

# Road Safety

CE576  
Fall 2011

🕒 Ahmed Abdel-Rahim, Ph.D., P.E.

Module 1-1


# The Nature of Road Safety



The image shows a white ambulance with red and orange stripes parked at a traffic light. The ambulance has "DEPT." and "MEDICAL SERVICES" visible on its side. In the background, there is a traffic light pole with a sign that reads "TRAFFIC SIGNALS WELL TO EXIT 64". The scene is set at night or dusk.

# Exercise 1: Defining Safety

## How do you define safety?



The image shows a white sticky note pinned to a surface with an orange pushpin. The sticky note is blank, symbolizing the task of defining safety.

Module 1-1

# Various Definitions

- 🕒 Public health
- 🕒 Highway safety professional
- 🕒 Design, maintenance, or operations engineer
- 🕒 Transit
- 🕒 Human Factors

Module 1-1

## A Definition of Road Safety



Roadway safety is the number of accidents (crashes), or accident consequences, by kind and severity, expected to occur on the entity during a specific period.



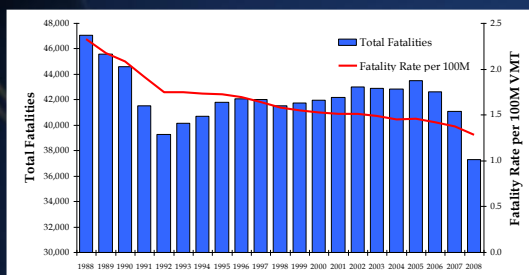
Ezra Hauer

4

Module 1-1

## National Highway Fatalities and Fatality Rates

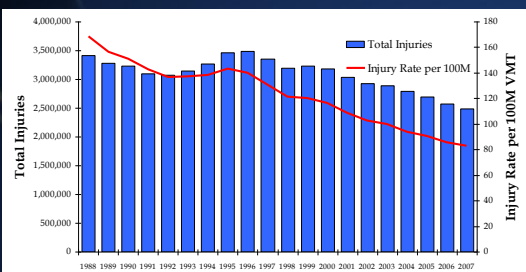
1988-2008\*



Source: Created by Cambridge Systematics based on fatality data retrieved from the Fatality Analysis Reporting System (National Highway Traffic Safety Administration) and vehicle miles traveled data (Federal Highway Administration). \*2008 Preliminary data retrieved from NHTSA Traffic Safety Facts Research Note DOT HS 811 124

Module 1-5

## National Highway Injuries and Injury Rates



Source: Created by Cambridge Systematics based on injury data retrieved from NHTSA Traffic Crash Facts 2007

Module 1-1 6

## The Public Health Perspective

### Events Causing Health Problems

- Cancer
- Heart disease
- Stroke
- Obesity
- Suicide
- Homicide

### Exposure to Risk

7

Module 1-1

## 10 Leading Causes of Death by Age Group, United States— 2010

Rank	ICD-10 Code	Age Groups										All Ages	
		<5	5-14	15-19	20-24	25-34	35-44	45-54	55-64	65+			
1	Cardiomyopathy I48	Myocardial Infarction I20	Myocardial Infarction I20	Myocardial Infarction I20	Myocardial Infarction I20	Myocardial Infarction I20	Myocardial Infarction I20	Myocardial Infarction I20	Myocardial Infarction I20	Myocardial Infarction I20	Myocardial Infarction I20	Myocardial Infarction I20	Heart Disease I00-I09
2	Stroke I60-I69	Cerebrovascular Disease I60-I69	Myocardial Infarction I20	Myocardial Infarction I20	Myocardial Infarction I20	Myocardial Infarction I20	Myocardial Infarction I20	Myocardial Infarction I20	Myocardial Infarction I20	Myocardial Infarction I20	Myocardial Infarction I20	Myocardial Infarction I20	Heart Disease I00-I09
3	COVID-19 U071	Unintentional Choking W80	Unintentional Choking W80	Unintentional Choking W80	Unintentional Choking W80	Unintentional Choking W80	Unintentional Choking W80	Unintentional Choking W80	Unintentional Choking W80	Unintentional Choking W80	Unintentional Choking W80	Unintentional Choking W80	Unintentional Choking W80
4	Pneumonia J60-J69	Myocardial Infarction I20	Unintentional Choking W80	Unintentional Choking W80	Unintentional Choking W80	Unintentional Choking W80	Unintentional Choking W80	Unintentional Choking W80	Unintentional Choking W80	Unintentional Choking W80	Unintentional Choking W80	Unintentional Choking W80	Heart Disease I00-I09
5	Pneumonia J60-J69	Unintentional Choking W80	Unintentional Choking W80	Unintentional Choking W80	Unintentional Choking W80	Unintentional Choking W80	Unintentional Choking W80	Unintentional Choking W80	Unintentional Choking W80	Unintentional Choking W80	Unintentional Choking W80	Unintentional Choking W80	Heart Disease I00-I09
6	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89
7	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89
8	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89
9	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89
10	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89	Unintentional Self-Harm S60-S89

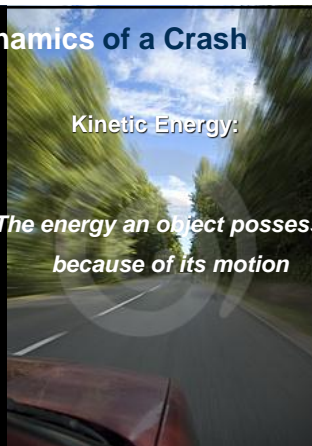
Source: National Vital Statistics System, National Center for Health Statistics, CDC



## The Dynamics of a Crash

Kinetic Energy:

The energy an object possesses because of its motion



## The Dynamics of a Crash



Crush energy:

Deformation of car and human parts

## Crash Models and Road Safety



11

Module 1-1

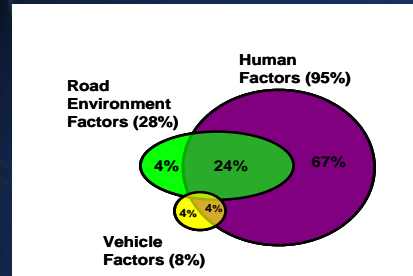
## Driver Behavior and Crash Models



12

Module 1-1

## Multidisciplinary Approaches



13

Module 1-1

## Road Safety – a Complex Field

*Road safety is a complex, multidisciplinary, multimodal field devoted to the prevention and/or mitigation of crashes, injuries, and fatalities.*

14

Module 1-1

## Major Topics

- ④ The Complex Nature of Road Safety
- ④ Safety Disciplines
- ④ 4 Es of Road Safety
- ④ Road Safety Modes
- ④ Crash Prevention Paradigm Shift

15

Module 1-1

## Safety Disciplines

- ⌚ Backgrounds
- ⌚ Education
- ⌚ Perspectives
- ⌚ Multimodal



16

Module 1-1

## Safety Silos

- ⌚ Institutional Levels
  - Federal
  - State
  - Local
- ⌚ Modes
  - Passenger vehicles
  - Trucks
  - Transit
  - Pedestrians/bicyclists



17

Module 1-1

## The 4 Es of Road Safety

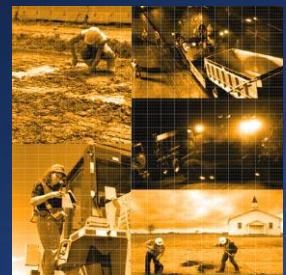
- ⌚ Engineering
- ⌚ Education
- ⌚ Enforcement
- ⌚ Emergency Response

18

Module 1-1

## Engineering

- ⌚ Design
- ⌚ Construction
- ⌚ Operations
- ⌚ Maintenance
- ⌚ Vehicle



19

Module 1-1

## Education

- ④ Behavior Change
- ④ Rules of the Road
- ④ Risk Awareness
- ④ Amplify Enforcement and Engineering Activities



20

Module 1-1

## Enforcement

- ④ Police
- ④ Prosecutors
- ④ Judges
- ④ Probation



21

Module 1-1

## Emergency Response

- ④ Incident Response
- ④ Emergency Medical Services
- ④ Fire and Rescue
- ④ Hazardous Materials Removal

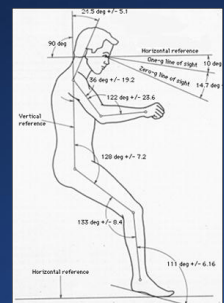


22

Module 1-1

## Human Factors & Biomechanics

- ④ Capabilities and Limitations of the Human Body
  - Strength
  - Reaction time
  - Visual acuity
  - Physical durability
- ④ Effects of Exceeding Human Limitations



23

Module 1-1

## Public/Private Administrators

- ④ Driver Licensing
- ④ Vehicle Registration
- ④ Analyze Insurance Claims
- ④ Set Rates for Vehicle and Health Insurance
- ④ Develop and Enforce Policies, Procedures, and Regulations

24

Module 1-1

## Vehicle Considerations

- ④ Passenger Vehicles
  - Largest number of crashes by far
  - Size
  - Performance characteristics
- ④ Mode Connectivity
- ④ Vehicle Characteristics
  - Crash types
  - Fleet diversity
  - Height and weight

25

Module 1-1

## Other Motorized Vehicles

- ④ Commercial Vehicles
  - Interaction with other vehicles
  - Roadway considerations
- ④ Motorcycles
- ④ Transit and Rail



26

Module 1-1

## Comparison of Vehicle Type Involved in Crashes

Vehicle Type	Crash Type	Total Number of Crashes	Rate (per 100 million vehicle-miles traveled)	Rate (per 100 million registered vehicles)
Passenger Cars	Fatal	25,029	1.55	18.52
	Injury	1,893,000	117	1,401
	Property Damage	4,169,000	258	3,085
Light Trucks	Fatal	22,838	2.01	24.05
	Injury	1,209,000	107	1,273
	Property Damage	2,919,000	257	3,074
Large Trucks	Fatal	4,932	2.21	58.15
	Injury	82,000	37	971
	Property Damage	354,000	159	4,176
Motorcycles	Fatal	4,655	43.22	74.75
	Injury	80,000	746	1,291
	Property Damage	18,000	168	291

27

Module 1-1

## Non-Motorized Transport

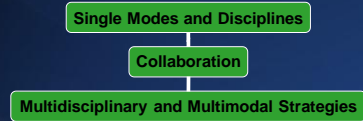
- ④ Pedestrians
- ④ Bicyclists
- ④ Roadway Facilities



28

Module 1-1

## Paradigm Shift



29

Module 1-1

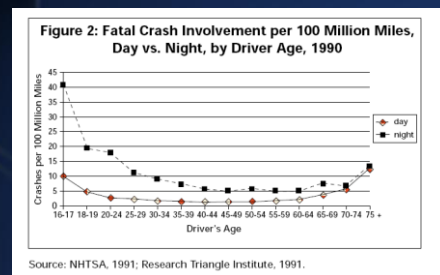
## Multidisciplinary Approaches

- ④ Young Drivers
  - Zero tolerance
  - Graduated driver licensing
- ④ Safety Corridors

30

Module 1-1

## Fatal Crash Involvement by Driver Age



31

Module 1-1



## State Licensing Law & Driver Fatal Crash Involvement

Table 1. State Licensing Law and Driver Fatal Crash Involvements 1989–1993

State Group	Learn Age	License Age	Number of States	Crash Rates/100k Population		
				15 & <15	16	17
1	16	16-17	9	0.24	1.38	2.18
2	15.2-15.8	16	12	0.59	2.26	3.03
3	15	16	17	0.67	2.82	3.12
4	14	16	5	1.14	3.13	3.32
5	14-15	14-15	8	2.33	2.59	3.66

Note: License law information is from Williams, Weinberg, et al., 1996; total involvements data are from FARS (NHTSA, 1991).

32

Module 1-1

## Life-Saving Interventions – GDL

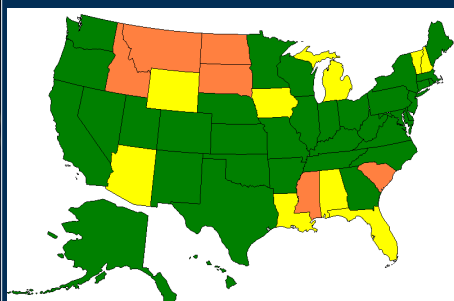


- **STRONGEST GDL** – reduction of 38% for fatal crashes and 40% for injury crashes among 16-year-old drivers.
- **WEAKEST GDL** – reduction of 11% for fatal crashes and 19% for injury crashes.

Source: Baker et al., 2007

INSURANCE INSTITUTE  
FOR HIGHWAY SAFETY

## Rating of GDL Laws in the United States



Legend

G = Good  
F = Fair  
M = Marginal  
P = Poor

[http://www.iihs.org/laws/gdl\\_intermediate.aspx](http://www.iihs.org/laws/gdl_intermediate.aspx)

## Safety Corridor Programs

- Legislation
- Data Analysis
- Signage
- Enforcement
- Public Education

35

Module 1-1

## Safety Corridors in New Mexico



36

Module 1-1