2
	7.1	7.2

NHTSA has also increased the number of components available inside the vehicle occupant compartment to add greater specificity and better describe injury patterns.

BioTab causation coding has included the ability to associate documented occupant comorbidities as Contributing Factors – factors deemed to increase the severity or likelihood of an injury. Due to the extensive medical data access in CIREN, a wide range of pre-existing conditions affecting injury causation have been documented since 2005. For CISS and SCI, a condensed list of relevant high-frequency pre-existing conditions, such as osteoporosis or obesity, can be linked to an injury's causation if documented in available medical records. Contributing Factors may also include items such as intrusion or the presence of an unbelted occupant.

Visual Anatomical Injury Descriptor

In 2014 NHTSA began discussions with the Department of Defense (DOD) Army Research Laboratory (ARL) based in Aberdeen Proving Ground, Maryland to use VisualAID software in its programs recording and analyzing detailed injury information. An Interagency Agreement was signed by both parties in May 2015, which allowed the use of VisualAID in NHTSA's CISS, SCI, and CIREN programs. ARL also incorporated NHTSA injury causation elements into a version of VisualAID for NHTSA use. This project is a novel collaboration between two different government agencies – the DOT and the DOD – to improve processes and leverage strengths within both organizations to create a viable finished product.

A Brief History of VisualAID

VisualAID is an injury visualization application created by the Warfighter Survivability Branch of the ARL in the year 2010 [6,7]. Originally VisualAID was a web application that would take a list of Abbreviated Injury Scores and produce images with color-coded anatomy denoting the severity of injuries. As user requests for VisualAID's analytical capabilities expanded, so too did its capability to visualize data in various ways and arrange and analyze data. VisualAID 3.0 was over ten times the size of its first iteration and was capable of being built into several versions including an online version and a database to persist and share user data.

VisualAID uses the Zygote 3D Male Human Anatomy to render images of specific tissues according to AIS code descriptions [8]. VisualAID renders the images of tissues in specific colors to denote AIS severity or Functional Capacity Index. For denoting severity, a qualitative "heat-map" color scheme of green to yellow to red is used; with green representing the lowest severity (severity 1) and dark red (severity 6) representing the highest injury severity, as shown in the example in Figure 1. AIS Codes with a post-dot "9" signify unknown severity and these are denoted in blue. Other annotations can be added to give the analysts contextual information and increase flexibility of the visualization tool. Multiple injury visualizations can be generated within VisualAID and then compared side-by-side to easily identify patterns and trends in injuries.

VisualAID is useful to those performing analysis of injuries based on information from occupant medical records or results from modeling and simulation. Benefits of the VisualAID tool include:

- A reference anatomy that is independent of personal identification which allows visualization of actual occupant trauma.
- Displaying of AIS-coded damage to various skeletal and organ structures.
- Support of rapid turn-around analysis and data reporting.
- Allows for the visualization and validation of AIS codes.
- Provides a technique for users to learn anatomy and the severity of injury as described by AIS.

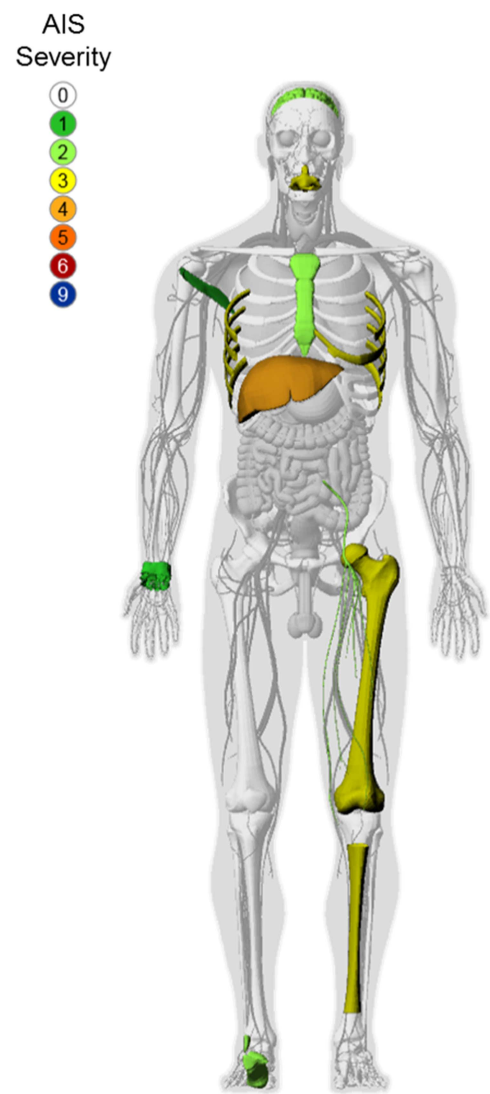

Figure 1. VisualAID rendered image, showing example injuries with AIS severity colors.

To ensure that the enhanced VisualAID tool was compatible with the previous injury recording tool used in CIREN, SCI and NASS, AIS 2005 Update 2008 codes and injury aspects were mapped to AIS 2015 codes and localizers [3,4]. Some additional localizers had to be added so that injuries could be translated from the historical system [9].

	AIS	Localizer	Description	# ICS	Rank
1	541826.4	0000	Liver laceration-> parenchymal disruption <=75% hepatic lobe; multiple lacerations >3cm deep; burst injury; major [OIS IV].	1	1
2	450203.3	2031,1031,2032	Rib Cage fracture(s) without flail, any location unilateral or bilateral-> >=3 ribs [OIS II]. Left Rib 1, Right Rib 1, Left Rib 2	1	2
3	710402.1	1061	Skin/subcutaneous/muscle contusion; hematoma. Right Arm	1	3

Figure 2. VisualAID Injury Selection by AIS Codes page with data grid and embedded BioTab coding.

VisualAID and the Injury Causation Scenario

Integrating the Injury Causation Scenario into VisualAID represented one of the most dramatic facelifts to one of VisualAID's core pages. This, along with the integration of AIS 2015, represents the fourth major iteration of the application.

In preparation for a collaboration with NHTSA on the Injury Causation Scenario forms, ARL constructed a prototype capable of displaying any type of questions potentially needed on the ICS form and split those questions into any number of pages. To support quick changes to this form, a workflow was established that allowed the forms to be recreated and the database populated from a text file. This allowed ARL to easily create and edit multiple versions of the ICS forms, the pages on those forms, the questions on those pages, the answers to those questions, and any validation rules that a given form or question may have.

The Injury Selection by AIS Codes page received a facelift, changing the AIS code input field from a long plaintext field into an excel-like data grid as shown in Figure 2. The page was modified to be far more flexible, altering its contents to conform to a wide range of monitor resolutions. Animations of the displayed injuries were added to increase VisualAID's visualization capabilities.

An example of a simple ICS long form summary is shown in Figure 3. This window provides an overview of the AIS code, injury description, localizers, and causation coding for the injury.

After collaborating with NHTSA and determining the structure of each version of the ICS forms ARL rebuilt the forms and added them to the database. A workflow was created to allow ARL to move their database structure onto NHTSA's database, transitioning not only from one server to another but from one database technology to another.

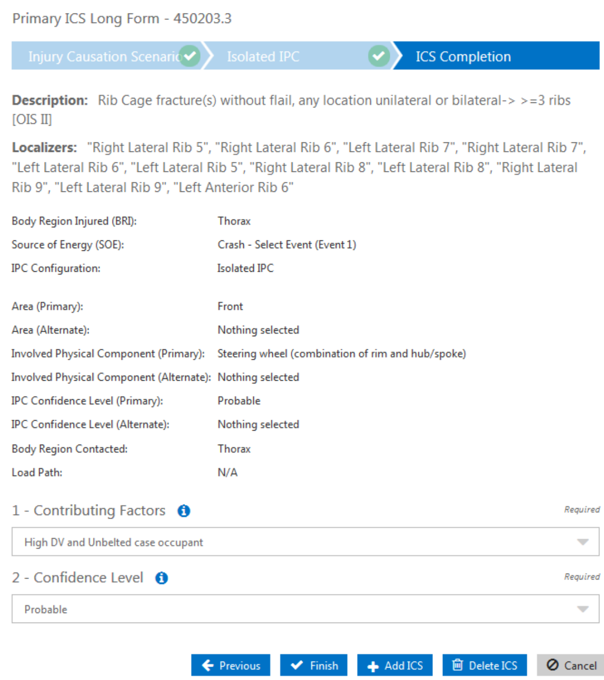

Figure 1. ICS Summary page example coding Injury Causation for rib fractures using the VisualAID interface.

VisualAID was altered to allow a new version of the application to be integrated into NHTSA's system. This version uses NHTSA user records' access privileges and was tailored to interact with the primary data entry software used in the investigation-based programs, the CISSWeb application. A link between the two applications was established so that vehicle occupant information could be securely passed from one database to another while maintaining a distinct separation between them. A user viewing a vehicle occupant in CISSWeb can now bring the relevant data into VisualAID, code that occupant's injuries, fill out his ICS form and return to CISSWeb where a summary of data entered will be displayed.

CONCLUSIONS

The Data Modernization Project was initiated to reaffirm NHTSA's position as a leader in investigation-based crash data collection. One of the chief outcomes was the replacement of NASS-CDS with the CISS program. CISS will have vast improvements over its predecessor in many areas such as sample design, IT infrastructure, and scene and vehicle documentation. Additionally, CISS will deliver stakeholders a much more robust set of injury data, which was one of the most widespread requests of the Data Modernization effort.

Three injury areas were addressed in the CISS redesign. First of all CISS, along with SCI and CIREN, have adopted an updated version of the AIS to score and classify injuries. This version keeps pace with the ever-evolving trauma field and will be the seventh version of AIS used by NHTSA since 1976.

Secondly, CISS and SCI have added ten data elements to describe injury causation scenarios for seriously injured occupants. The scenarios are a condensed version of the data traditionally collected in the CIREN program. Because of the large volume of weighted cases in CISS, the addition of this data will be a valuable resource to researchers as they identify crashworthiness areas where further improvements can be made.

Lastly, NHTSA's investigation-based programs will be using state-of-the-art software developed by the Department of Defense Army Research Laboratory to enter and present injury data. The interactive coding tool, VisualAID, includes error checks and conformance with the AIS dictionary during the initial entry of injury codes. The VisualAID version used by NHTSA will also describe injury causation scenarios, present injury data with increased detail, and provide data in a more user-friendly format.

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