Today’s presentation…

- Magnitude of the problem
- Injury and safety definitions
- Injury prevention models
  - Environmental and technological approaches
  - Policy and Regulatory Approaches
- Successful injury prevention strategies
- Examples of policies, regulations, & laws
- Challenges
- Resources for further information
“Only you can prevent forest fires”
- Smoky Bear
Injury Prevention

- Slogans, pamphlets, and cautioning to “be careful” are NOT effective...
  - At least, not effective in isolation
- Effective injury prevention requires a multi-disciplinary approach.
  - There is no single or simple “magic bullet” as with infectious diseases.
- Changes in behavior, culture, engineering, and environments.
Firefighting on a Budget in San Diego
Study says crews did their best, but had limited resources.

Vast majority of voters in hardest hit precincts voted against taxes to support improvements in equipment and staffing. Chaparral and trees not cleared to meet fire protection standards.
## 10 Leading Causes of Death by Age Group, 2001

<table>
<thead>
<tr>
<th>Rank</th>
<th>Age Groups</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Congenital Anomalies 5,473</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Congenital Anomalies 549</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>SIDS 2,648</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Maternal Pregnancy Comp. 1,389</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Respiratory Distress 1,110</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Placenta Cord Membranes 1,029</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Unintentional Injury 846</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Bacterial Sepsis Septicemia 67</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Circulatory System Disease 667</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Atelectasis 647</td>
<td></td>
</tr>
</tbody>
</table>

**Unintentional Injury**

- **1**: Congenital Anomalies 1,389
- **2**: Congenital Anomalies 1,459
- **3**: Congenital Anomalies 1,632
- **4**: Congenital Anomalies 1,836
- **5**: Congenital Anomalies 2,038
- **6**: Congenital Anomalies 2,240
- **7**: Congenital Anomalies 2,442
- **8**: Congenital Anomalies 2,644
- **9**: Congenital Anomalies 2,846
- **10**: Congenital Anomalies 3,048

**Suicide**

- **1**: Suicide 242
- **2**: Suicide 391
- **3**: Suicide 486
- **4**: Suicide 581
- **5**: Suicide 686
- **6**: Suicide 781
- **7**: Suicide 881
- **8**: Suicide 981
- **9**: Suicide 1,081
- **10**: Suicide 1,181

**Heart Disease**

- **1**: Heart Disease 183
- **2**: Heart Disease 186
- **3**: Heart Disease 290
- **4**: Heart Disease 293
- **5**: Heart Disease 397
- **6**: Heart Disease 400
- **7**: Heart Disease 504
- **8**: Heart Disease 608
- **9**: Heart Disease 712
- **10**: Heart Disease 816

**Chronic Low Respiratory Disease**

- **1**: Chronic Low Respiratory Disease 49
- **2**: Chronic Low Respiratory Disease 90
- **3**: Chronic Low Respiratory Disease 209
- **4**: Chronic Low Respiratory Disease 310
- **5**: Chronic Low Respiratory Disease 410
- **6**: Chronic Low Respiratory Disease 510
- **7**: Chronic Low Respiratory Disease 610
- **8**: Chronic Low Respiratory Disease 710
- **9**: Chronic Low Respiratory Disease 810
- **10**: Chronic Low Respiratory Disease 910

**Cerebrovascular Disease**

- **1**: Cerebrovascular Disease 158
- **2**: Cerebrovascular Disease 258
- **3**: Cerebrovascular Disease 358
- **4**: Cerebrovascular Disease 458
- **5**: Cerebrovascular Disease 558
- **6**: Cerebrovascular Disease 658
- **7**: Cerebrovascular Disease 758
- **8**: Cerebrovascular Disease 858
- **9**: Cerebrovascular Disease 958
- **10**: Cerebrovascular Disease 1058

**Diabetes Mellitus**

- **1**: Diabetes Mellitus 168
- **2**: Diabetes Mellitus 268
- **3**: Diabetes Mellitus 368
- **4**: Diabetes Mellitus 468
- **5**: Diabetes Mellitus 568
- **6**: Diabetes Mellitus 668
- **7**: Diabetes Mellitus 768
- **8**: Diabetes Mellitus 868
- **9**: Diabetes Mellitus 968
- **10**: Diabetes Mellitus 1068

**Influenza & Pneumonia**

- **1**: Influenza & Pneumonia 168
- **2**: Influenza & Pneumonia 268
- **3**: Influenza & Pneumonia 368
- **4**: Influenza & Pneumonia 468
- **5**: Influenza & Pneumonia 568
- **6**: Influenza & Pneumonia 668
- **7**: Influenza & Pneumonia 768
- **8**: Influenza & Pneumonia 868
- **9**: Influenza & Pneumonia 968
- **10**: Influenza & Pneumonia 1068

**Septicemia**

- **1**: Septicemia 168
- **2**: Septicemia 268
- **3**: Septicemia 368
- **4**: Septicemia 468
- **5**: Septicemia 568
- **6**: Septicemia 668
- **7**: Septicemia 768
- **8**: Septicemia 868
- **9**: Septicemia 968
- **10**: Septicemia 1068

**Liver Disease**

- **1**: Liver Disease 168
- **2**: Liver Disease 268
- **3**: Liver Disease 368
- **4**: Liver Disease 468
- **5**: Liver Disease 568
- **6**: Liver Disease 668
- **7**: Liver Disease 768
- **8**: Liver Disease 868
- **9**: Liver Disease 968
- **10**: Liver Disease 1068

**Malignant Neoplasms**

- **1**: Malignant Neoplasms 167
- **2**: Malignant Neoplasms 267
- **3**: Malignant Neoplasms 367
- **4**: Malignant Neoplasms 467
- **5**: Malignant Neoplasms 567
- **6**: Malignant Neoplasms 667
- **7**: Malignant Neoplasms 767
- **8**: Malignant Neoplasms 867
- **9**: Malignant Neoplasms 967
- **10**: Malignant Neoplasms 1067

**HIV**

- **1**: HIV 168
- **2**: HIV 268
- **3**: HIV 368
- **4**: HIV 468
- **5**: HIV 568
- **6**: HIV 668
- **7**: HIV 768
- **8**: HIV 868
- **9**: HIV 968
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**Unintentional Injury**

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**Source:** National Center for Health Statistics Vital Records Data, 2001, Compiled by National Center for Injury Prevention & Control.
Death Rates from Injuries and Other Causes, United States, 1910 - 2000

per 100k population

Year
Injury

- Leading cause of death of children, adolescents, and young adults in the U.S.
- For every injury death, there are 45 hospitalizations and 1,300 ER visits.
- Most serious injuries can be prevented.
Injury Pyramid

145,655 Deaths
2,701,000 Hospitalizations
33,950,000 Emergency Department Visits
65,555,000 Visits to Office-based Physicians
59,550,000 Injuries Requiring Medical Attention or Time Off Work

Source: National Center for Health Statistics (1999)
Global perspective

- Each year > 5 million people die of injuries.
- 2/3 are males.
- Majority young adults 15-44.
- MV crashes are the largest cause of injury death.

Source:
Global Burden of Disease,
WHO, World Bank,
Injury

Definition

Any unintentional or intentional damage to the body resulting from acute exposure to thermal, mechanical, electrical, or chemical energy or from the absence of essentials such as heat or oxygen.

We usually define injuries as occurring during a short period of time, as opposed to the effects of repeated exposures to chemical agents or cumulative damage from repetitive motions.
Injury Prevention

- Injuries are NOT “accidents”
  ...injuries **can** be prevented

\[\text{ACCIDENT}\]
“Accident”

- Vague term
  - Better: Fall, Car crash, Poisoning
- Suggests lack of understanding of causes
- Suggests random chance, luck, or fate
- Suggests unpredictability
Injury as a Public Health Problem

For most of the 20th Century, injury prevention focused on assumed shortcomings of the victims.

- Traffic safety movement of 1920s
  - Education, pamphlets, posters
- Home safety movement of 1950s
  - Education, pamphlets, posters
“Once a sense of personal responsibility for accident causation can be created in the minds of people, great progress will have been made. Then the sequel to an accident will no longer be an orgy of self-pity for having been the victim of an uncontrollable event. Instead there can be a character-building period of self-evaluation during which acts of personal stupidity, carelessness, and indifference may be identified.”

Modern view of injury

- Personal responsibility not eliminated but:
  - Greater weight is now assigned to other issues such as environmental factors
  - Hugh De Haven fall studies:
    - Not the force, per se, that produced the injury but the structural environment that controlled the deceleration of the force and the distribution of the force over the body.
If the fall could not be prevented, then “Structural provisions to reduce impact and distribute pressures can enhance survival and modify injury ... in aircraft and automobile crashes.”

- De Haven H. Mechanical analysis of survival in falls from heights of fifty to one hundred fifty feet. War Med 1942: 586-596.
Environmental Model

“Man responds to the flux of energies which surround him – gravitational, mechanical, radiant, thermal, and chemical ... Injuries can only be produced by an energy exchange between man and his environment.”

Injury Prevention

The fundamental task is:

- Prevent the agent (energy) from reaching people in amounts or rates that exceed the capacity of their body to tolerate it
Epidemiological Model

Environment

Host

Agent
Epidemiological Model

Injury Triad

Environment
  Physical
  Social

Human

Energy

Vehicle
Epidemiological Model

Injury Triad – Motor Vehicle Crashes

Environment

Physical
- Road Conditions
- Weather

Social
- Acceptance of speed limits
- Rejection of DUI

Human
- Experience
- Age

Energy
- Speed
- Design
- State of Repair
William Haddon, Jr.

- Expanded on Gibson to address preventive approaches.
- Demonstrated that the host, agent, and environmental factors interact over time to cause injury.
# Haddon Phase-Factor Matrix

Useful for planning, strategy identification, resource allocation

<table>
<thead>
<tr>
<th>Phase</th>
<th>Host (Human)</th>
<th>Vector (Vehicle)</th>
<th>Physical Environment</th>
<th>Cultural Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Event</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Event</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-Event</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Haddon Phase-Factor Matrix
Useful for planning, strategy identification, resource allocation
Motor vehicle crash

<table>
<thead>
<tr>
<th>Phase</th>
<th>Host (Human)</th>
<th>Vector (Vehicle)</th>
<th>Physical Environment</th>
<th>Cultural Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Event</td>
<td>Alcohol Experience Judgment</td>
<td>Brake status Tires</td>
<td>Night, Rain</td>
<td>Acceptance of drinking and driving</td>
</tr>
<tr>
<td>Event</td>
<td>No seat belt</td>
<td>No air bag Hardness of surfaces</td>
<td>Tree too close to road, no guard rail</td>
<td>Speed limits Enforcement of seat belt laws</td>
</tr>
<tr>
<td>Post-Event</td>
<td>Physical condition</td>
<td>Fuel system integrity Cell phone</td>
<td>Distance of emergency response</td>
<td>Support for trauma systems Training level of EMS personnel</td>
</tr>
</tbody>
</table>
Haddon’s 10 Countermeasures

1. Prevent creation of the hazard
   - Stop producing hazardous substances like highly toxic pesticides or fireworks

2. Reduce the amount of the hazard
   - Package toxic drugs in smaller, safe amounts
   - Reduce speed limits

3. Prevent inappropriate release of any existing hazard
   - Make bathtubs less slippery
Haddon’s 10 Countermeasures

4. Modify the rate or spatial distribution of the hazard
   - Require automobile seatbelts and air bags
   - Require soft playground surfaces
Playground injuries

More than 170,000 children sustain playground equipment related injuries each year; 90% of the serious injuries are from falls to the ground surface beneath the equipment.

Source: American Academy of Pediatrics
Modify the rate or spatial distribution of the hazard
Haddon’s 10 Countermeasures

5. Separate release of the hazard in time or space
   - Install pedestrian sidewalks
Haddon’s 10 Countermeasures

5. Separate release of the hazard in time or space

- Reroute high speed traffic around residential neighborhoods or slow it with speed bumps and roundabouts
- Spray pesticides at a time of day when people aren’t around
Haddon’s 10 Countermeasures

5. Separate release of the hazard in time or space

- Install Red Light Cameras
Haddon’s 10 Countermeasures

5. Separate release of the hazard in time or space
   - Install Red Light Cameras
Haddon’s 10 Countermeasures

6. Put a barrier between the hazard and people at risk
   - Install fences around pools
   - Install cover guards on dangerous machinery
   - Install proper guardrails along roads
   - Use child-proof packaging
   - Store handguns in a locked metal box
   - Use extension cords with good insulation
Put a Barrier Between the Hazard and the Potential Victim:

- Protective closures
- Pool isolation fences
- Safety guards on tools and machines
Place A Barrier Between the Hazard and the Potential Victim: Child-Resistant Caps on Baby Aspirin

Rate* of Aspirin Death, Children > 5, United States, 1955-1990

*Per million children
Sources: Clark & Walton, Pediatrics, 1979; Rogers GB, Arch Ped Adol Med, 2002; NCHS Vital Records
Place A Barrier Between the Hazard and the Potential Victim: Window Guards

Window Fall Deaths in Children, New York City, 1972-1975

[Bar chart showing a decrease in window fall deaths from 1972 to 1975 after the code for window guards was established.]
Haddon’s 10 Countermeasures

7. Change the basic nature of the hazard
   - Make crib slat spacing too narrow to strangle a child
   - Modify equipment by rounding sharp corners
Haddon’s 10 Countermeasures

8. Increase resistance of people to the hazard
   - Improve physical condition through proper nutrition and regular exercise

9. Begin to counter damage already done by the hazard
   - Provide emergency medical care

10. Stabilize, provide definitive care, rehabilitate
    - Availability of appropriate acute care and rehabilitation facilities
General Model for Injury Control

Monitor Incidence → Identify Risk Factors → Intervene → Evaluate

- Identify Morbidity
- Mortality
- Costs

- Social
- Genetic
- Environmental
Injury Prevention: The Role of Policy and Law

- In dealing with any public health problem, governments can fund programs or enact laws.
- Legislation can provide agencies with the power to establish administrative rules.
Proven Injury Prevention Interventions

- Car safety seats and belts
- Air bags
- Motorcycle helmets
- Bicycle helmets
- Child resistant packaging
- Swimming pool fencing
- Smoke detectors
- Self extinguishing cigarettes
SUCCESS - Motor Vehicle Injuries

- Since 1920’s
  - Six fold increase in number of drivers
  - 11 times the number of motor vehicles
  - 10 times the number of miles traveled

- 90% decrease in the annual death rate per 100 million vehicle miles traveled

Source: NHTSA
SUCCESS - Poison Prevention Packaging Act

45% decrease in poisoning deaths

Why?
- Child-proof containers
- Packaging in non-lethal doses
SUCCESS - Motor Vehicle Injuries

- 27% decrease in MV occupant deaths among 16-20 year olds

Why?
- Increase in the legal drinking age
- Graduated licensing
Success: Residential Fire Injuries

Smoke Alarm Distribution Programs Save Lives

Oklahoma City Lifesavers Project
Outcome Evaluation Per 100,000 Population
Oklahoma City, May 1990-April 1994*

Injury Rate per 100,000 Population

Target Area
Rest of City

80% Decrease
8% Increase

*NEJM 335:27-31, 1996
Occupant Fatality Rates, Infants, United States 1960-2000
Reduce the Amount of Energy Transferred

“Correctly installed and used child safety seats reduce the risk of death by 71%, hospitalizations by 67%, and minor injuries by 50%.”

Source: American Academy of Pediatrics
Reduce the Amount of Energy Transferred

- Changes to vehicles
- Changes to road design
- Changes to signs, light posts, and barriers
Bicycle Helmets

“Bicycle helmets reduce the risk of head injury by 85% and risk of brain injury by almost 90%, yet only 5% of child bicyclists in the U.S.A. wear helmets.”

Source: American Academy of Pediatrics
Challenges

- Need to maintain what works
  - Poison Control Centers
  - Trauma Systems

- Need to implement what works
  - Bicycle helmets
  - Smoke detectors
Injury Prevention Policy

The ideal policy is:

a prudent course of action selected from among the alternatives to guide present and future decisions and behavior. It is an idea or plan of what to do in a particular situation that has been agreed to by a group of people, a business, or a government. Thus, although laws are policies, not all policies are laws.
Public Health Policy Formation

- Public Health: Illuminate the patterns
- Put in context with other health issues
- Identify groups at risk in the population

Surveillance
+ Hypothesis testing studies
+ Clinical experience

Basis for policy
Injury Prevention Policy
Cellular Telephones in Motor Vehicles

- Businesses shall establish rules that prohibit the use of cellular telephones while driving a vehicle.
- Communities shall enact local ordinances that restrict the use of cellular telephones while driving a vehicle.
- Professional, civic, social, and faith organizations shall recommend to members that they refrain from using cellular telephones while driving a vehicle.
Injury Prevention Policy
Child Death Review Teams

Every state and county shall have a multidisciplinary team that reviews the causes and circumstances of each child's death to find hazards that may place other children at risk from neglect, abuse, violence, and unintentional injuries. This information should be used to prioritize and focus community prevention activities and not exclusively to establish blame.
Injury Prevention Policy

Children Left Alone In Motor Vehicles

- States and communities shall enact and enforce laws or ordinances to prohibit children from being left unattended in motor vehicles.
Injury Prevention Policy

Enforcement of Passenger restraint Laws

- Local police shall enforce laws that require motor vehicle occupants to be appropriately restrained with seat belts or safety seats.
States and communities shall enact and enforce building codes that require four-sided isolation fencing around residential swimming pools. The fencing shall be of appropriate height and with self-closing, self-latching gates.
Nature of Injury Prevention Laws

- Federal Authority
- State and Local Authority

- Statutory laws can either REQUIRE or PROHIBIT

- They can be directed at:
  - Individual behavior
  - Products
  - Environmental conditions or places
Examples of State and Local Laws

- Regulate the color and speed capacity of school buses
- Mandate buildings to be constructed to meet codes and standards.
- Require child abuse reporting
- Restrict sale or giving of alcohol to children
## Examples of State and Local Laws

<table>
<thead>
<tr>
<th>Human Factors (people)</th>
<th>Prohibit</th>
<th>Require</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drag racing</td>
<td></td>
<td>Seatbelt use</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vehicle/Agent (things)</th>
<th>Prohibit</th>
<th>Require</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speedometers registering over 80 m.p.h.</td>
<td></td>
<td>Specified maximum window tint</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Environment (places)</th>
<th>Prohibit</th>
<th>Require</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rigid barriers within specified distance of roadway</td>
<td>Break-away sign posts, soft bridge rail end points</td>
<td></td>
</tr>
</tbody>
</table>
Individuals can make a difference

- Cindy Lightner
- Rose Lineweaver
- Jeanette Fennel
- Terrill Struttmann
- June McCarroll
- Elbert D. Botts
Individuals can make a difference

- Cindy Lightner – MADD
- Rose Lineweaver – Crib Safety
- Jeanette Fennel – Trunk Releases
- Terrill Struttmann – Children in Cars
- June McCarroll – Highway Center Lines
- Elbert Botts – Raised Pavement Markers
Regulation versus Individual Freedom

- You and I can’t tell if a bridge or building is at risk for falling down, but…
  - Engineers and architects can foresee such things
  - Standards can be established and required in construction
  - Inspectors can provide assurance that standards are met
Regulation versus Individual Freedom

- What of individual freedom and free trade?
  - Leave everyone to regulate his own business
  - Let the customer decide
  - Demand and supply are suitable regulators
  - Although some customers will make mistakes, the public will eventually recognize those who offer the best product.
Regulation versus Individual Freedom

- What of individual freedom and free trade?
  - As the customer is being blown up, crushed, run over, poisoned, or knocked down dead they will discover that they have made a mistake.
Regulation versus Individual Freedom

- What of individual freedom and free trade?
  - “Bullet-proof” vests made from defective material
    - Internal documents show that Second Chance Body Armor knew that Zylon material used in vests quickly deteriorates with age and failed to protect.
  - Ford “Crown Victoria” long known as the standard police cruiser, subject to fuel tank fires.
Regulation versus Individual Freedom

- Proverb:
  - A burned child will dread the fire and learn caution.

But of what use for safety is dread, after the child has burned to death.
Parents and Childhood Safety
Regulation Versus Responsibility

Eight-year old Robbie LaPeen jumps 10 cars for “Ripley’s Believe It or Not” TV Show -- February 2001

LaPeen Auto Brite Collision Shop, Clio, MI
Useful Websites

http://www.injurypreventionweb.org
Contains injury data for every U.S. state, over 1,100 links to injury prevention sites worldwide, and includes suggestions for injury-related books and journals.

http://www.cdc.gov/ncipc/
National Center for Injury Prevention and Control

http://www.safetypolicy.org
Healthy People 2010 Objectives, Injury Prevention Policy Statements

http://www.cippp.org
Center for Injury Prevention Policy and Practice
Useful Websites

http://www.SafetyLit.org
A free weekly update of the research literature selected from over 200 professional journals from the health, engineering, psychology, ergonomics and human factors, economics, law and law enforcement, sociology, social work, anthropology, and other fields.
Occupant Fatality Rates – All Ages

Fatality Rate per 100 M Mi Traveled

Miles Traveled x 100 Million