# Saving Lives Through Data

## World Health Day 2004

Grand Rounds

Singapore General Hospital

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**National Highway Traffic Safety Administration**

# The Effect of Public Policies on Mitigating the Burden of Injuries

# Motor Vehicle Injuries:

*The* leading cause of injury, worldwide!

# Worldwide

- **5 million injury deaths each year**
- **Road traffic collisions is the leading cause**

# Worldwide 1998

- **1.2 million people killed in car crashes**
- **20% of total for all injury deaths**

# Yearly Global Cost

**$518 billion (USD)**

# Leading Causes of Death

| 1998 | 2020 |
|---|---|
| 1. Lower respiratory infections | 1. Ischaemic heart disease |
| 2. HIV/AIDS | 2. Unipolar major depression |
| 3. Prenatal conditions | *3. Road traffic injuries* |
| 4. Diarrhoeal disease | 4. Cerebrovascular disease |
| 5. Unipolar major depression | 5. Chronic obstructive pulmonary disease |
| 6. Ischaemic heart disease | 6. Lower respiratory infections |
| 7. Cerebrovascular disease | 7. Tuberculosis |
| 8. Malaria | 8. War |
| *9. Road traffic injuries* | 9. Diarrhoeal disease |
| 10. Chronic obstructive pulmonary disease | 10. HIV/AIDS |

Source: Global Burden of Disease, WHO, 1996

- Injury is a disease
- Public policy seeks the cure

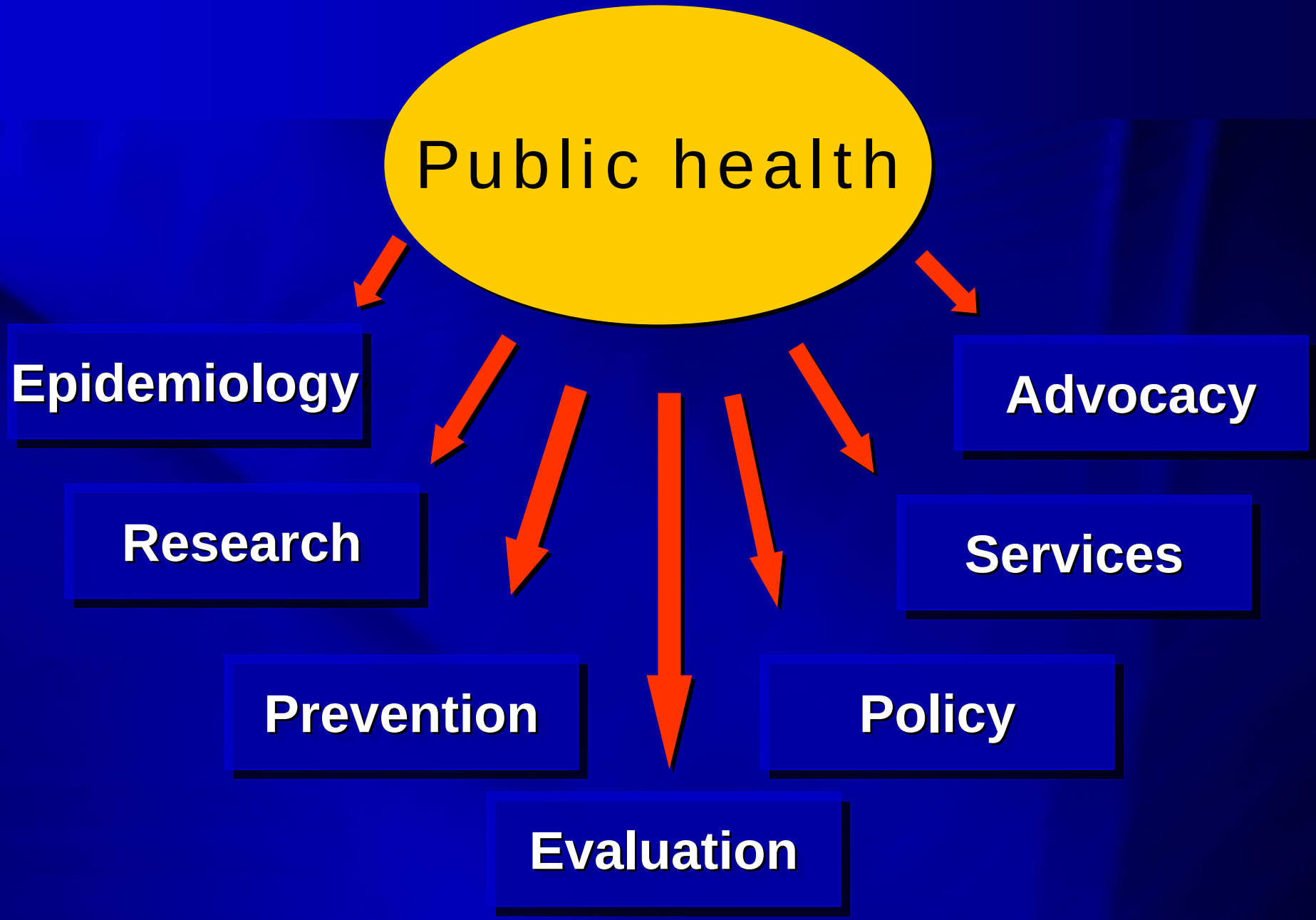
# Challenges

- Requires multi disciplinary approach
- Misconceptions
- Lack of awareness

- Weak political interest

- Low Funding

- No prevention


Public health
Epidemiology
Research
Prevention
Evaluation
Policy
Services
Advocacy

# What is Needed

- **Data on magnitude and consequences**
- **Research on interventions, effective in developing countries**
- **Widespread implementation of interventions**
- **Capacity building**
- **Mobilize political leadership**

# NHTSA Data Collection Systems


- **FARS – Fatality Analysis Reporting System**


- **NASS – National Automotive Sampling System**


- **State Data Systems**

# FARS Data Sources


- Police crash reports
- State files
  - Vehicle registration
  - Driver licensing
  - Highway department
- Vital statistics
- Death certificates
- Coroner/medical examiner reports
- Hospital medical records
- Emergency medical services reports

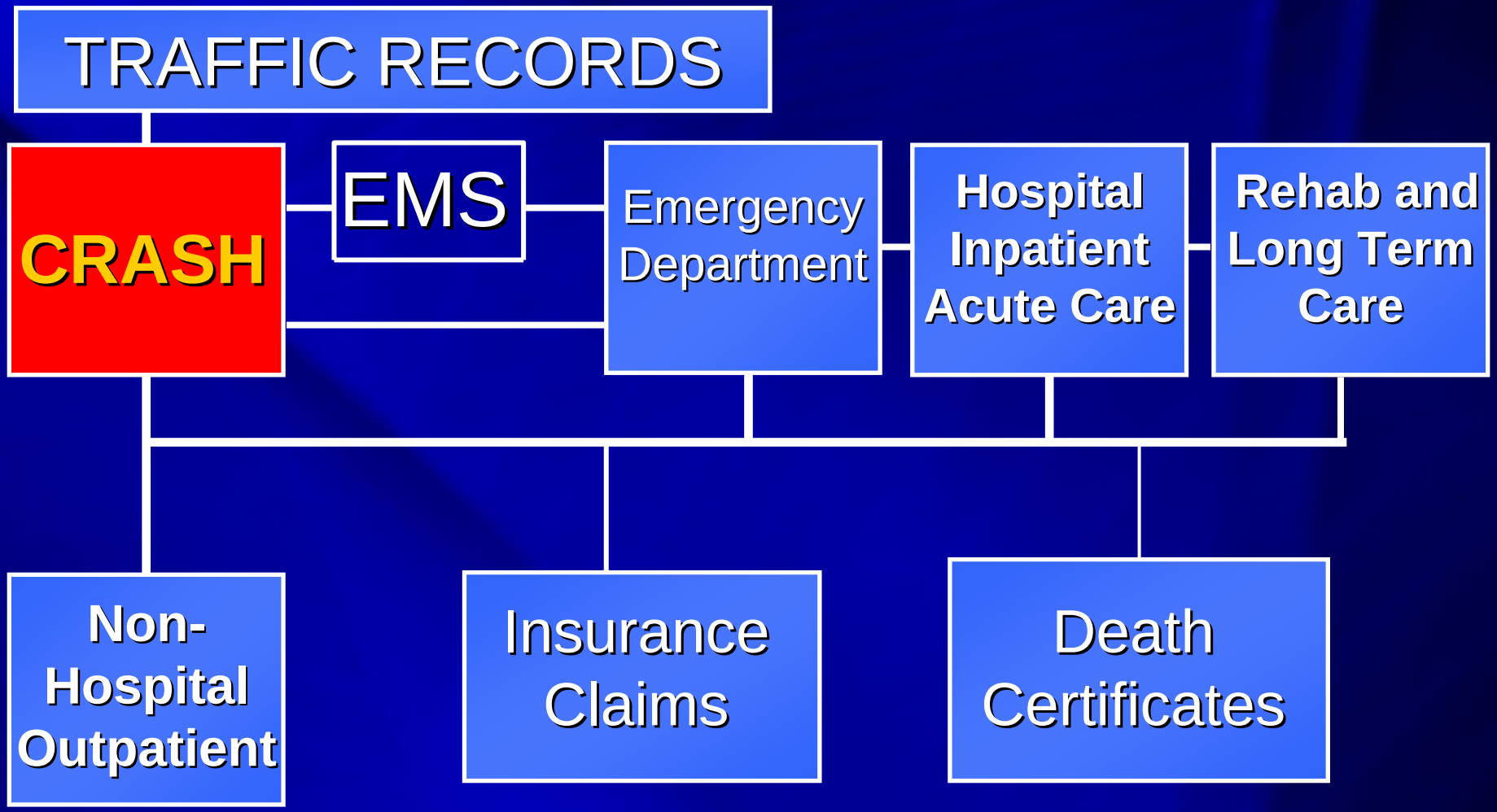
# NASS Characteristics

- Nationally representative sample design
- Data collection supervised with quality control
- Allows monitoring of trends
- Provides data on police-reported crashes
- Detailed crash investigations

# State Data System

- Police reported crashes
- 25 states
- Examples of data use
  - Vehicle recalls
    - Nissan Altima
    - Ford Explorer
    - Kia Sportage
    - Ford Focus
- Static stability factor

# Crash Outcome Data Evaluation System - CODES



# 1991 - ISTEA (Intermodal Surface Transportation Efficiency Act)

- **Mandated report to Congress on the benefits in motor vehicle crashes of:**
  - **Safety belts**
  - **Motorcycle helmets**
- **To reduce:**
  - **Mortality**
  - **Morbidity**
  - **Injury severity**
  - **Health care costs**

# CODES Helmet Results Report to Congress

- **Benefits of motorcycle helmets**
  - **35% effective in preventing fatality**
  - **67% effective in preventing brain injury**
- **Motorcycle helmets save money**
  - **About $15,000 saved during first year if brain injury prevented**

# Data Drives

- **Policy**
- **Practice**

# CIREN

- **Collaboration of engineers, medical clinicians, and others with crash data (e.g., police, EMS, automakers)**
- **In-depth study of car crashes to improve car design and improve care of trauma patients**

# CIREN Network

# CIREN

- Fifty cases a year for each center
- Crash data
  - Approximately 650 data elements
- Medical data
  - Approximately 250 data elements

# Inclusion Criteria

- Late model year
- Frontal (full or offset), restrained
- Side impact, unrestrained
- Rollover, if less than 2¼ turns
- All children, un/restrained
- AIS severity of 3 or greater

# Medical and Crash Data are Combined and Reviewed

# CIREN

- Research program combining medical data with crash data
- CIREN data can be used:
  - To anticipate specific injuries associated with specific crashes
  - To facilitate triage and transport
  - To decrease time to diagnose injuries

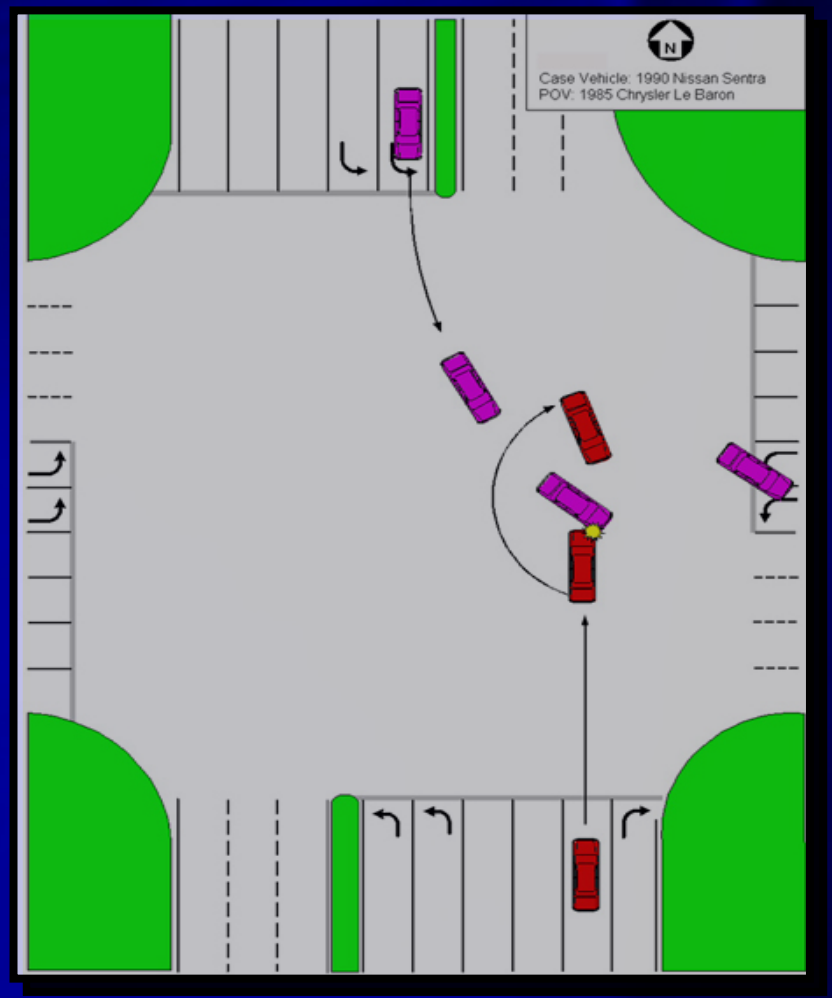
# Saved Time = Saved Lives

- **Utilizing crash mechanisms to identify injury patterns**
- **Reduce time to diagnose injuries**
  - **Faster definitive treatment**
  - **Better outcomes**
- **Reduce chance of missing occult injuries**

# Field Opportunities to Inform Medical Community

- **2 – Point Safety Belts**
- **Moderate crash**

**Right Front Damage**



# Field Opportunities to Inform Medical Community

- **’90 Nissan Sentra**
- **Delta V 25 mph**
- **Max crush: 22”**
- **Right frontal offset**
- **Lap belt only worn**

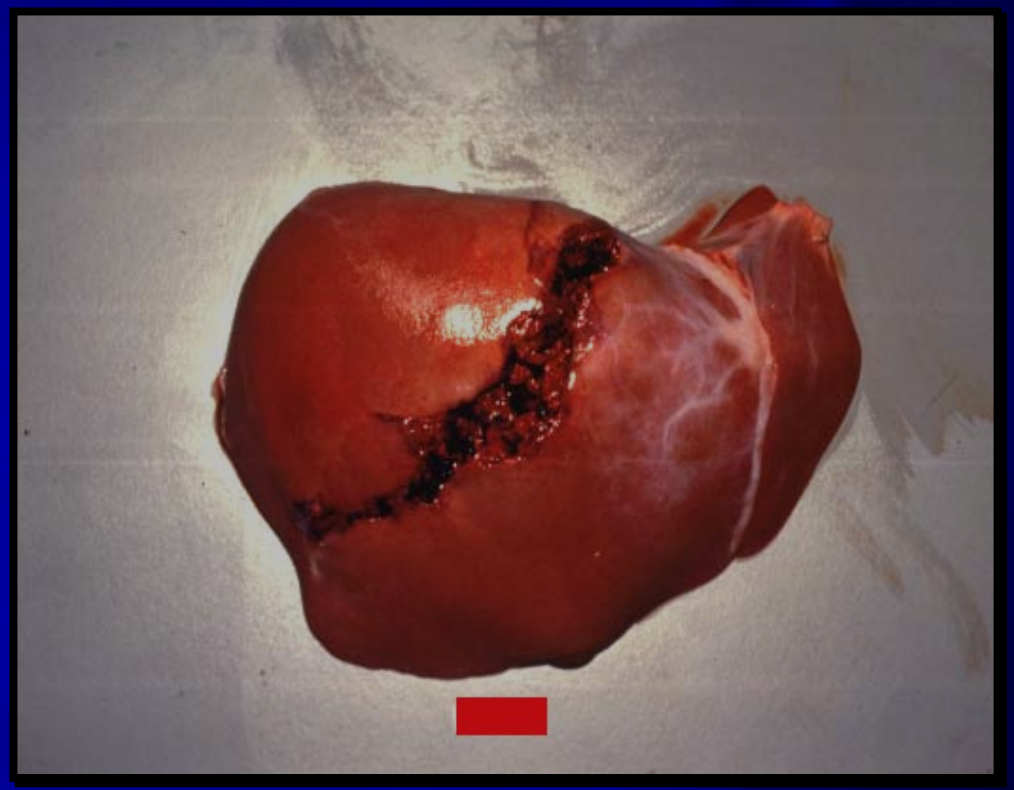
**No Intrusion**

# Case Facts
## Field Opportunities to Inform Medical Community

- **Occupant stated he was OK at scene**
- **Taken to hospital for BAC check**
- **Taken to jail**
- **Complained of extreme abdominal pain 12 hours post-crash**

# Injury Outcome
## Field Opportunities to Inform Medical Community

- **No obvious indication of severe injury**
- **Severe liver laceration**
- **AIS 4**



# Case Facts
## Field Opportunities to Inform Medical Community

- **Delta V 23 mph**
- **Driver side impact**
- **Max crush: 15”**
- **Side intrusion**

- **These crash factors are indicative of a moderate speed side impact crash with potential for severe outcome**

# Field Opportunities to Inform Medical Community

- 82 y/o female driver
- 138 lb. , 5’ 6”
- Restrained by lap and shoulder belt
- Injuries:
  - AIS-4 Aortic Laceration
  - AIS-3 Ruptured Lung
  - AIS-2 Pubis Fracture
  - AIS-2 Rib Fracture

# Aortic Injuries

## Field Opportunities to Inform Medical Community

- **Difficult to recognize**
- **Frequently fatal if not recognized and treated**
- **No long term impairment after rehabilitation**

# Overall Benefits . . .

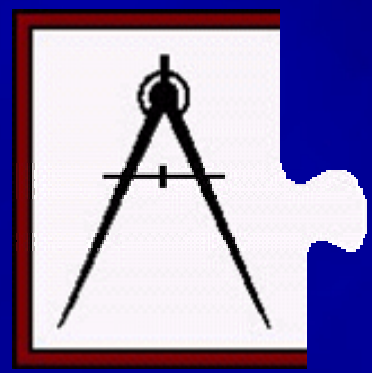
- **Better informed first responders look for indications of occult injuries**
- **First responders can now provide medical treatment center with crash specifics for consideration in their diagnosis and treatment**

# The Car Can Tell You a Story

- **Link injuries to mechanisms**

# Putting It All Together

- **Injury patterns are predictable based on crash configuration**
- **Injury severity can be predicted using crash severity, configuration, occupant characteristics, restraint usage…..**



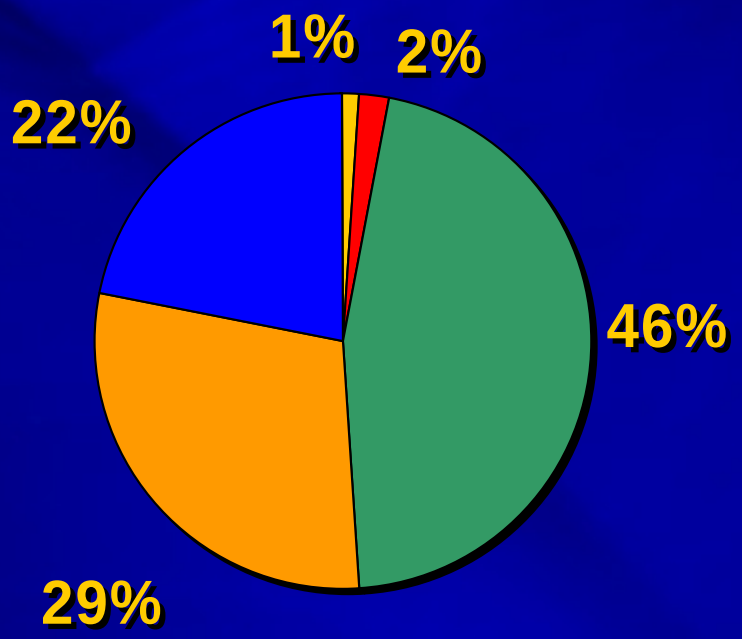
# Putting It All Together

- **CIREN data can be used:**
  - **To anticipate specific injuries associated with specific crashes**
  - **For appropriate triage in the field**
  - **To decrease time to find injuries**

# Vehicles and Fatalities by Collision Type - 2002

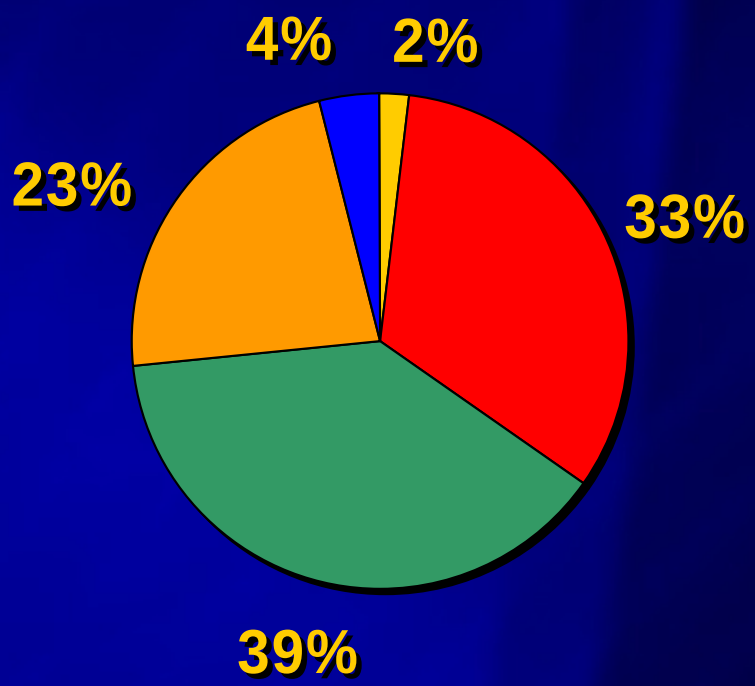
## Passenger Vehicles in Crashes

**Approx. 10.6 million vehicles involved**




## Passenger Vehicle Occupant Fatalities

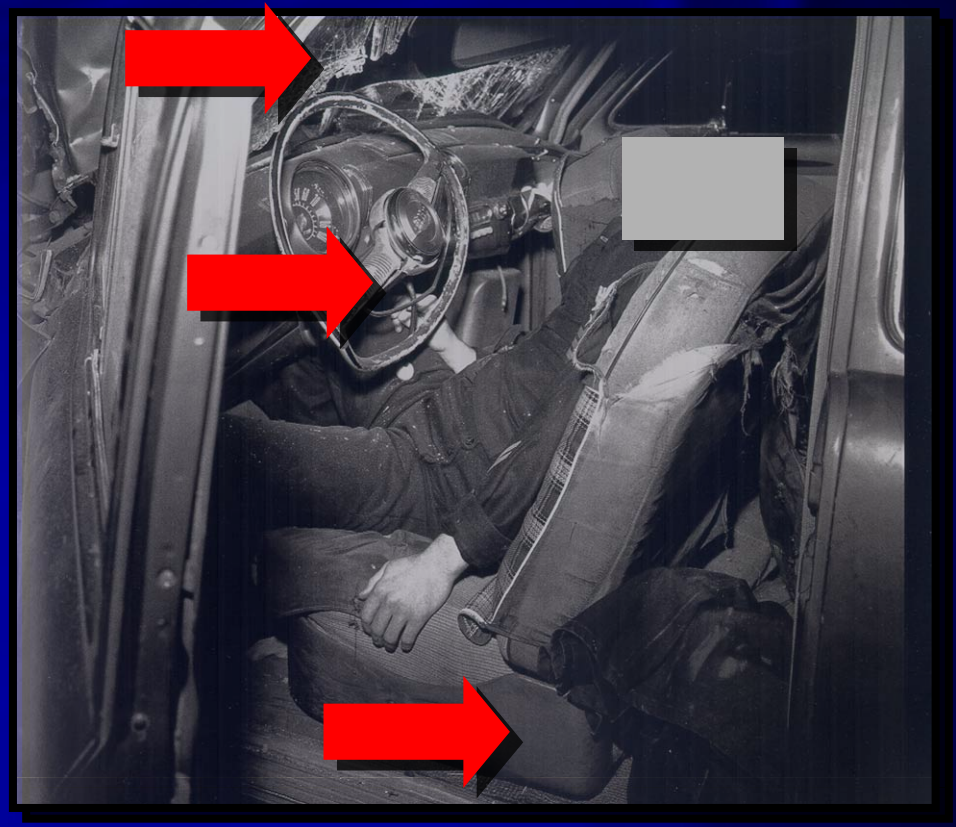
**32,335 total occupants killed**




Rollover Front Side Rear Other

# Where We Were . . .

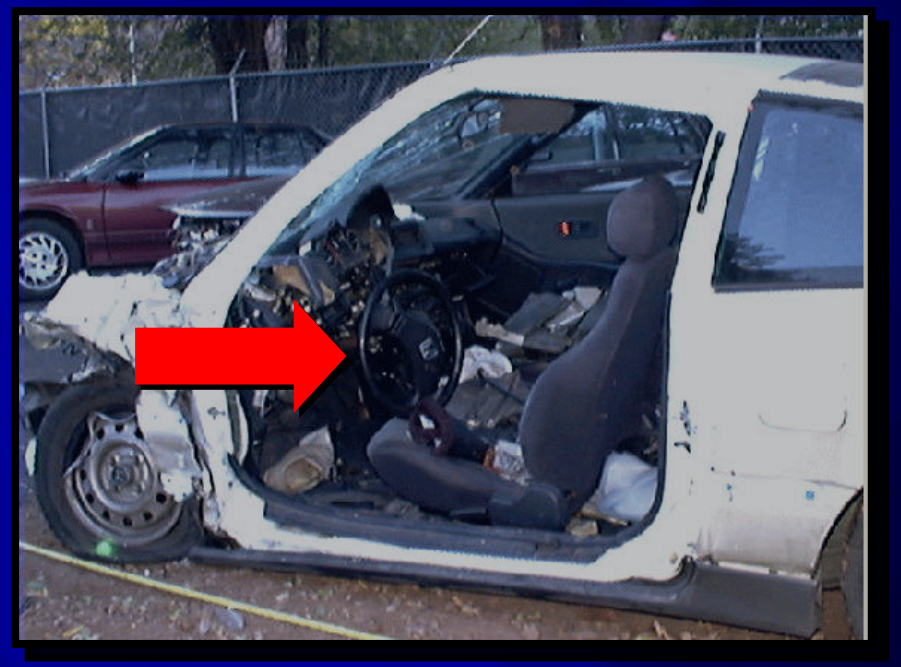
- Crashes before seatbelts
- No restraint systems
- No safety glass
- Non energy absorbing steering columns



# Need For Air Bags
# Injury Prevention

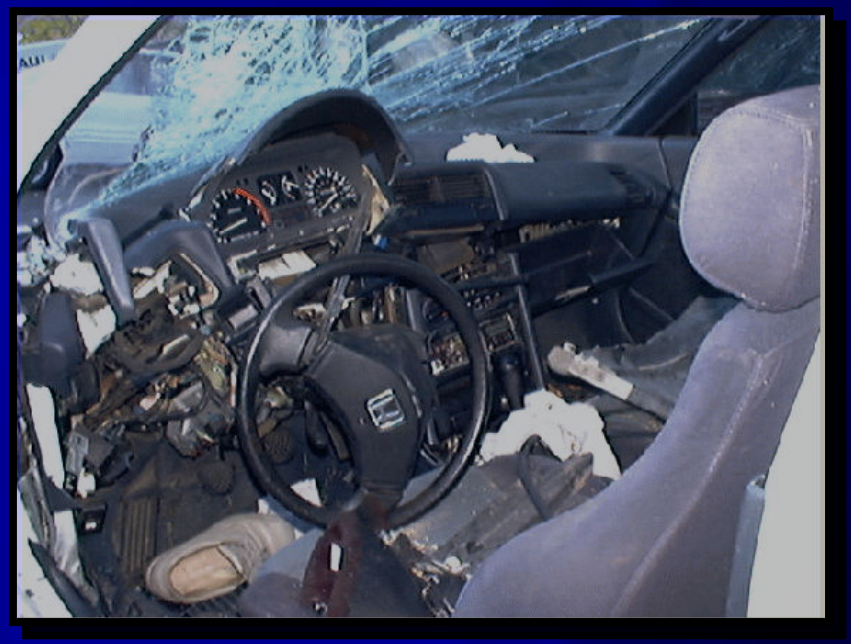
## Safety Belt Only Vehicle

**(Approximate delta V 21 mph)**



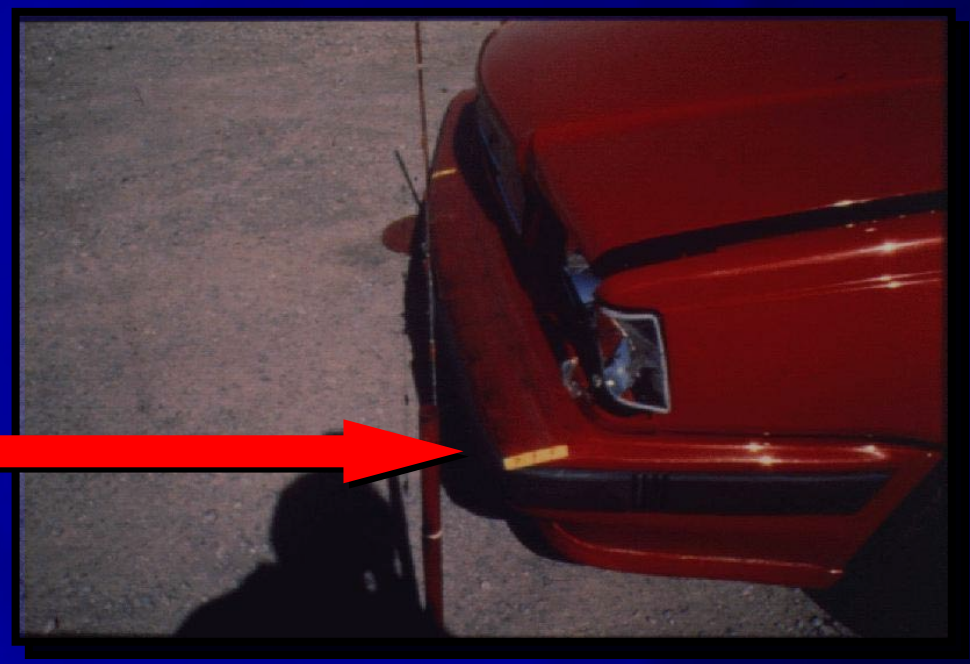
# Injuries in 1990 Honda CRX (Safety Belt – No Air Bags)

- **Driver - critically injured - died six days after the crash**
- **Passenger expired 30 minutes following the crash**



# Air Bags
## Unintended Consequences

- **First generation air bags - low speed crash**
- **Some minor crashes resulted in extremely high injury severity (fatal)**



# Air Bags
## Unintended Consequences

- **Low speed crash – high injury severity**
- **Unbelted/out-of-position occupant**
- **Air bag contacted under the neck**
- **Occupant lifted vertically**
- **Fatal cervical spine and brain stem injuries**

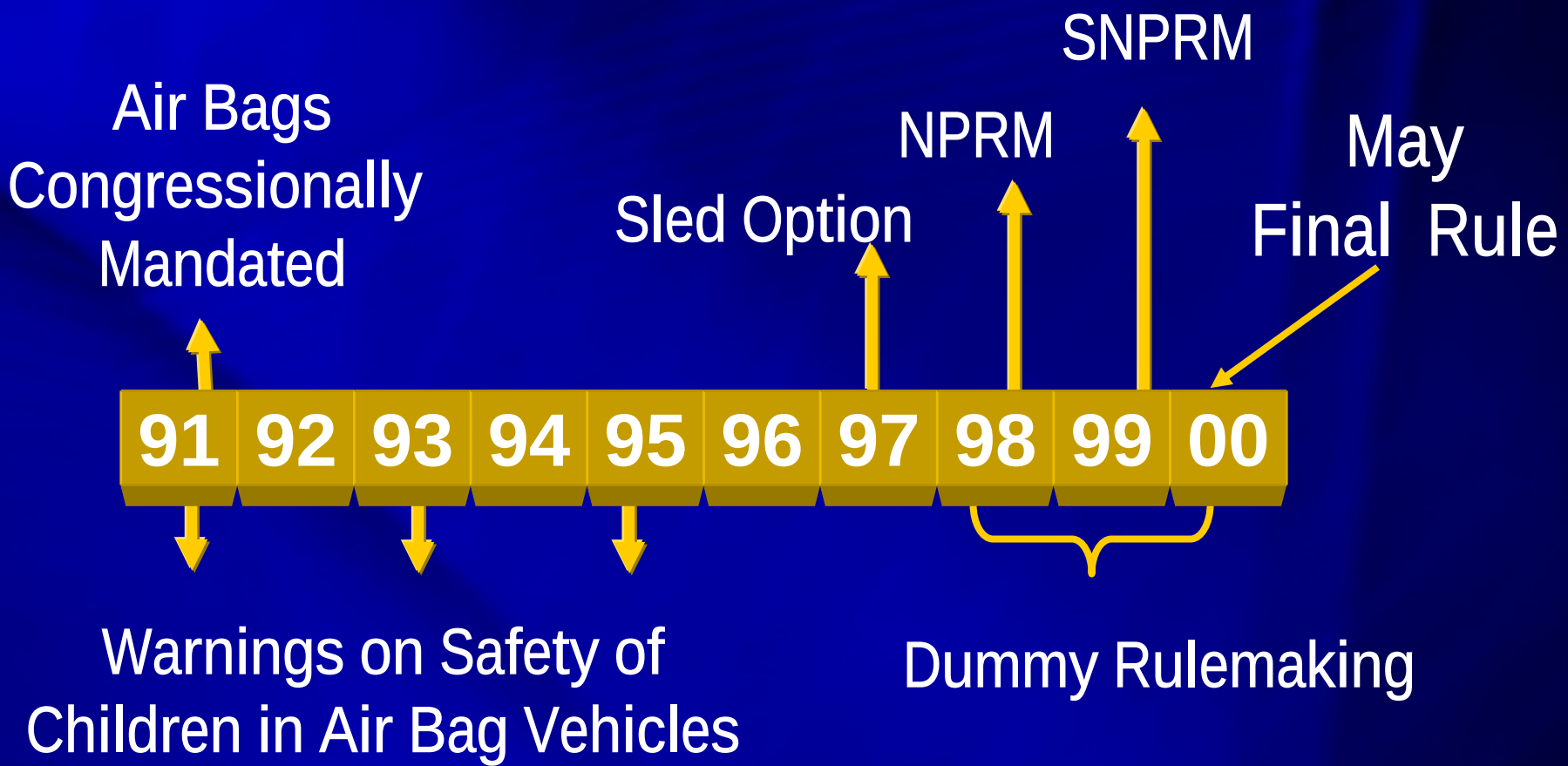
# Fatal Air Bag Injury Pattern For an Out-of-Position Child

- **Typical unrestrained child/air bag interaction injury pattern**
- **Air bag typically wrapped around neck**
- **Lifted neck vertically during air bag expansion**

# Sample of Head & Neck Injuries Related to First Generation Air Bag Deployments

| Injury Description |
|---|
| A/O, CORD, SKULL FXS |
| ANTERIOR DISLOCATION OF THE CERVICAL SPINE BETWEEN C1 AND C2 WITH CPMPLETE CORD SYNDROME |
| ATLANTO-OCCIPITAL (A/O) C-SPINE TRANS |
| ATLANTO-OCCIPITAL AND ATLANTO-AXIAL DISLOCATION |
| ATLANTO-OCCIPITAL DISLOCATION AT C1 WITH TRAVSECTION OF THE UPPER CERVICAL SPINAL CORD |
| ATLANTO-OCCIPITAL DISLOCATION WITH COMPLETE TRAVSECTION OF THE SPINAL CORD |
| ATLANTO-OCCIPITAL DISLOCATION WITH CONTUSION TO THE SPINAL CORD |
| ATLANTO-OCCIPITAL DISLOCATION WITH SPINAL CORD LACERATION |
| BASAL SKULL FX |
| BASILAR SKULL FRACTURE, BRAINSTEM LACERATION |
| BASILAR SKULL FX BRAIN STEM LAC, OFTEN W/ C-SPINE &/OR BRAIN INJURIES |
| BILATERAL SUBDURAL HEATOMA, SUBARACHNOID HEMORRAGE |
| BLUNT TRAUMA TO NECK WITH ASPHYXIA |
| BRAIN |
| BRAIN INJURY/BUBDURAL HEMATOMA/SUBARACHNOID HEMORRHAGE |
| BRAIN STEM LACERATION, COMPLETE OCCIPITAL BONE SEPARATION, SUBARACHNOID HEMORRHAGE |
| BRAIN STEM OMPRESSION WITH GLOBAL SUBARACHNOID HEMORRHAGE |
| BRAIN UPPER EXT |
| BRAIN, NECK |
| BRAINSTEM CONTUSION AND AN ATLANTO-OCCIPITAL DISLOCATION, RIB FRACTURE |
| BRAINSTEM CONTUSION, BASILAR SKULL FRACTURE, SUBARACHNOID HEMORRHAGE |
| BRAINSTEM LACERATION, BRAIN HEMORRHAGE, LACERATION TO AORTA AND HEART |
| BROKEN NECK |

# Air Bag Chronology



# Interim - Redesigned Air Bags

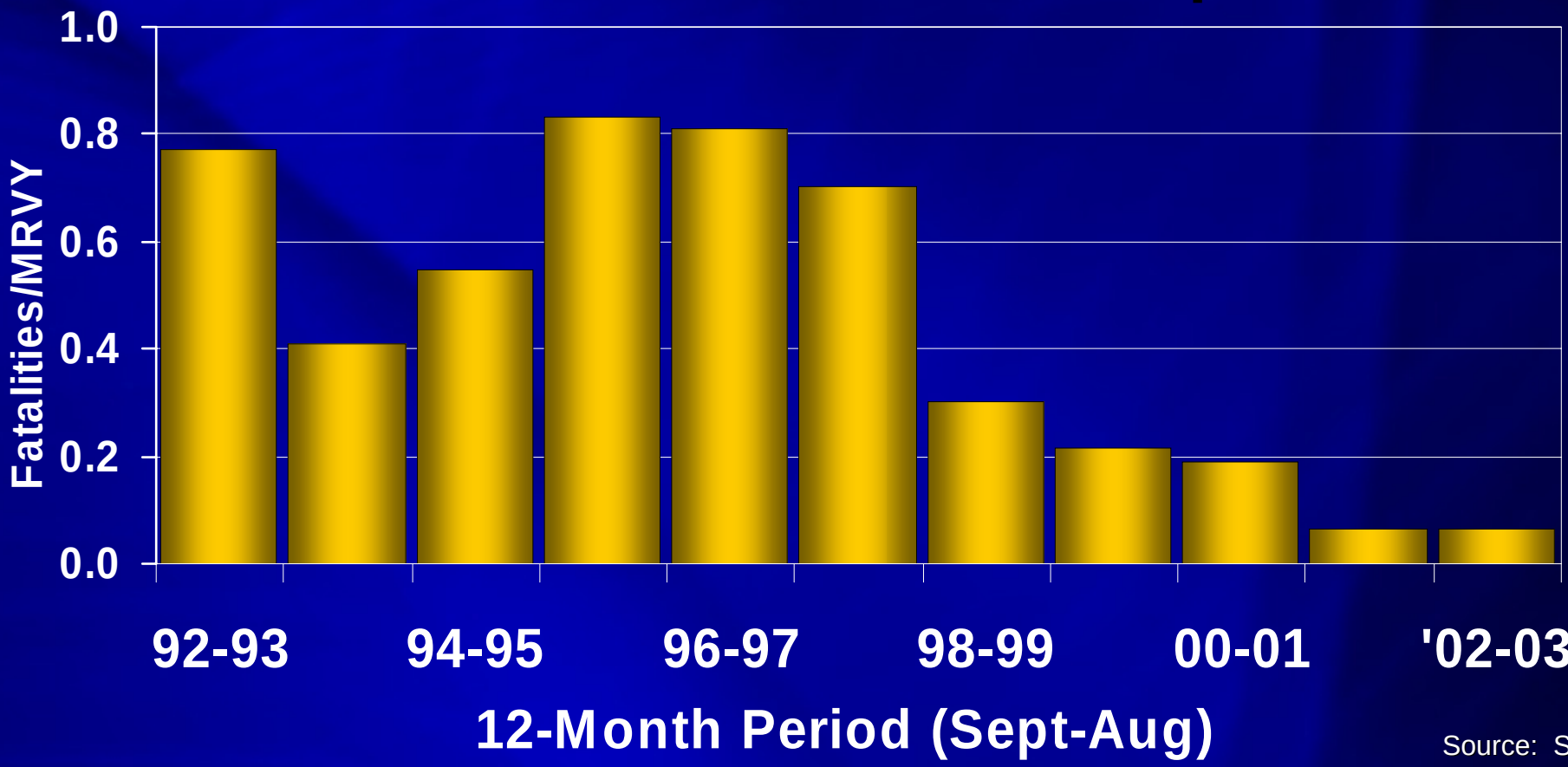
- Less forceful
- Reduce serious/fatal injuries for smaller and out of position occupants
- Head-on crash
- 2000 Honda Accord
- Delta V's ~ 14 mph

# Injuries in Redesigned Air Bag Vehicle

- **Driver loaded the manual restraint and deployed driver's air bag**
- **Sustained only:**
  - **Sprained left wrist**
  - **Left shoulder contusion**
  - **Driver did not receive any medical treatment**

# Special Crash Investigations Frontal Crash Data

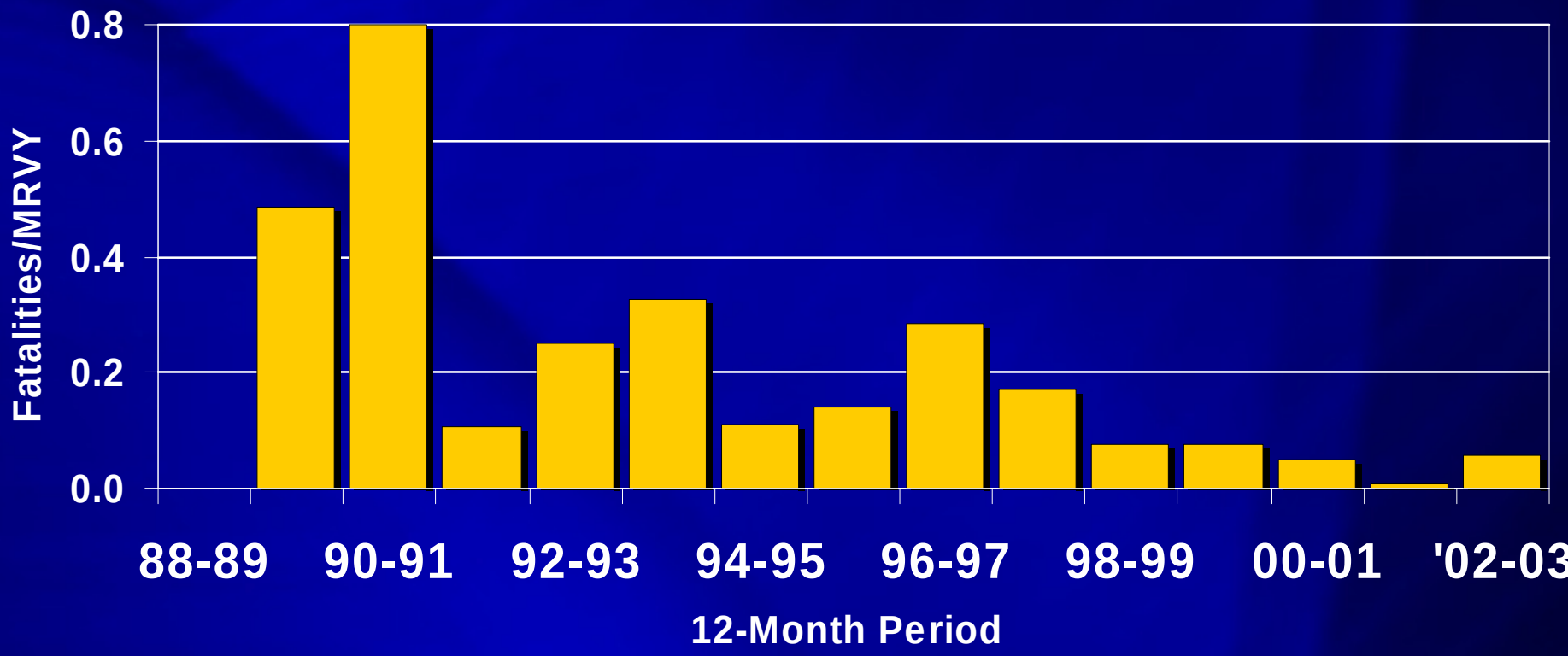
## Fatally Injured by a Passenger Air Bag
## Normalized by Million Registered Vehicle Years
## Confirmed and Unconfirmed as of April 1, 2004




Source: SCI

# Special Crash Investigations Frontal Crash Data

## Fatally Injured by a Driver Air Bag
## Normalized by Million Registered Vehicle Years
## Confirmed and Unconfirmed as of April 1, 2004




Source: SCI

# Solutions

- Create ownership
- Educate
- Raise awareness

- Increased political interest

- Increased funding
- Technical cooperation

# Highway Safety Formula

- Central agency
- Adequate funding
- Good data
- Systematic approach
- Vehicle remedies

# An Example of How the System Was Changed to Save Lives: United States Case Study

- **In the 1960s, there was an alarmingly high rate of road traffic injuries and fatalities in the USA**

# An Example of How the System Was Changed to Save Lives: United States Case Study

- **The USA undertook a major campaign to address this problem that included:**
  - **Making cars safer (seatbelts, airbags, impact-absorbing front ends)**
  - **Changing road designs to separate lanes in two directions; eliminate intersections on highways; and separate pedestrians, bikes, and fast-moving cars**
  - **Changing driver behavior, passing tough laws against drinking and driving, and enforcing these laws**

# Lessons Learned from the USA's Experience

- **The most important step: deciding that the high rates of road traffic deaths were unacceptable — and then taking action**
- **The government created a lead agency to address this problem: The National Highway Transportation Safety Administration**

# Lessons Learned from the USA's Experience (continued)

- **Through a program of applied research, program implementation, and enforced regulations they brought about one of the most striking miracles of modern day public health**
- **As a result, more than 250,000 people are alive today who would have been killed in crashes**

# Adapting Approaches that Work

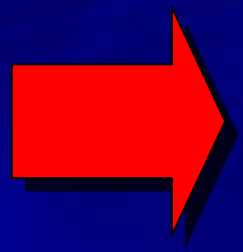
- **What is effective in developed countries may not be what is needed in developing countries**
  - **There are many affordable interventions that work. These can be adapted and applied**

# Adapting Approaches that Work (continued)

- **However, there is a need for more in-depth research in developing countries (science and technology are not luxuries that should be reserved for developed nations)**
- **We need to be selective and think at both system and intervention level**
- **And, we should learn as we go and not wait**

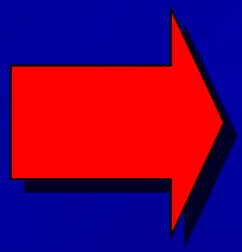
# The Potential for Saving Lives Is Enormous

**If we reduce the current rate of fatalities by 10%, we can save 125,000 per year**



**We can save a minimum of 2.5 million lives over the next 20 years.**

**If we reduce the current rate of nonfatal injuries by 10%, we can save 3,750,000 per year**



**We can reduce the impact from injury on a minimum of 750 million lives over the next 20 years.**

*“The fact that all injuries are preventable means that not to develop programmes to prevent injuries is not doing your job as a doctor - it’s almost immoral.”*

Dr. B. Barlow, Harlem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