Crash Injury Data for Automotive Engineers

Lessons from Real Life

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Motor Vehicle Crashes

- 1,000,000 deaths per year worldwide

- No. 2 global health problem by the year 2020 – W.H.O.
Crashes in the USA

40,000 killed
(115/day, 1/13 minutes)

3,000,000 injured
Crash Injury for Engineers:

Femur load
HIC
TTI
TTI
Real life!

It can’t be replicated by dummies and standardized tests.
Automotive Safety

• It’s not about numbers, forces, percentages.
• It’s about people. Human loss and suffering.
People don’t sit still and behave logically.

Real life crash conditions may not resemble those in the crash laboratory.
Case 1

- Case Vehicle: 1995 Ford Taurus
- Object Struck: Tree
- Impact Type: Offset Frontal (34% VOL)
- PDOF: 0
- CDC: 12FDEW3
- Direct Damage: 46 cm
- Max Crush: 81 cm
Case Vehicle: 1995 Ford Taurus
Object Struck: Tree

1 = Scuff mark and vanity mirror broken
2 = Scuff mark, key top broken and blood deposit
3 = Visible dent
4 = Visible dent
Left forehead laceration
Left frontal bone fracture
Soft tissue swelling
The population is comprised of a diverse collection of individuals. There are few 50th percentile males.
A

- Female, 165 cm, 77 kg
- Age = 27 years

B

- Female, 165 cm, 78 kg
- Age = 78 years
A

- Female, 165 cm, 77 kg
- Age = 27 years

Bone density/quality

B

- Female, 165 cm, 78 kg
- Age = 78 years
C

- Female, 168 cm, 50 kg
- Age = 18 years

D

- Female, 165 cm, 49 kg
- Age = 72 years
C
- Female, 168 cm, 50 kg
- Age = 18 years

D
- Female, 165 cm, 49 kg
- Age = 72 years

Bone Density/Quality
Muscle Mass/Quality
C

- Female, 168 cm, 50 kg
- Age = 18 years

D

- Female, 165 cm, 49 kg
- Age = 72 years
E
- Male, 183 cm, 86 kg
- Age = 38 years

F
- Male, 183 cm, 80 kg
- Age = 79 years
7A
- Male, 183 cm, 86 kg
- Age = 38 years

7B
- Male, 183 cm, 80 kg
- Age = 79 years
7A
- Male, 183 cm, 86 kg
- Age = 38 years

7B
- Male, 183 cm, 80 kg
- Age = 79 years

Bone Density
Muscle Mass/Quality
Fat Mass/Distribution
H
- Male, 38, 178 cm
- Weight = 73 kg

G
- Male, 35, 180 cm
- Weight = 114 kg

Fat Mass/Distribution
Safety systems effectiveness would be improved if they were tuned for the occupant, like skis for skiers and drugs for patients.
Lesson from medicine: Treat the patient, not the disease.

Treatment and prevention must be customized: surgery, chemotherapy, narcotics, antibiotics.
More lessons from medicine

• One can’t cure or prevent every disease.
• Problems and solutions need to be prioritized.
• Each intervention has a different risk/benefit ratio.
• Short and long-term outcome of each intervention must be assessed.
Automotive Safety

- Vehicles are safer than they have ever been.
- Laboratory testing has led to great improvements in safety.
Laboratory findings must be validated with real life observations.
CIREN

• Thousands of data elements
• Detailed injury analysis
  – Severity
  – Source
  – Mechanism of injury.
• Medical specialists, automotive engineers, bioengineers, crash investigators…
It’s difficult to solve a problem without understanding its mechanism.

Typhoid
Polio
Smallpox
There is nothing permanent except change.

_Heraclitus_

“The only steady state is death.”
Increase in the Number and Percentage of Older People

<table>
<thead>
<tr>
<th>Year</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>(150,216,000)</td>
</tr>
<tr>
<td>1980</td>
<td>(227,658,000)</td>
</tr>
<tr>
<td>2000</td>
<td>(267,955,000)</td>
</tr>
<tr>
<td>2030</td>
<td>(304,807,000)</td>
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</table>
Involvement, Injury, and Fatality Rates
(rates per vehicle miles of travel)

Rate

Age Group


19 24 29 34 39 44 49 54 59 64 69 74 79 84

Involvement Rate
Serious Injury Rate
Fatality Rate
Vehicle fleet changes as truck sales increase

Vehicle Incompatibility:
Mass, Stiffness, Geometry
In a changing world

• Real-life human data is irreplaceable.

• Reality checks are absolutely essential since all assumptions/approximations are suspect.

• *Golden opportunity at present with the recent introduction of innovative safety systems.*
Time is of the essence!

To save injured people.
To make cars safer.
Trauma Deaths

The graph illustrates the distribution of trauma deaths over time. The x-axis represents time after injury, divided into hours and weeks. The y-axis represents the number of deaths.

- **Immediate deaths** are shown as a sharp decrease in the first few hours.
- **Early deaths** occur within the first few days.
- **Late deaths** are spread over several weeks.

The curve shows that the majority of deaths occur in the immediate and early stages, with fewer deaths in the late stages.
When time is of the essence, Communication is critical.
Trauma Deaths

• There are many ways to die:
  Airway - face, neck
  Breathing - lung, chest wall
  Circulation - heart, blood vessels, organs
Golden Hour

Notification

Extrication & Transport

Resuscitation

Diagnostic Evaluation

Treatment

Record of the occupant’s body’s response to the crash. Anatomic detail, three dimensional. CIREN subjects are real-life crash dummies.
CIREN

- Engineers, physicians, crash investigators, regulators.....
- Thousands of data elements
- Detailed injury analysis
  - Severity
  - Source
  - Mechanism of injury
CIREN

Not only data....but mutual understanding and communication...
People working together to save people.