Off Road and At-Risk: The Challenges of Kids on Off-Road Motorized Vehicles

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Injury Free Coalition for Kids®

Objectives

- Understand the magnitude of the injury problem
- Discuss properties of ATVs and dirtbikes making them risks for injury
- Learn specific risk factors for injuries
- Discuss the public health approach to prevention
- Suggest interventions to the ATV problem

Case

- 10 y/o female
- 15 mph on flat surface
- No helmet or seatbelt
- Sharp turn
- Vehicle flipped
- Suffered traumatic brain injury
- Pt died in the ICU 3 days later

Yamaha Rhino 660

The Injury Problem

10 Leading Causes of Death by Age Group, United States – 2004

Rank	Age Groups <1	1-4	5-9	10-14	15-24	25-34	35-44	45-54	55-64	65+	Total
1	Congenital Anomalies 5,622	Unintentional Injury 1,641	Unintentional Injury 1,126	Unintentional Injury 1,540	Unintentional Injury 15,449	Unintentional Injury 13,032	Unintentional Injury 10,471	Malignant Neoplasms 49,520	Malignant Neoplasms 96,956	Heart Disease 533,302	Heart Disease 652,486
2	Short Gestation 4,[illegible]	Congenital Anomalies 569	Malignant Neoplasms 526	Malignant Neoplasms 493	Homicide 5,085	Suicide 5,074	Malignant Neoplasms 14,723	Heart Disease 37,[illegible]	Heart Disease 63,613	Malignant Neoplasms 385,847	Malignant Neoplasms 553,888
3	SIDS 2,246	Malignant Neoplasms 399	Congenital Anomalies [illegible]	Suicide 283	Suicide 4,316	Homicide 4,495	Heart Disease 12,925	Unintentional Injury 16,942	Chronic Low. Respiratory Disease 11,754	Cerebro-vascular 130,538	Cerebro-vascular 150,074
4	Maternal Pregnancy Comp. 1,715	Homicide 377	Homicide 122	Homicide 207	Malignant Neoplasms 1,709	Malignant Neoplasms 3,633	Suicide 6,638	Liver Disease 7,496	Diabetes Mellitus 10,780	Chronic Low. Respiratory Disease 105,197	Chronic Low. Respiratory Disease 121,987
5	Unintentional Injury 1,052	Heart Disease 187	Heart Disease 83	Congenital Anomalies 184	Heart Disease 1,038	Heart Disease 3,163	HIV 4,826	Suicide 6,906	Cerebro-vascular 9,966	Alzheimer's Disease 65,313	Unintentional Injury 112,012
6	Placenta Cord Membranes 1,042	Influenza & Pneumonia 119	Chronic Low. Respiratory Disease 46	Heart Disease 162	Congenital Anomalies 483	HIV 1,468	Homicide 2,984	Cerebro-vascular 6,181	Unintentional Injury 9,651	Diabetes Mellitus 53,956	Diabetes Mellitus 73,138
7	Respiratory Distress 875	Septicemia 84	Benign Neoplasms 41	Chronic Low. Respiratory Disease 74	Cerebro-vascular 211	Diabetes Mellitus 599	Liver Disease 2,799	Diabetes Mellitus 5,567	Liver Disease 6,569	Influenza & Pneumonia 52,760	Alzheimer's Disease 65,965
8	Bacterial Sepsis 827	Perinatal Period 61	Septicemia 38	Influenza & Pneumonia 49	HIV 191	Cerebro-vascular 567	Cerebro-vascular 2,361	HIV 4,422	Suicide 4,011	Nephritis 35,105	Influenza & Pneumonia 59,664
9	Neonatal Hemorrhage 616	Benign Neoplasms 53	Cerebro-vascular 34	Benign Neoplasms 43	Influenza & Pneumonia 185	Congenital Anomalies 420	Diabetes Mellitus 2,026	Chronic Low. Respiratory Disease 3,511	Nephritis 3,963	Unintentional Injury 35,020	Nephritis 42,480
10	Circulatory System Disease 593	Chronic Low. Respiratory Disease 48	Influenza & Pneumonia 33	Cerebro-vascular 43	Chronic Low. Respiratory Disease 179	Septicemia 328	Influenza & Pneumonia 891	Septicemia 2,251	Septicemia 3,745	Septicemia 25,644	Septicemia 33,373

Source: National Vital Statistics System, National Center for Health Statistics, CDC.
Produced by: Office of Statistics and Programming, National Center for Injury Prevention and Control, CDC.

- Leading cause of death from ages 1-44 years
- Results in more deaths in children than all other diseases combined
- #1 cause of years of potential life lost
- Costs hundreds of billions of dollars annually in US

10 Leading Causes of Injury Death by Age Group Highlighting Unintentional Injury Deaths, United States – 2004

Rank	Age Group									
	<1	1-4	5-9	10-14	15-24	25-44	45-54	55-64	65+	Total
1	Unintentional MV Traffic 139	Unintentional MV Traffic 584	Unintentional MV Traffic 922	Unintentional MV Traffic 6,757	Unintentional MV Traffic 6,834	Unintentional MV Traffic 6,451	Unintentional MV Traffic 6,088	Unintentional MV Traffic 3,936	Unintentional Fall 14,899	Unintentional MV Traffic 43,432
2	MV Traffic 139	Unintentional Fire/burn 169	Suicide Suffocation	Homicide Firearm 4,127	Unintentional Poisoning 3,641	Unintentional Poisoning 6,444	Unintentional Poisoning 6,033	Suicide Firearm 2,328	Unintentional MV Traffic 7,175	Unintentional Poisoning 20,950
3	Homicide Unspecified 133	Unintentional Fire/burn 228	Unintentional Drowning 131	Homicide Firearm 139	Unintentional Poisoning 2,259			Unintentional Poisoning 1,577	Unintentional Unspecified 4,868	Unintentional Fall 18,807
4	Homicide Other Spec., Classifiable 101	Homicide Unspecified 164	Homicide Firearm 45	Unintentional Drowning 138	Suicide Firearm 2,104	Firearm 2,283	Firearm 1,895	Poisoning 1,737	Unintentional Fall 1,393	Suicide Firearm 16,750
5	Unintentional Drowning 62	Unintentional Suffocation 125	Unintentional Suffocation 45	Unintentional Fire/burn 87	Suicide Suffocation 1,516	Suicide Suffocation 1,592	Suicide Suffocation 1,667	Suicide Suffocation 1,231	Suicide Poisoning 801	Unintentional Suffocation 3,369
6	Undetermined Suffocation 56	Unintentional Pedestrian, Other 113	Unintentional Other Land Transport 37	Unintentional Other Land Transport 87	Unintentional Drowning	Suicide Poisoning 817	Suicide Poisoning	Unintentional Fall	Suicide Suffocation 775	Adverse Effects 1,857	Suicide Suffocation 7,336
7	Homicide Suffocation 42	Homicide Other Spec., Classifiable 69	Unintentional Other 36	Unintentional Suffocation 68	Homicide Cut/pierce 484	Undetermined Poisoning 602	Un...	...cide ...arm ...8	Unintentional Fire/burn 1,125	Unintentional Unspecified 6,173
8	Unintentional Fire/burn 28	Unintentional Fall 47	Unintentional Struck by or Against 21	Suicide Firearm 59	Suicide Poisoning 363	Homicide Cut/pierce 479	Un... 659	Undetermined Poisoning 1,019	Unintentional Suffocation 443	Unintentional Poisoning 901	Unintentional Suffocation 5,891
9	Undetermined Unspecified 24	Unintentional Natural/ Environment 39	Homicide Unspecified 20	Unintentional Poisoning 47	Undetermined Poisoning 329	Unintentional Drowning 385	Homicide Cut/pierce 450	Unintentional Fire/burn 504	Unintentional Fire/burn 427	Suicide Suffocation 544	Suicide Poisoning 5,800
10	Unintentional Fall 23	Homicide Firearm 36	Four* Tied 13	Unintentional Firearm 35	Unintentional Other Land Transport 284	Unintentional Fall 320	Unintentional Drowning 435	Unintentional Suffocation 468	Adverse Effects 403	Suicide Poisoning 521	Undetermined Poisoning 3,455

*Four causes are: Unintentional Firearm, Unintentional Natural/Environmental, Unintentional Other Transport, and Unintentional Unspecified.

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

Produced by: Office of Statistics and Programming, National Center for Injury Prevention and Control, CDC.

Pool fences, flotation devices

Restraint systems, road design

Smoke alarms, smoking cessation

???

Motorized Recreational Vehicles

- All-terrain Vehicles (ATVs)—off-road use, no license, > 34,000 injuries/yr
- Powered off-road cycles—use on rough terrain; no license, > 18,000 injuries/yr
  - Minibikes—small, bicycle frame, lawn mower engine
  - Minicycles—miniature motorcycles, more horsepower
  - Trail bikes—larger, more powerful than minicycles
- Powered Street-use Cycles— >5,000 injuries/yr
  - Mopeds—bicycles with small motors, may not need license
  - Scooters—enclosed engine, small wheels, larger engine
  - Motorcycles—greater speeds, license required, 20 x > risk of death than MVC
- Golf cart injuries roughly 5000 injuries/yr

ATV Characteristics

- Gasoline powered
- Knobby tires
- High center of gravity
- Engine displacement

  50-500 cm^3
- Speeds $\geq$ 70 MPH
- Mainly designed for a single rider and off-road use

ATV Injury Trends

Year	Reported Deaths[1]	Estimated Deaths	Estimated Number of Emergency-Room Treated Injuries
2008[1]	410	*	135,100
2007	699	816	150,900
2006	832	907	146,600
2005	804	932	136,700
2004	753	855	136,100
2003	653	762	125,500
2002	548	606	113,900
2001	517	593	110,100
2000	450	551	92,200
1999	397	534	82,000
1998	251	287	67,800
1997	241	291	52,800

[1] Roughly 40,000 ED injuries to kids < 16 yrs of age

http://www.atvsafety.gov/stats.html

Increasing Injuries and Exposure

- ATV-associated fatalities have increased nearly 46% recently:
  - 450 deaths in 2000
  - 832 deaths in 2006
  - However, significant decline 2007 & 2008
- Nonfatal ATV injuries treated in ED's have also risen about 49%:
  - 92,200 visits in 2000
  - 150,900 visits in 2007

ATV Injury Risks

- Children under 16 years old make up:
  - **14%** of ATV drivers
  - **~35%** of injuries and deaths
- Most children killed (95%) are operating vehicles rated for adults
- Rural white males are typical victims
- Annual hospital charges exceed $70 million
- RR of death for children is 4 to 16 times that of adults

CPSC 1998; Rodgers, 2001

ATV Injury Patterns

- Mean age = 11.1 years
- Body parts injured
  - 32% face/head, 13% lower ext, spinal cord, abd injuries
- Types of injuries sustained
  - 31% fractures, 12% lacs, 11% organ,6% ICI
- 14% occurred on the street, 70% home/other site
- 72% No protective gear or helmet

Gittelman, Pediatrics 2006

ATV Deaths

- Deaths occur in:
  - Collisions (56% of deaths)
    - more than half with fixed object
  - Overturns (35% of deaths)
    - backward more common than forward
  - 60% occur on roadways
  - Only 1% on ATV trails

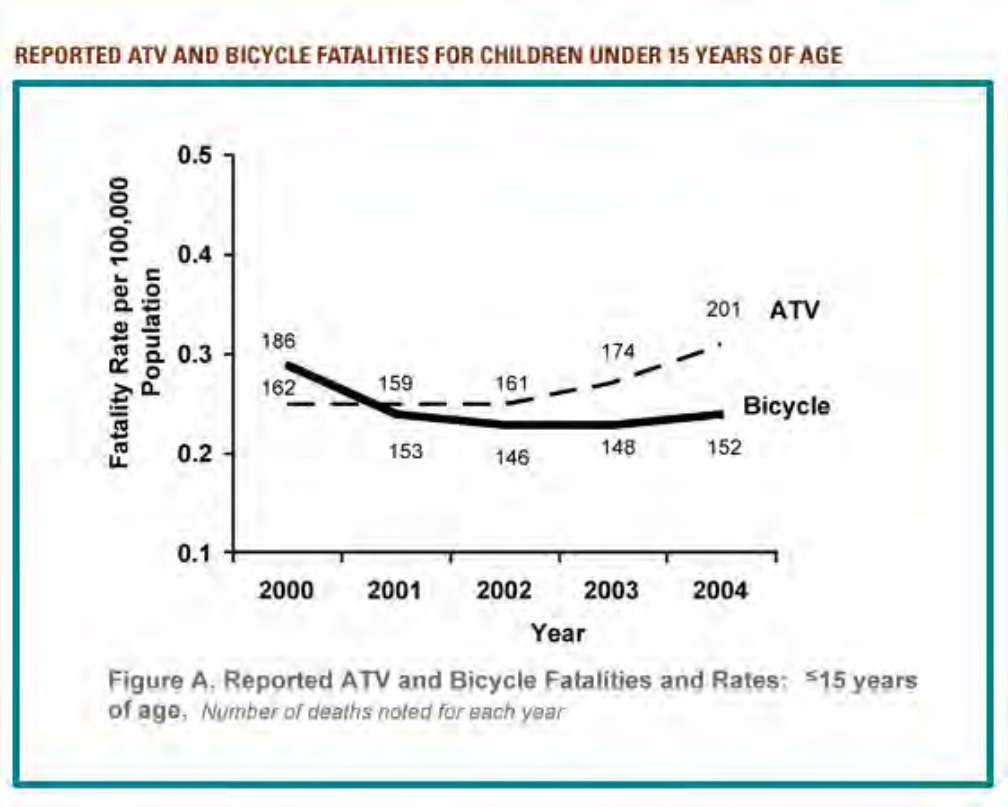
ATVs vs. Bicycles,Cars, & Motorcycles

- ATV injury severity significantly higher than bicycle injury for children
- Injury severity scores comparable to MVC

Brown, J Pediatric Surgery 2001

- More frequent head trauma (50%) among patients who sustained ATV rather than motorcycle injuries (30%)

Acosta and Rodriguez, J of EM 2007



Dirtbike Characteristics

- Two-wheeled, motorized vehicles (minibikes, trailbikes, dirtbikes, mopeds, etc.) used for recreation and transportation.
- Many are illegally operated at excessive speeds, by minors, on public roads.
- US Consumer Product Safety Commission estimated 40,000 ED visits nationwide due to two-wheeled off-road vehicles (26% to children < 15 years old)
  - Mean age of pediatric moped injuries is < 13 years.

Off –Road Cycle Risks

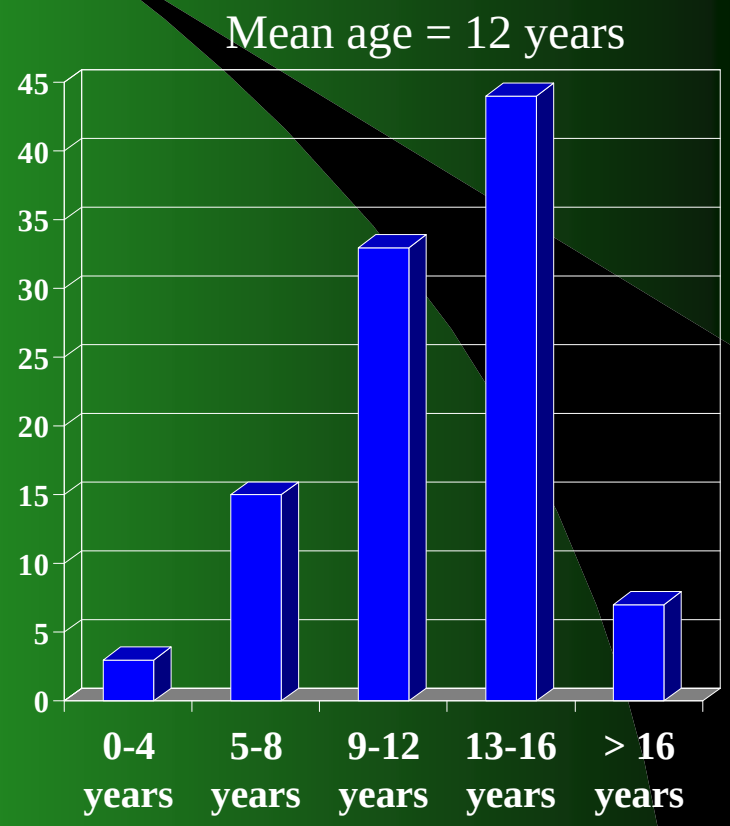
- Illegal use on roadways
- Poor design
  - Small tires
  - Short wheelbase
  - Slow acceleration
  - Inadequate brakes
- No helmet
- Young age, inexperienced driver
- Males
- Alcohol

Street use Cycle Risks

- > 1 rider
- Male >> female
- No helmet
- < 20 y.o/Inexperienced driver
- High traffic roads
- Insufficient acceleration, smaller engines
- Lack of stability and protection in a crash
- Alcohol

Motorized Two-wheeled Injury Patterns

- Body parts injured
  - 37% lower ext, 28% face/head
- Types of injuries sustained
  - 54% fractures, 14% lacs, 6% ICI
- 40% occurred on the street
- Protective gear
  - 59% no helmet, 97% no protective gear

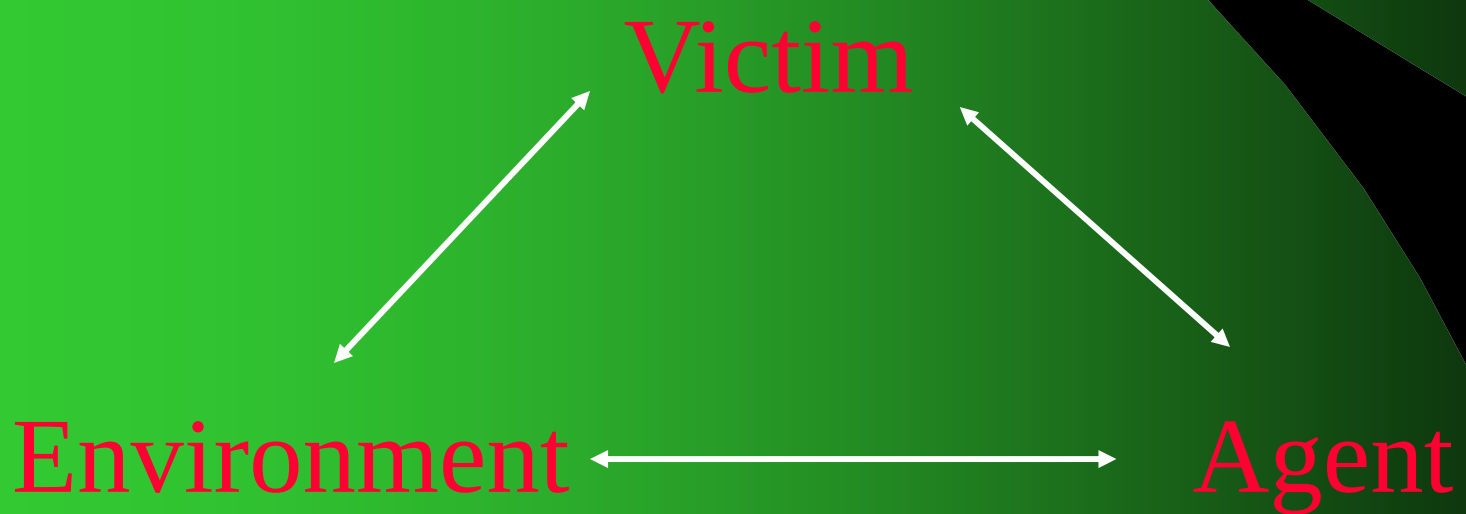


Pomerantz, Pediatrics 2005

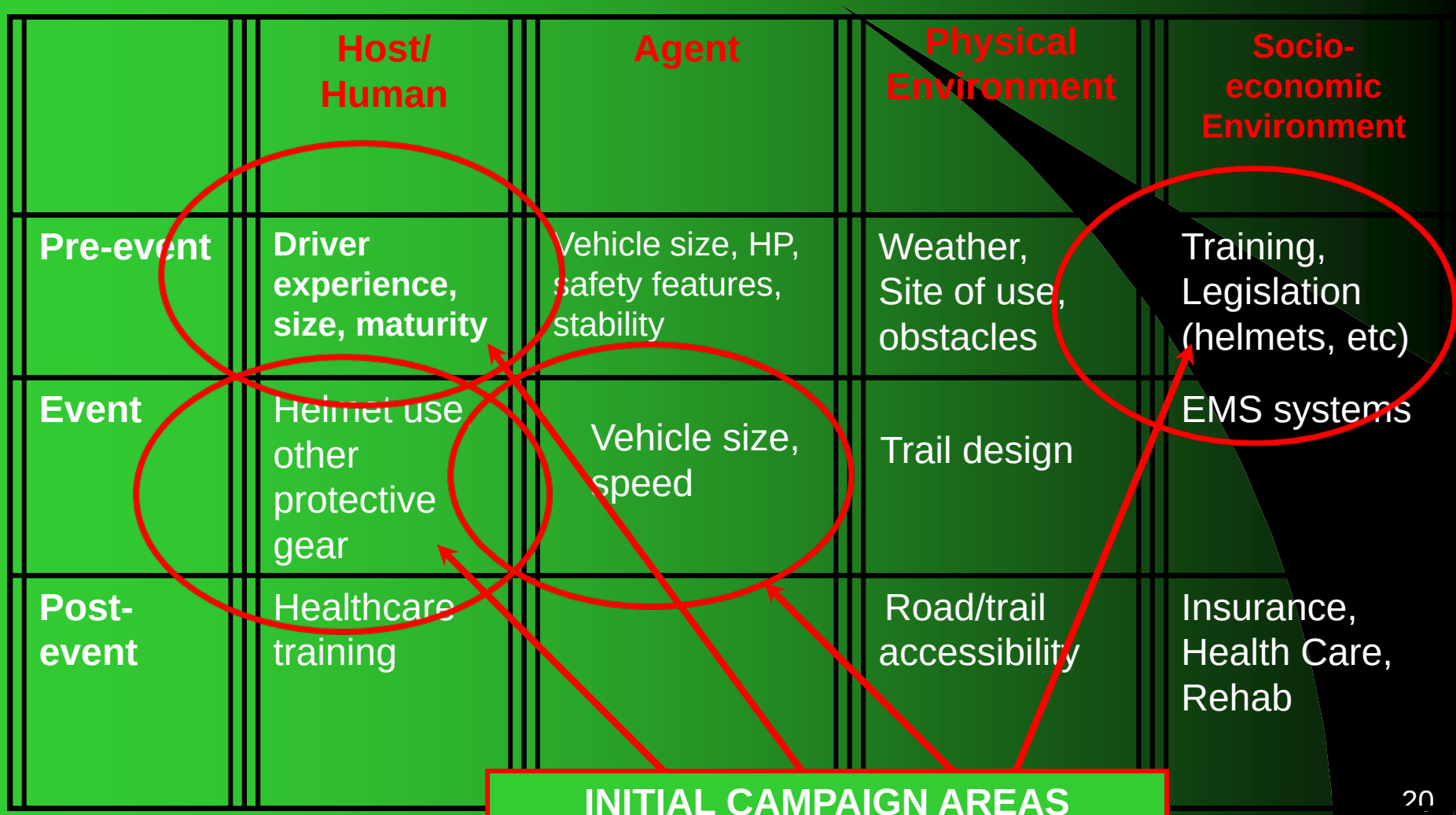
Public Health Approach to Prevention

- Define the problem
- Identify causes or risk factors
- Develop or test interventions
- Implement intervention and measure prevention effectiveness

Factors in the Prevention of Injury



Haddon Matrix for ATV Injury



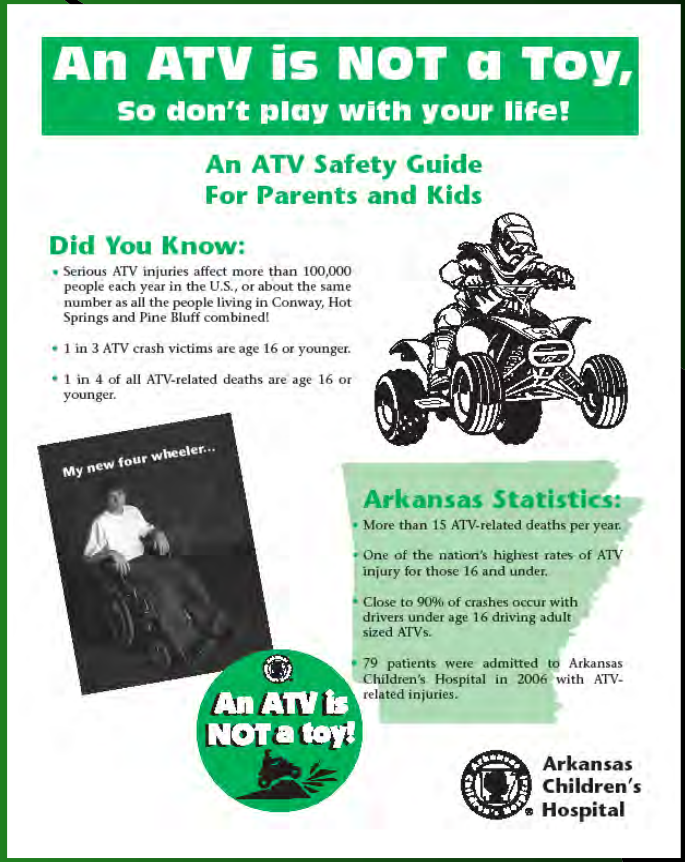
	Host/ Human	Agent	Physical Environment	Socio-economic Environment
Pre-event	**Driver experience, size, maturity**	Vehicle size, HP, safety features, stability	Weather, Site of use, obstacles	Training, Legislation (helmets, etc)
Event	Helmet use, other protective gear	Vehicle size, speed	Trail design	EMS systems
Post-event	Healthcare training		Road/trail accessibility	Insurance, Health Care, Rehab

INITIAL CAMPAIGN AREAS

Education

- Industry-sponsored programs (SVIA)
  - <10% of new purchasers comply
  - Large secondary market with limited access
  - No formal evaluation published
- National 4H program
  - Consultant evaluation demonstrated increased helmet use and safety gear
  - Less effective with use on or along roads

    4-H Community Safety Program, *Changing Behaviors, Saving Lives*, 2004
- Other programs—hospitals, research



Key questions: Education

- What is the message—no ATV use or safer ATV use?
- What is the most important target audience—parents, adolescents?
- Dose of exposure needed to cause change in behavior?
- Does training really work?
- Can objective markers of physical readiness and/or maturity predict ATV risk?
- How effective is secondary prevention—can brief interventions work to motivate parents/youth after an ATV crash?
- Should we adopt a Graduated Driver's Licensing approach to ATV safety?

Enactment of Policies

- American Academy of Pediatrics
- Consumer Product Safety Commission
- Other Federal Agencies
- State level policies

Professional Society Policy

- **American Academy of Pediatrics:**
  - **Education:** motorcycle helmets; eye protection; and protective reflective clothing
  - **Engineering:** seat belts; roll bars; headlights; and speed governors
  - **Legislation:** helmet use; banning 3 wheelers; requirements for licensing/certification; minimum driver age 16 years; prohibition of alcohol, passengers, and ATV use at night

Pediatrics, 105: 1352-54, June 2000

Federal ATV Policy

- **1983-86**: 300% increase in ATV-related ED visits
- **1988-98**: Consumer Product Safety Commission
  - Banned three-wheeled ATV's
  - 10 year consent decree
    - warning labels, minimum age recommendations
    - increased voluntary safety standards, nationwide training program
- **2002-04:** Petition to CPSC to ban ATV sales to youth under 16 years
- **2006:** Senate hearings on new rules for manufacturing standards and youth ATVs

Changing Rules at CPSC?

- Previous standards:
  - 50 cc: ages 12 and under
  - 90 cc: ages 12-16
  - > 90 cc: ages 16 and older
- Proposed new standards:
  - Speed rather than size determines vehicles considered “youth models”
  - More rigid manufacturing standards
  - Restricts some offshore imports

Do laws work for ATVs?

- Study compared states with
  - No laws
  - Laws governing equipment only
  - Laws governing driver behavior
- States with no laws had injury rates twice as high as those with laws

Source: Helmkamp, AJPH, 2001

- Several studies indicating a trend toward increased helmet use in jurisdictions with helmet laws

State-level Legislation

- 44 states have at least minimal ATV legislation
  - Typical legislation includes parental supervision for young children, licensing/registration requirements, and bans on riding ATVs on public roads
  - States without these laws have significantly higher death rates

AJPH, 91: 1792-1795, November 2001

Acceptability of Legislation

- Recent wave of laws nationally indicates support
- Recent survey of Ohio voters:
  - 90% supported legislation in general terms
  - 78% supported helmet requirement
    - Among ATV riders, helmet use would double if law passed
  - 81% of voters supported passenger restriction and restriction for children <16
  - 77% supported training requirements

Source: Center for Injury Research and Policy, Columbus, OH, 2007

Enforcement

- Poor enforcement of existing policies is a major downfall
- Even in areas with motivated enforcement, laws may not apply on private property
- Substantial local variability in support for legislation, including ATV use on paved surfaces

Key questions: Enactment

- Do existing policies work to decrease injuries?
- What combination of policies is required to achieve effective prevention?
- How can we improve enforcement?
- Are other avenues for policy (insurance, liability) potentially more effective than legislation?

Engineering

- Little is known (outside the ATV manufacturing industry) about the real-life performance characteristics of ATVs
- Less is known about vehicle performance with children on board
- Little is known about the performance characteristics of protective gear
  - Helmet effectiveness—reduction of 42% for mortality; 62% reduction in any head injury - *Rodgers, Accident Anal Prev,1990*
  - Yet no significant difference in mean ISS between helmeted and non-helmeted riders. Helmet usage was not associated with a reduction in head/facial injuries. –Gittelman, Pediatrics, 2006
- Engineering research from objective sources is lacking

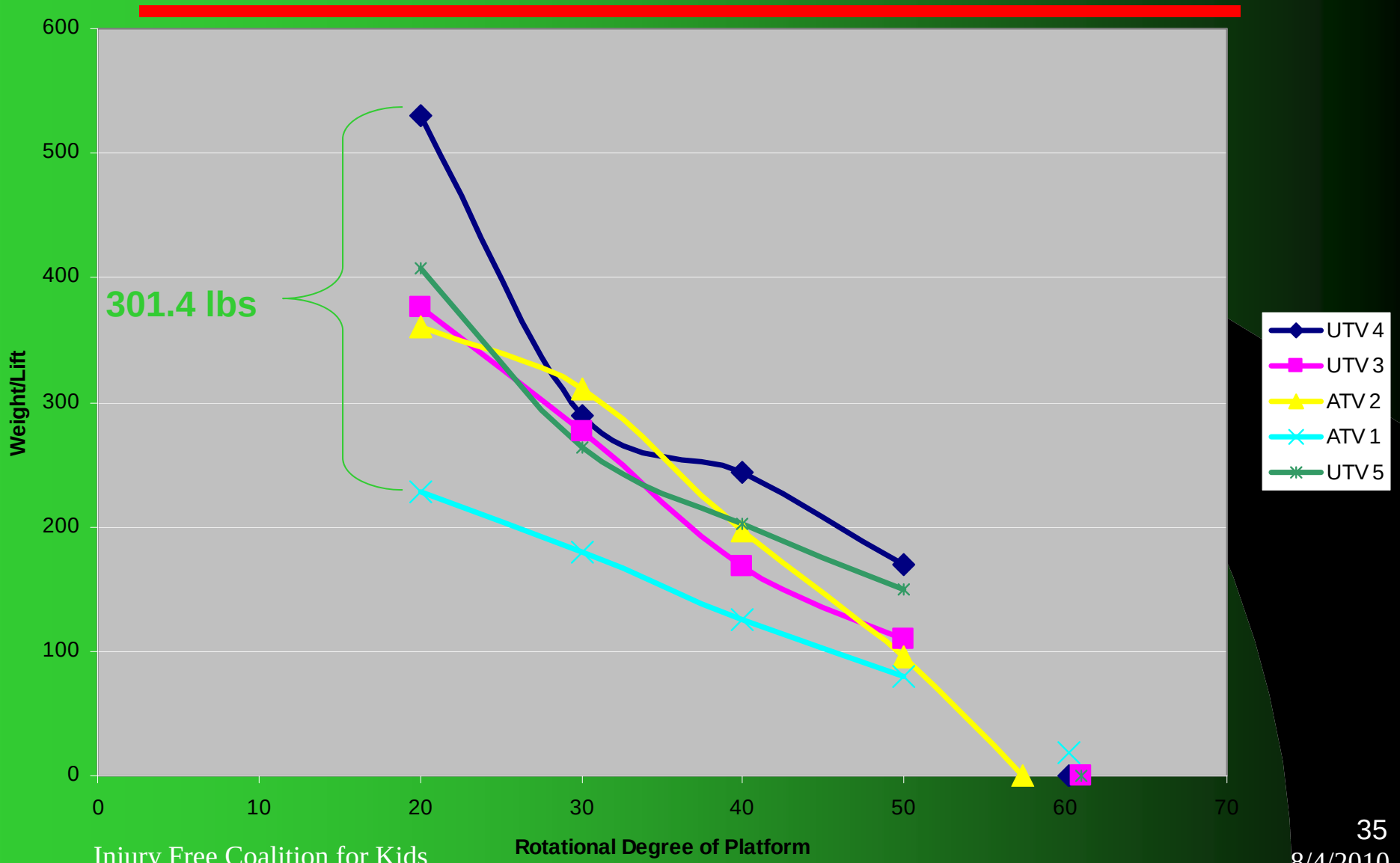
ATV Stability Project

- 45% of ATV crashes result from the machine tipping over
  - 43% lateral (side to side)
  - 57% longitudinal (front to back)
- Objective: Determine if tipping increases with
  - engine size
  - weight of person
  - number of passengers

ATV testing

Results

Front to Rear Comparison



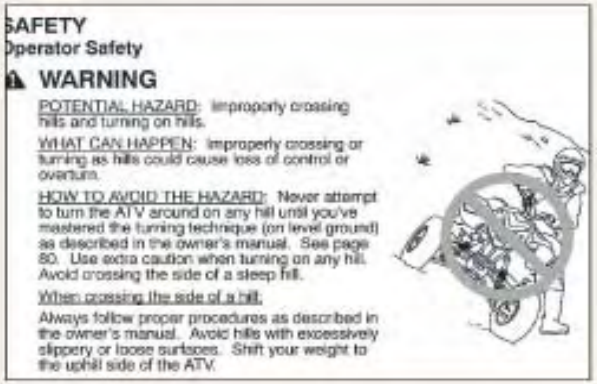
Do as they say, not as they advertise

When it comes to marketing ATVs, manufacturers emphasize thrills and ruggedness – not the extensive hazard warnings that come with the machines. Advertising images seem to contradict cautions against climbing steep hills, making jumps, performing stunts and riding over rough terrain. Disclaimers, if present, are usually fleeting or in small print.

POLARIS

ON THE WEB SITE: [redacted] shown turning sharply enough to kick up dirt on what looks like a 25-degree hillside.

IN THE OWNER'S MANUAL: "Use extra caution when turning on any hill. Avoid crossing the side of a steep hill. ... Never operate this vehicle on hills steeper than 25 degrees."


SAFETY
Operator Safety

⚠ WARNING

POTENTIAL HAZARD: Improperly crossing hills and turning on hills.

WHAT CAN HAPPEN: Improperly crossing or turning as hills could cause loss of control or overturn.

HOW TO AVOID THE HAZARD: Never attempt to turn the ATV around on any hill until you've mastered the turning technique (on level ground) as described in the owner's manual. See page 80. Use extra caution when turning on any hill. Avoid crossing the side of a steep hill.

When crossing the side of a hill:

Always follow proper procedures as described in the owner's manual. Avoid hills with excessively slippery or loose surfaces. Shift your weight to the uphill side of the ATV.

WHAT [redacted]S: The ATV shown on the Web site "is not being operated in violation of warnings and is not intended to depict actual riding conditions. ... The distorted view and lighting effects are intended to project a surreal look for the vehicle."

ARCTIC CAT

ON THE WEB SITE: [redacted] model is shown in midair with the text: "Hold on for all you're worth." No visible disclaimer.

IN THE OWNER'S MANUAL: "Never attempt stunts, such as wheelies or jumps. ... The faster you go, the more likely you are to destroy your head and internal organs, and skip the wheelies, jumps, stunts and any other showboating."

WHA[redacted] SAYS: "These are professional riders in a controlled [redacted] racing machine built to jump."

BOMBARDIER/CAN AM

ON THE WEB SITE: The steep incline and boulders suggest [redacted] der can tackle the most rugged terrain.

IN THE OWNER'S MANUAL: "Never operate ... on hills too steep for the vehicle or for your abilities. ... Do not operate on excessively rough, slippery or loose terrain until you have learned and practiced the skills necessary."

W[redacted]IER SAYS: Declined to respond to multiple requests for comment.

— Susan Goldsmith

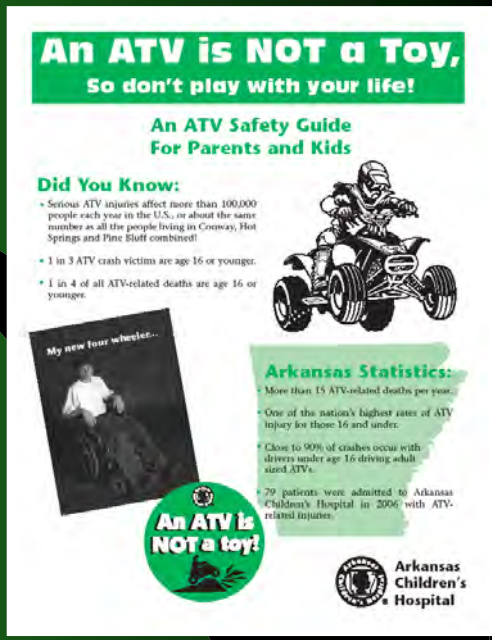
The Oregonian, May 18, 2007

Key questions: Engineering

- Can vehicles be modified to make them safe(r) for children?
  - If so, how: Speed regulators, stability control, roll bar/seat belts?
- Which is more important in safety: speed control or size of vehicle?
  - Will such vehicles be produced?
  - If produced, will they appeal to consumers?
- Can helmets be improved (more appealing, lighter, cooler) and retain effectiveness?

Injury Control Strategies

- Human
  - Education/Empowerment
    - Industry-sponsored programs
    - 4 H Program
    - Hospital, schools, etc.
- Agent
  - Engineering/Technology
    - Tipping, seatbelts, rollbars, engine size
- Environmental modifications
  - Enforcement/Legislation
    - AAP Policy, CPSC, State Govt
  - Safe places to ride



- Collaborative effort
- Multidisciplinary
- A variety of settings

Summary

- Significant injuries occur to children as a result of ATVs and Dirtbikes
- ATV/Dirtbike injury prevention challenges many accepted paradigms of injury control
  - May be some successes as deaths have declined
- Many questions exist about effective prevention strategies
- Successful ATV injury prevention will require:
  - Collaboration across all stakeholders
  - Rigorous application of behavioral, public health, and engineering sciences
  - New and creative approaches
  - Long term perspective

Questions?