An Update on the Crash Injury Research and Engineering Network (CIREN)

SAE Government Industry Meeting
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Human Injury Research Division
**Program history**

- **1990**: Hospital Studies (four sites)
- **2000**: Phase I (ten sites)
  - GM fuel tank settlement (dedicated funding)
  - Database structure created
  - CIREN created
- **2010**: Phase II (eight sites)
  - Formalized biomechanics coding created
- **Phase III (six sites)**
  - Peer review process and web-based case reviews initiated
- **Phase IV (five* sites)**
  - New NHTSA data system

*As of 2020*
NHTSA field data collection

- National Center for Statistics and Analysis (NCSA)
  - FARS - records-based census of fatal traffic crashes
  - CRSS - records-based sample of reported crashes
  - CISS - investigation-based statistical sample of tow-away crashes
  - SCI - targeted high-interest investigations
- Human Injury Research Division (Office of Vehicle Safety Research)
  - CIREN - injury causation-focused investigation-based purposive sample
CIREN field investigation

• CIREN follows the standard NHTSA field crash investigation approach with a few exceptions
  – Only access consented participants’ vehicles
  – Additional seat, steering, and restraint documentation
• Crash investigators undergo standard NHTSA training
<table>
<thead>
<tr>
<th>CIREN core functions</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Database</strong></td>
<td><strong>Knowledgebase</strong></td>
</tr>
<tr>
<td>• ~200 cases/year</td>
<td>• Physicians</td>
</tr>
<tr>
<td>• &gt;5,500 total cases</td>
<td>• Engineers</td>
</tr>
<tr>
<td>• Biomechanics coding</td>
<td>• Epidemiologists</td>
</tr>
<tr>
<td>• DICOM repository</td>
<td>• Crash investigators</td>
</tr>
<tr>
<td>• Shared design</td>
<td>• Industry</td>
</tr>
<tr>
<td>• Public access</td>
<td>• NHTSA</td>
</tr>
<tr>
<td><strong>Catalyst</strong></td>
<td><strong>Sentinel</strong></td>
</tr>
<tr>
<td>• Hypothesis generation</td>
<td>• Early problem identification</td>
</tr>
<tr>
<td>• Research initiatives</td>
<td>• NHTSA directives</td>
</tr>
<tr>
<td>• Real-world driven</td>
<td>• Real-time capture</td>
</tr>
</tbody>
</table>
Revised CIREN center roles

• Continued emphasis on in-depth review of injury causation
  – Split data collection and biomechanical analysis roles
  – The “enrolling” center investigates crash and collects data, then a “reviewing” center assigns injury causation
    • Medical Center - enrolls patients and investigates crashes
    • Engineering Center - conducts biomechanical analysis of cases
    • Integrated Center - performs both Medical Center and Engineering Center roles
• Joint case review meetings allow group discussion on all but the simplest cases
Competitive procurement

- Indefinite Delivery Indefinite Quantity (IDIQ) contract mechanism
- Base-level awards issued July 2017
- Occupant enrollment Task Order issued September 2017
  - Base year with four option years - through September 2022
  - Crash investigators underwent training at updated NHTSA Crash Investigation Training Academy in Oklahoma City, OK
- Future Task Orders anticipated
  - Research projects
  - Vulnerable road users
Current CIREN sites

**Medical Centers**
- Inova Trauma Center
  - University of Virginia Hospital
  - Winchester Medical Center
- University of Alabama at Birmingham
- University of Maryland, Baltimore

**Engineering Centers**
- Medical College of Wisconsin
- University of Virginia

**Integrated Centers**
- Emory University
- Wake Forest University
What’s new for CIREN?

- NHTSA Data Modernization
  - Crash Data Acquisition Network (CDAN)
  - Updated field investigation techniques
    - Total Station for scene and vehicle crush measurement
    - Rugged convertible tablet PCs allow in-field data entry
What’s new for CIREN?

• Inclusion criteria
• Injury coding
  – AIS 2015
  – Enhancements to BioTab (injury causation coding)
  – New coding application
  – CISS and SCI using similar approach
Inclusion criteria

• CIREN strives to enroll seriously injured occupants in “clean” crashes of newer model vehicles
  – Higher confidence in causation assessment
  – Helps identify potential problem areas with the latest designs
  – More suitable for analysis and reconstruction
• Purposive study design gives us this flexibility
  – We aren’t forced to take specific cases
• Minimize time spent on cases that won’t tell us very much
<table>
<thead>
<tr>
<th>Vehicle criteria</th>
<th>Restraint criteria</th>
<th>Occupant position</th>
<th>Injury severity</th>
<th>Vehicle criteria</th>
<th>Restraint criteria</th>
<th>Occupant position</th>
<th>Injury severity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Deployed frontal bag outboard (unbelted)</td>
<td></td>
<td></td>
<td>Deployed frontal bag (unbelted)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CY-6 (+SC)</td>
<td>3pt belt NGM + DFA</td>
<td>Row 1 outboard</td>
<td>AC †</td>
<td>MY2005+</td>
<td>Side torso and head bag deployment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MY1998+</td>
<td>3pt belt NGM</td>
<td>Rows 2+</td>
<td>AC n/a</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MY1998+</td>
<td>3pt belt NGM + DFA</td>
<td>Row 1 outboard</td>
<td>TLS n/a</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MY1998+</td>
<td>WCR</td>
<td>Any</td>
<td>Any n/a</td>
<td></td>
<td></td>
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<td></td>
</tr>
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</table>

Side Crashes – generally 8 o’clock to 10 o’clock or 2 o’clock to 4 o’clock impact angle with side plane damage

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<th>Injury severity</th>
</tr>
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<tbody>
<tr>
<td>CY-6 (+SC)</td>
<td>Any</td>
<td>Near-side any row</td>
<td>AC MY2005+</td>
<td>Side torso and head bag deployment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MY2005+</td>
<td>3pt belt NGM</td>
<td>Far-side any row</td>
<td>AC</td>
<td>Any</td>
<td>†</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MY2005+</td>
<td>WCR</td>
<td>Any</td>
<td>Any n/a</td>
<td></td>
<td></td>
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Rear – generally 5 o’clock to 7 o’clock impact angle with rear plane damage

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<th>Injury severity</th>
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<tbody>
<tr>
<td>n/a</td>
<td>CY-6 (+SC) 3pt belt</td>
<td>Any</td>
<td>AC</td>
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Rollover Crashes

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<td>n/a</td>
<td>CY-6 (+SC) 3pt belt</td>
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Success Cases* – high-energy crashes with minor or no injury to case occupant

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<tr>
<td>n/a</td>
<td>CY-6 (+SC) 3pt belt</td>
<td>Any</td>
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AC=adult conventional, CY=calendar year, DFA=deployed frontal airbag, MY=model year, NGM=no gross misuse (lap and shoulder belt positioned over occupant as designed), SC=sisters and clones, TLS=thoracolumbar spine, WCR=wheelchair-seated occupant using adaptive restraint

* requires NHTSA pre-approval, must prove other properly-restrained occupants sustained serious injury

† same criterion as in Preferred
Inclusion criteria

• Admission to CIREN trauma center or partner site (direct or transfer)
• Injury severity (AIS 2015)
  – One AIS 3+
  – Two AIS 2 in different body regions
  – Some clinically significant AIS 2 qualify (due to demotion in newer AIS)
• Newer vehicles - six years or less in age generally
  – Sisters and clones (accounts for generational changes)
  – Some special exceptions
• Emphasize cases with high research value
Injury coding

- Visual Anatomical Injury Descriptor (developed by US Army Research Lab)
- AIS 2015 coding engine with visualization
- Customized for NHTSA to include BioTab injury causation coding
  - CISS, SCI and CIREN utilize same core variables and attributes
  - CIREN includes evidence and mechanism variables
Modified Injury Case "test1"
Injury Count: 9, TSP: 001242.4, MAIS: 4, ISS: 34, NISS: 34, mpFCI: 1

1. [110402.1 0100] Scalp; contusion; subgaleal hematoma if >6 months old; Right
2. [441408.3 01ES, 01ET] Lung; contusion; unilateral; major; 1 or more lobes; Right, Lung Lobe 1; Right, Lung Lobe 2
3. [450202.2 1033, 1034] Rib Cage; fracture(s) without flail; any location unilateral or bilateral two ribs [OIS I]; Right Anterior / Frontal, Rib 3; Right Anterior / Frontal, Rib 4
4. [410402.1 0170] Skin/subcutaneous/muscle; contusion; hematoma; Right, Chest
5. [752211.2 0200] Radius fracture; Radius shaft fracture; Left
6. [856151.2 01NT, 01NU] Pelvic ring fracture, posterior arch intact [stable fracture]; Right, Ilium Bone; Right, Ischium Bone
7. [853252.3 0100] Femur fracture; Femur Shaft fracture; simple; spiral; oblique; transverse; Winquist I; open; Right
8. [857361.2 0100] Calcaneus fracture; fracture line into one joint surface; Right
9. [140628.4 0100] Cerebrum [includes basal ganglia, thalamus, putamen, globus pallidius]; diffuse axonal injury (DAI); NFS; Right
BioTab injury causation coding revisions

• Since initiated in 2005, over 2,900 cases (>24k injuries) coded using the formalized approach
• Protocol has evolved due to lessons learned
  – Revised attribute lists for evidence and contributing factors
  – Revised rules/configurations for Involved Physical Components
    • Isolated: Generally one, maybe adjacent component
    • Tandem: sequential or stacked components (new)
    • Critical: multi-point contact
  – BioTab generally described in Schneider et al 2011, but expect more detail on the current approach in another forum
CIREN data access

- Case viewer
  - XML-based
  - Query feature
  - New URL soon
- SAS data sets
  - Crash portion like NASS-CDS
  - Data dictionary
  - 2017 release: 2,104 cases

- Cases enrolled in Phase IV will be accessible separately from the “legacy” cases - anticipated access summer 2018
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www.nhtsa.gov
(then navigate to Crash Injury Research or just search for “NHTSA CIREN” on Google)