CIREN
Improved Injury Causation Coding Methods; An Initial Review

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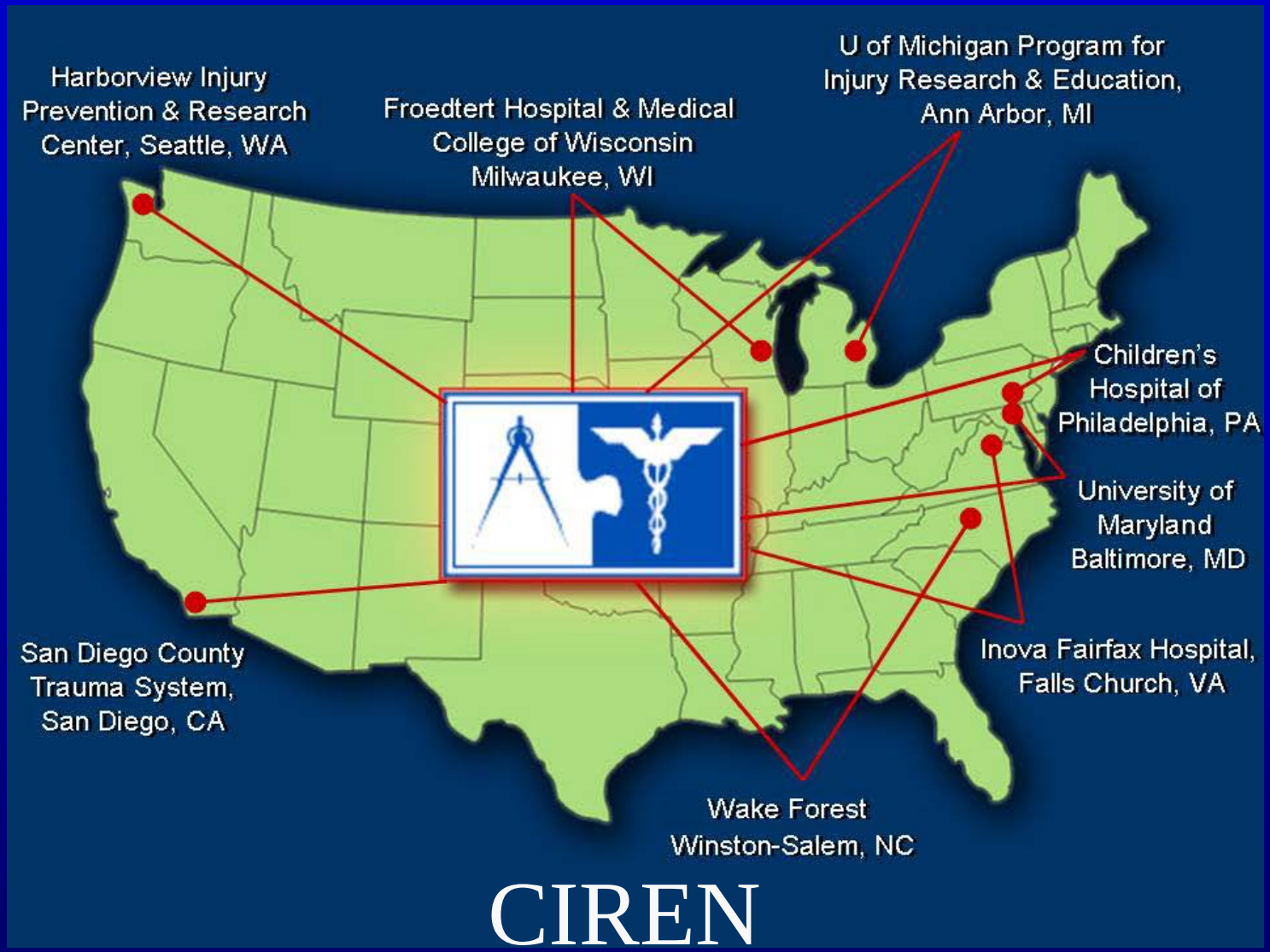
Crash Injury Research Engineering Network



ORIGINAL CRASH DATA

- Environment
  - Roadway, weather, traffic control devices and so on…
- Vehicle
  - Make, model, year, weight, crush measures, AB location and deployment, intrusion measures, tire tread depth, number of engine cylinders, tire pressure and so on…
- Occupant
  - Gender, race, age, HT, WT, vitals, GCS, hospital days, blood given, seat position, posture, belt status, mortality, admit and dc times, ABG, AIS injury code(s), injury aspects, source of injury – and that's about it.

Data Out of Balance

Previous Model Data Issues

- "Broad Brush" conclusions to causation
  - Multi event crash
    - All injury assigned to RANK 1 event
  - No ID on injury from injury
    - Some injuries are a result of another injury (double dip)
  - Intrusion not related
    - Factor or Critical to causation (component level)
  - Contributing factors relationship
    - Osteoporosis, obesity, seat belt interaction…
    - Often documented and discussed – not linked
  - Single component source
    - Are all injuries caused by single source contact

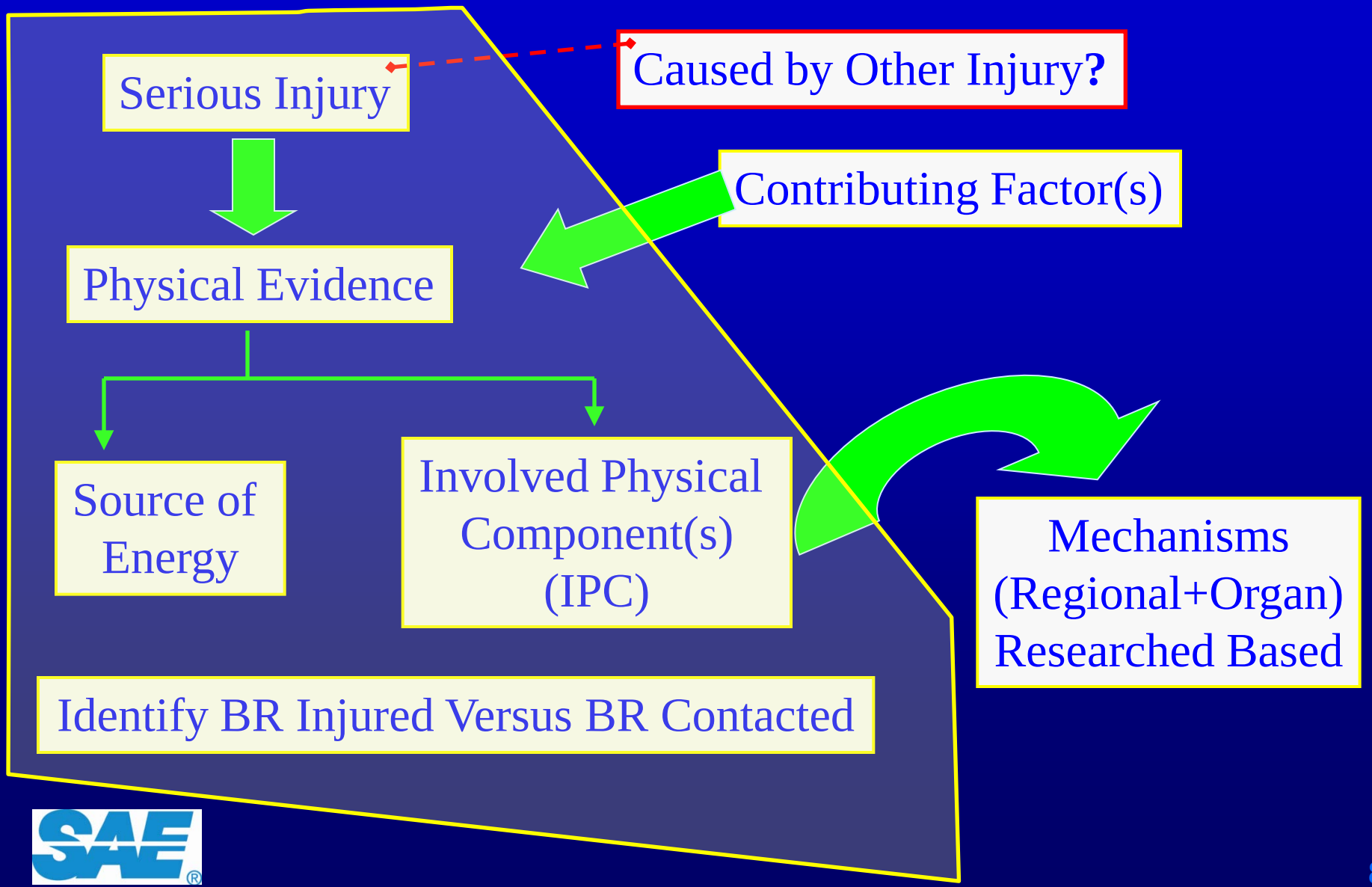
Data Issue

- Uniformly capture the multidisciplinary CIREN discussion that occurs on every significant injury in every case.
  - Medical
  - Engineering
  - Crash Investigation
- **Apply peer reviewed research**

Need

- Design a method by which causation evidence and factors are uniformly related to an applicable injury.

Bio-Tab Injury Causation Coding



Innovation and Improvement

- Complete medical documentation access and appropriate interpretation
  - Injury pattern and kinematic comparisons
    - Fracture patterns, soft tissue contacts, injury location
  - “Damage pattern” for the occupant matched to the damage pattern on the vehicle
  - Radiology access (image and report) and expert interpretation
  - Comorbidities accurately associated to causation
    - Direct relationship per injury
    - Not per occupant
  - Injury relationship to impact biomechanical research

Innovation and Improvement

AIS Body Regions
- Head
- Face
- Neck
- Thorax
- Abdomen
- Spine
- Up Extremity
- Low Extremity

Bio-Tab Body Regions
- Head/Face
- Neck
- Shoulder
- Arm
- Elbow
- Forearm
- Wrist Hand
- Thorax
- Abdomen
- Cervical spine
- Thoracic spine
- Lumbar spine
- Pelvis
- Hip
- Thigh
- Knee
- Leg
- Ankle
- Foot

Why?

- Define as -Joints and Segments
- Ability to determine and code load paths

Innovation and Improvement

- Directly relate injury mechanism(s) to established peer-reviewed literature.
  - Approved mechanical/biomechanical
  - Approved medical
- Match life to lab

Balanced Data

Old versus New

AIS 6502343

Cervical spine vertebral body fracture (C4)

- Source – Belt restraint
- Indirect contact injury

AIS 6502343

Cervical spine vertebral body fracture (C4)

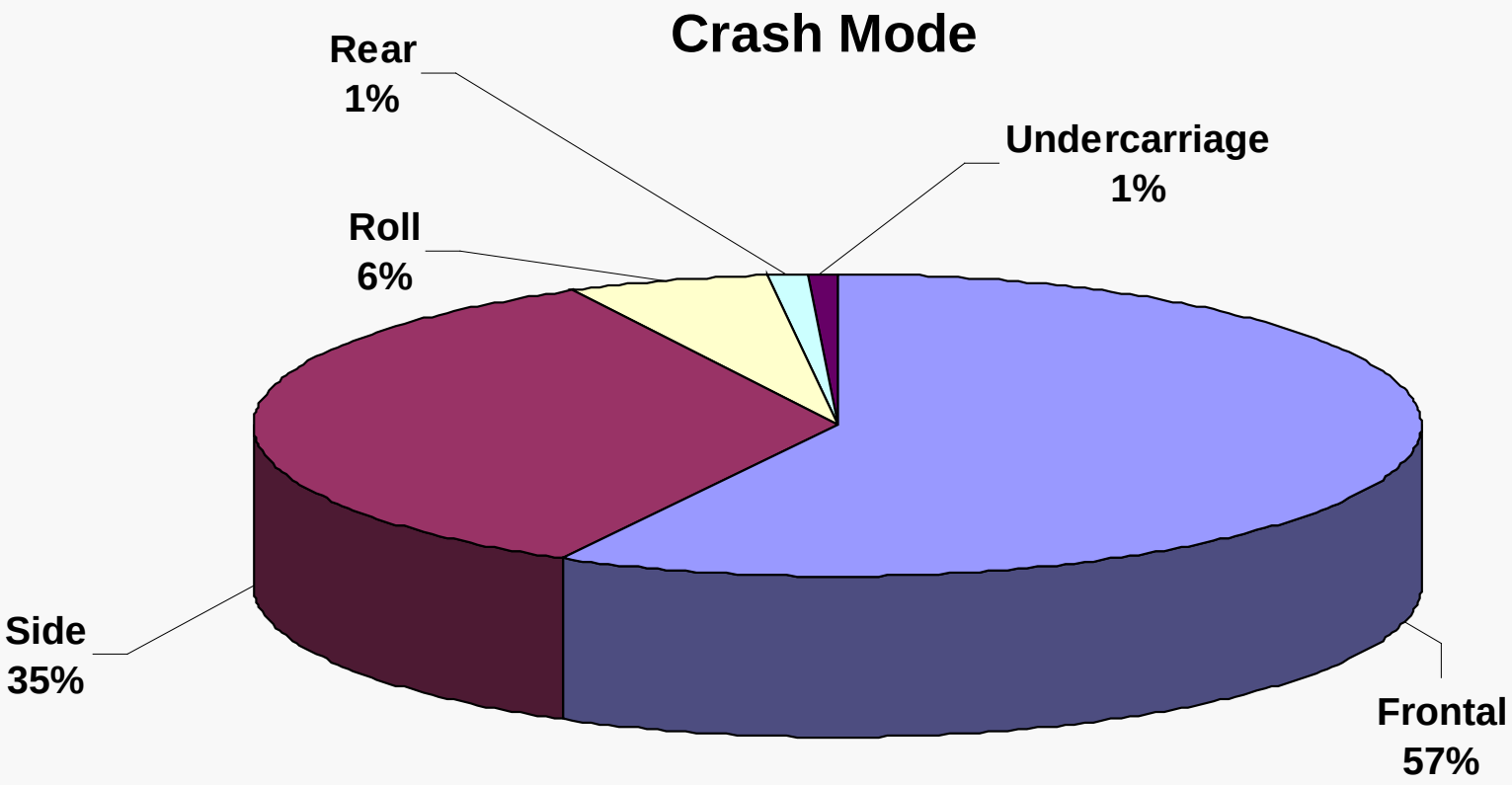
- Source of Energy – Crash (event specific)
- IPC – Belt restraint
- Load path – Thorax / Thoracic spine / Cervical spine
- Contributing factor – Comorbidity of ankylosing spondylitis
- Regional mechanism – Flexion and compression
- Evidence – Loaded belt, chest/abd belt contusion, anterior column compression fx w/post ligament disruption

Increase Confidence with Evidence

- 81 yr old driver (belted/5'10")
- 03 Ford Focus (frontal w/jumped curb)
- AIS3 C-spine fx (C4-C7, T5)
- DV=14 kph / 8.7 mph

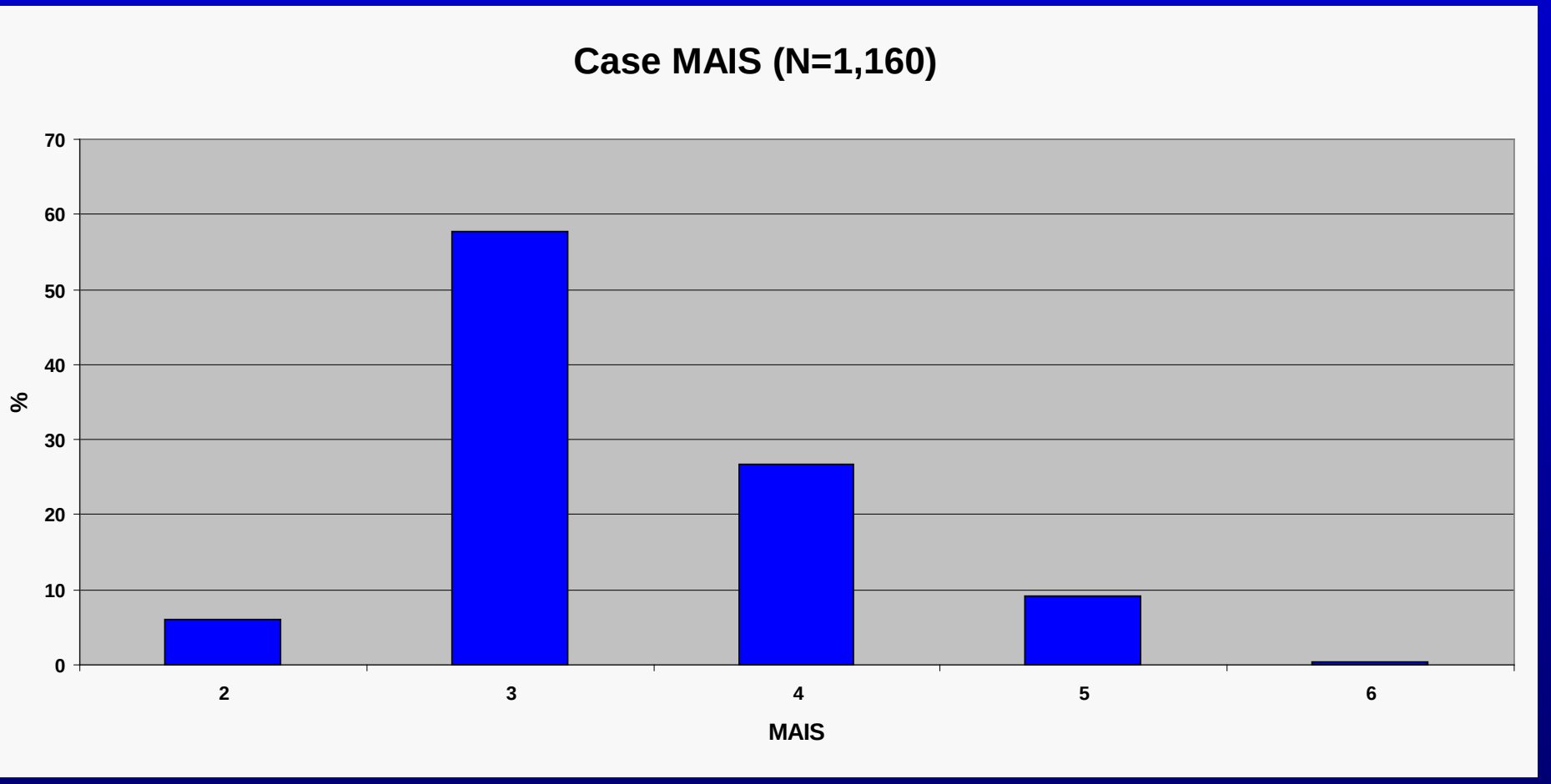
- Belt loading w/ flexion?
  - Not supported
- Head contact= compression w/ extension of the C-spine
  - Scalp contact (under hair)
  - Posterior spine fxs
  - Confidence - Improved

Current Bio-Tab Population



- Cases coded = 1,160

Current Bio-Tab Population



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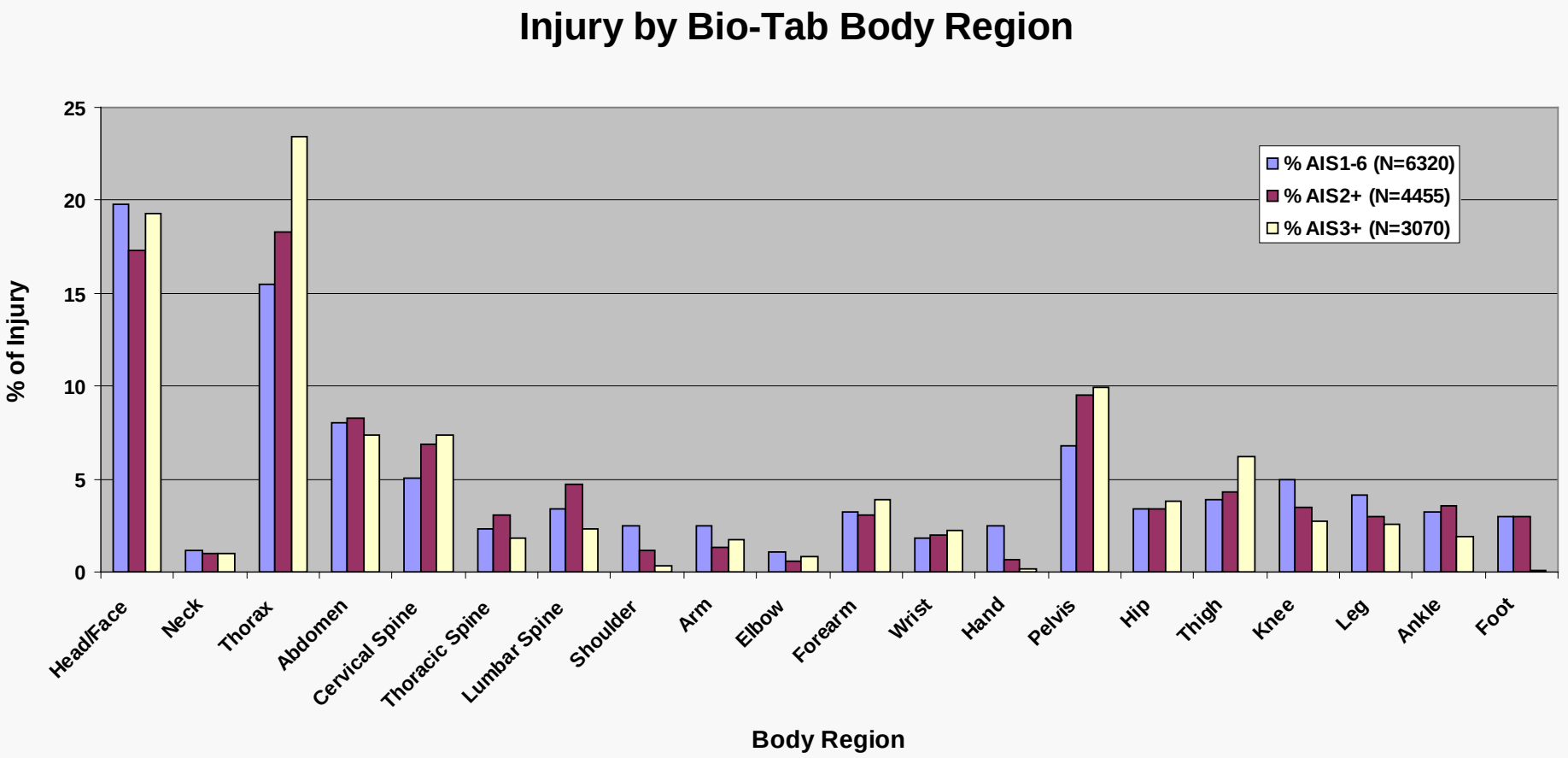
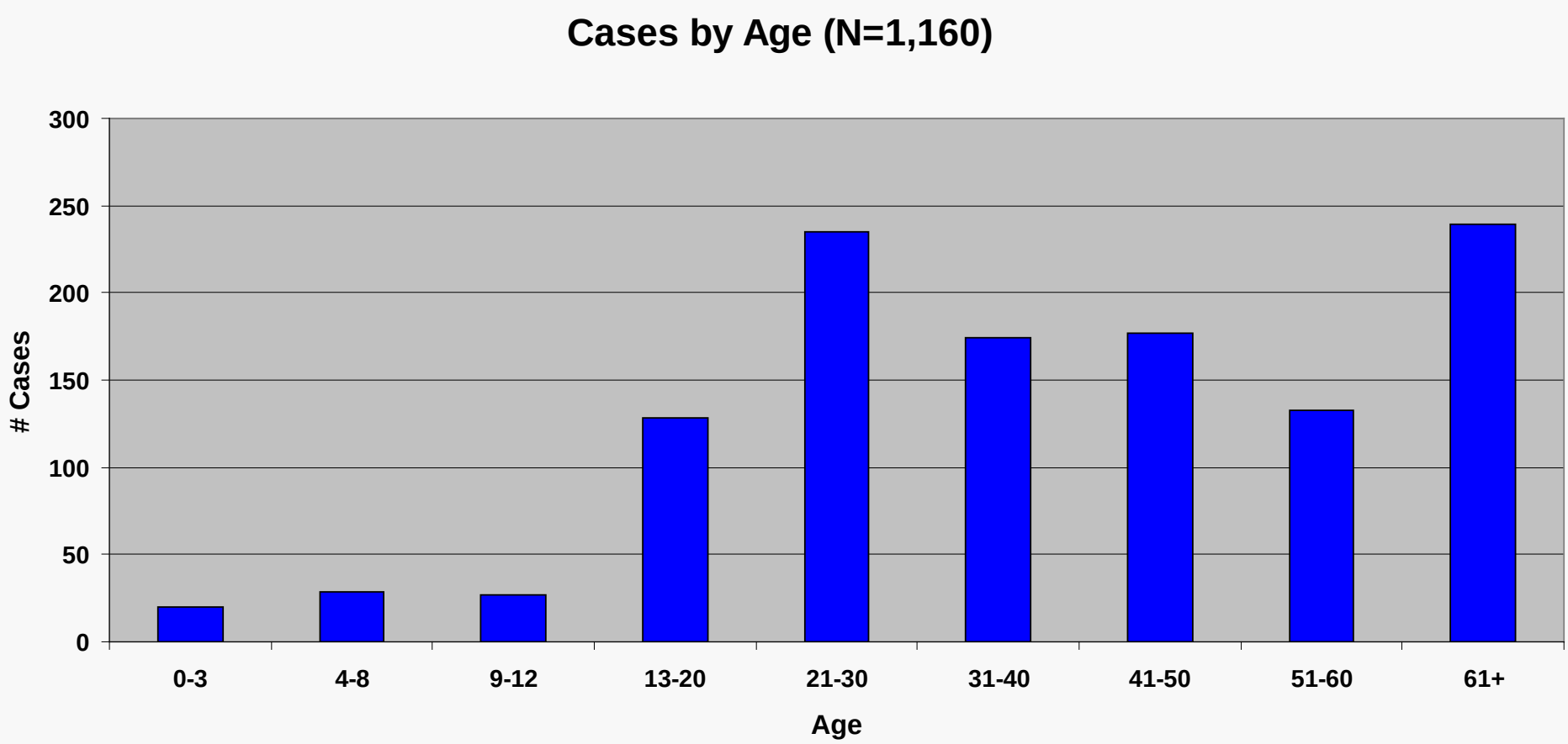
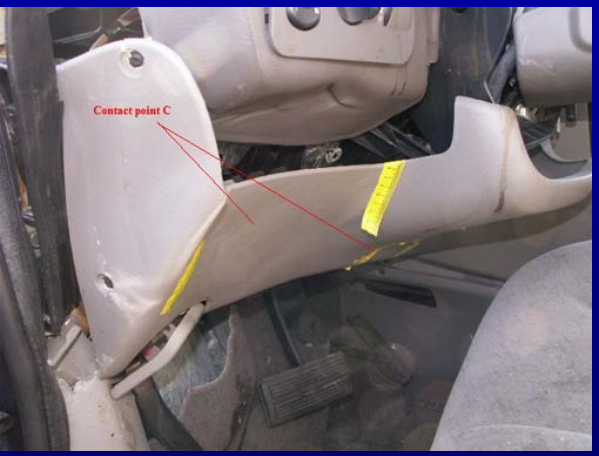
Injury Severity



Population Age



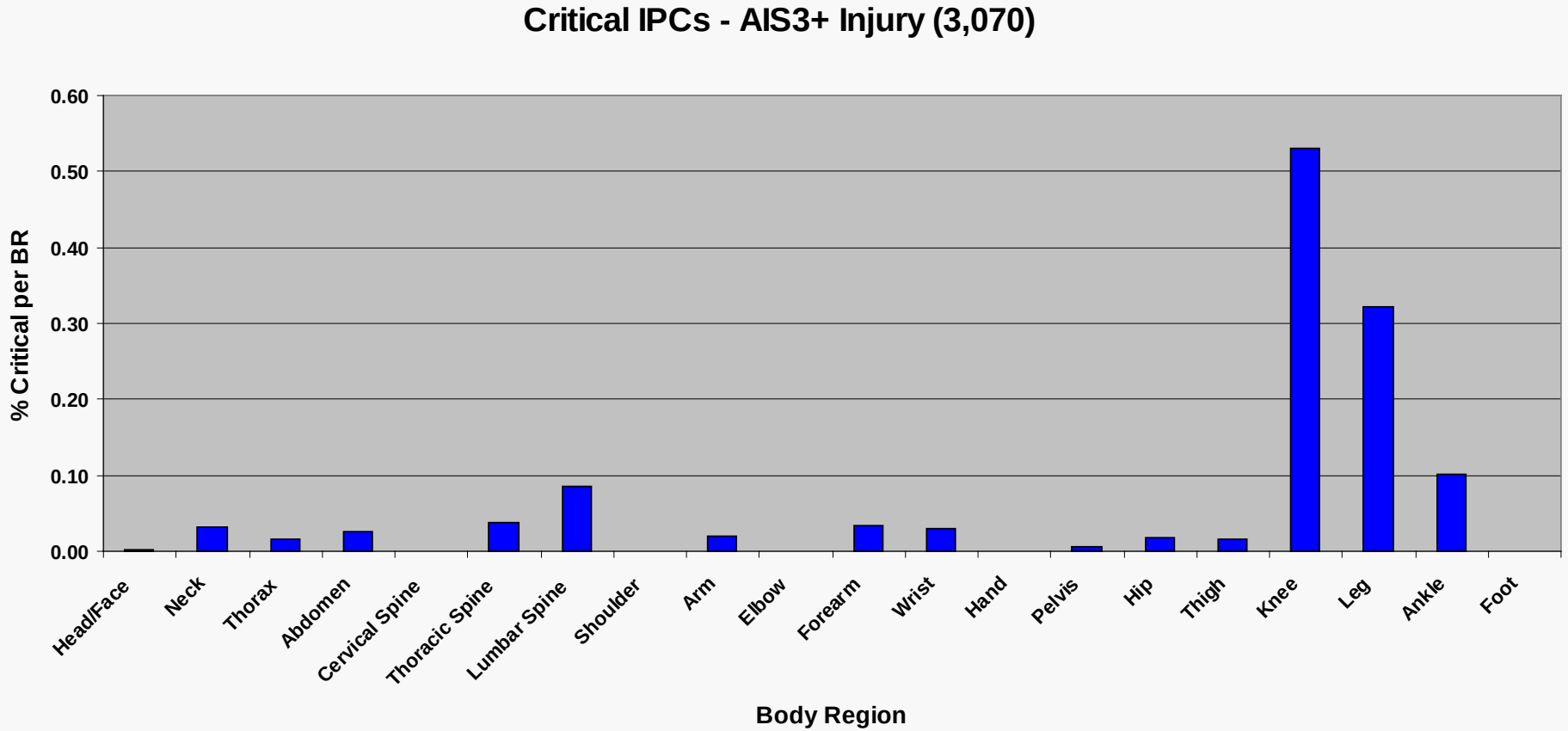
Multi-Contact Causation Example



- 2003 Dodge Caravan (frontal)
- Open Rt. tibial shaft fx
- Rt. knee contact to KB
- Rt. foot contact to TP/Pedal
- Intrusion (as well)

Multi-Source Data

6% of all AIS3+ injury w/ two “critical” IPCs

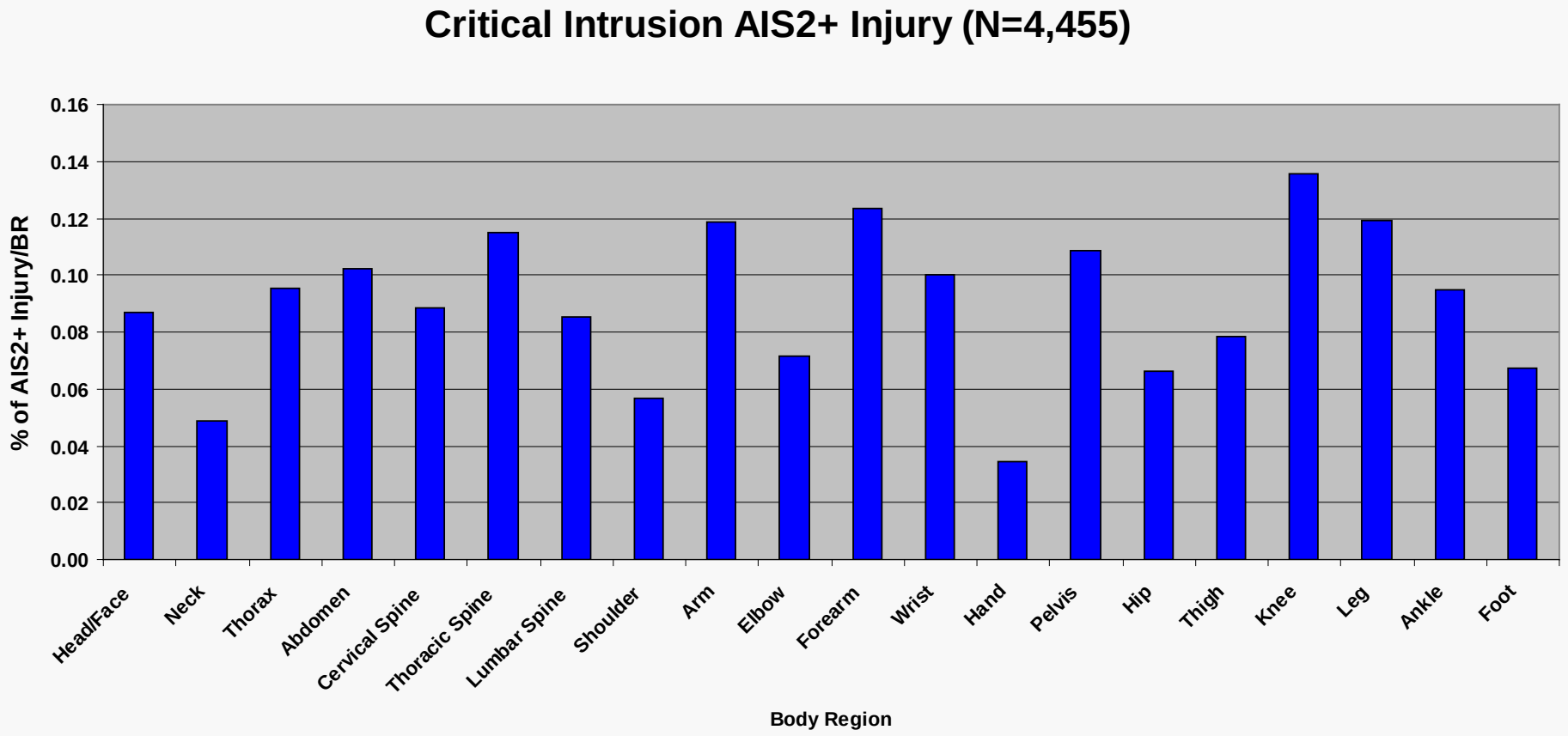


Critical Intrusion Example

- 2007 Toyota Yaris (frontal)
- 25 yr old male driver (belted)
- 5’ 10”
- Open Lt. tempo-parietal skull fx
- A-pillar intruded 23 cms

Critical Intrusion Data

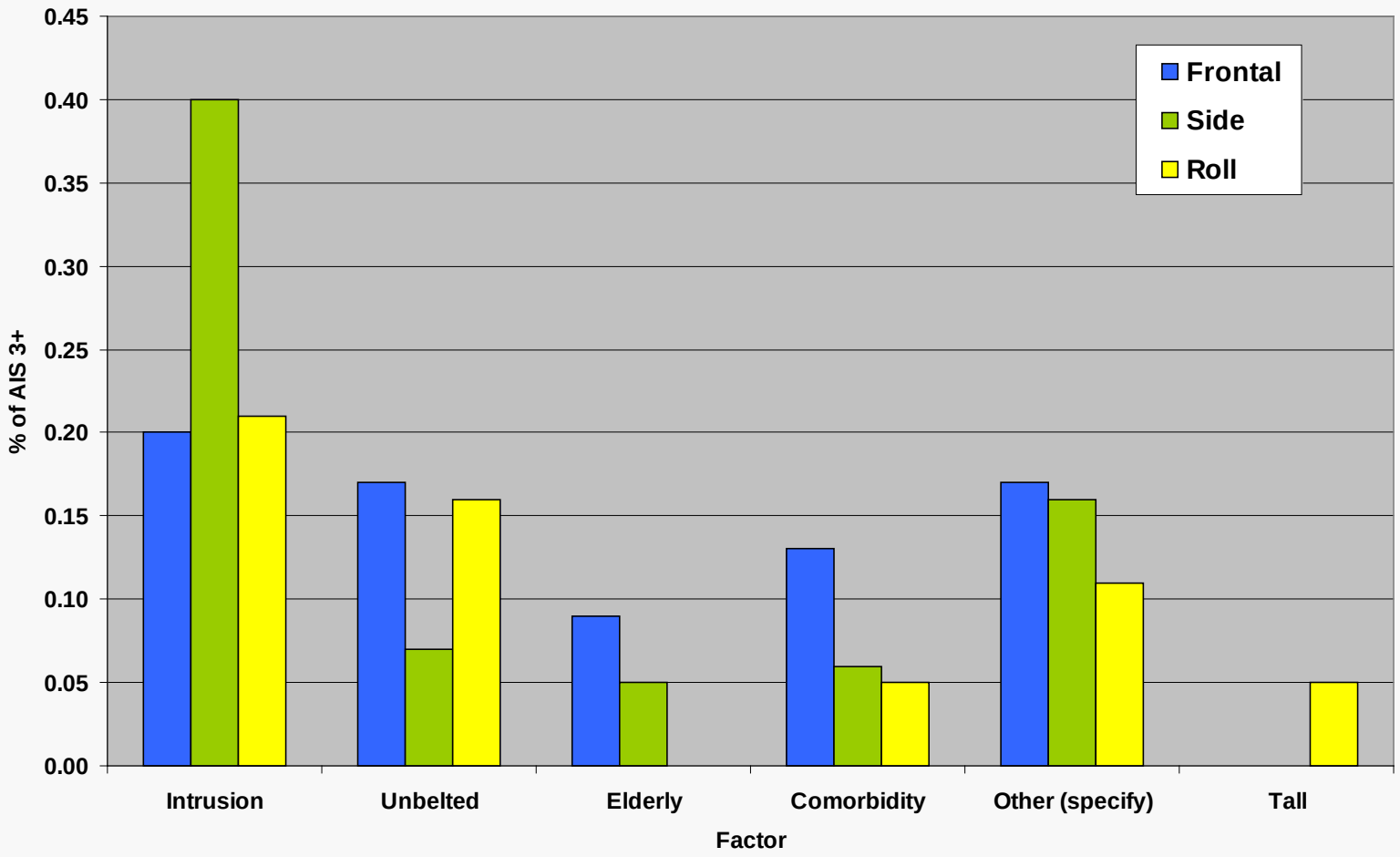
9% of all AIS2+ injury had “critical” intrusion



Contributing Factors (Top 5 of AIS 3+)

BR	1*	2*	3	4	5
Thorax (N=718)	Intrusion 26%	Other (specify) 17%	Unbelted Case Occupant 15%	Elderly – General 11%	Comorbidity – pick 10%
Head/Face (N=591)	Intrusion 27%	Other (specify) 15%	Unbelted Case Occupant 10%	High DV 9%	Posture 7%
Pelvis (N=305)	Intrusion 43%	Other (specify) 18%	Comorbidity – pick 14%	Unbelted Case Occupant 11%	Elderly – General 7%
Abdomen (N=228)	Intrusion 22%	Other (specify) 17%	Unbelted Case Occupant 15%	High DV 10%	Posture 9%
C-spine (N=228)	Intrusion 26%	Other (specify) 22%	Unbelted Case Occupant 14%	Elderly – General 13%	Comorbidity – pick 13%

Bio-Tab Data Contributing Factors



Conclusions - Structure

- Each significant injury sustained by an occupant can have factors and evidence coded and related individually.
- Full access to the medical record and applicable experts is required.
- Improved understanding of occupant and vehicle interaction results.

Conclusions - Data

- Nearly 1,200 cases coded
- Over 3,000 AIS3+ injuries coded
- Critical IPC's are isolated to knee/lower leg injury
- Critical intrusion observed in majority of BR's (low %)
- Intrusion and Belt status universal contributing factors to severity
- Review of CF "Other (specify)" required
- No research cited can be an indicator of limit biomechanical research knowledge
- **Reduce** assumption, case loss and imputation in later research

Thank You

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