Cost-effectiveness of Wearing Head Protection on ATVs

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University of Kentucky
October, 19-23, 2008
Sixth International Symposium
Public Health and the Agricultural Rural Ecosystem
Saskatoon, Saskatchewan

Acknowledgments

- Editorial assistance of Teresa Donovan of the University of Kentucky, College of Public Health

- Funded by NIOSH Cooperative Agreement 5U50 OH0747-04

- Human subjects review by the University of Kentucky Office of Research Integrity, IRB# 06-0557-P4S

Overview

- The ATV Injury Problem
- Brad's Last Ride
- Decision Analysis
  - What is the probability of an ATV crash?
  - What is the probability of a head injury from an ATV crash?
  - How many injuries can be averted when a helmet is worn?
- Cost Analysis
  - What is the expected value of wearing a helmet?
  - What is the social savings associated with using a safety helmet during a crash?

The All-Terrain Vehicle (ATV) Injury Problem
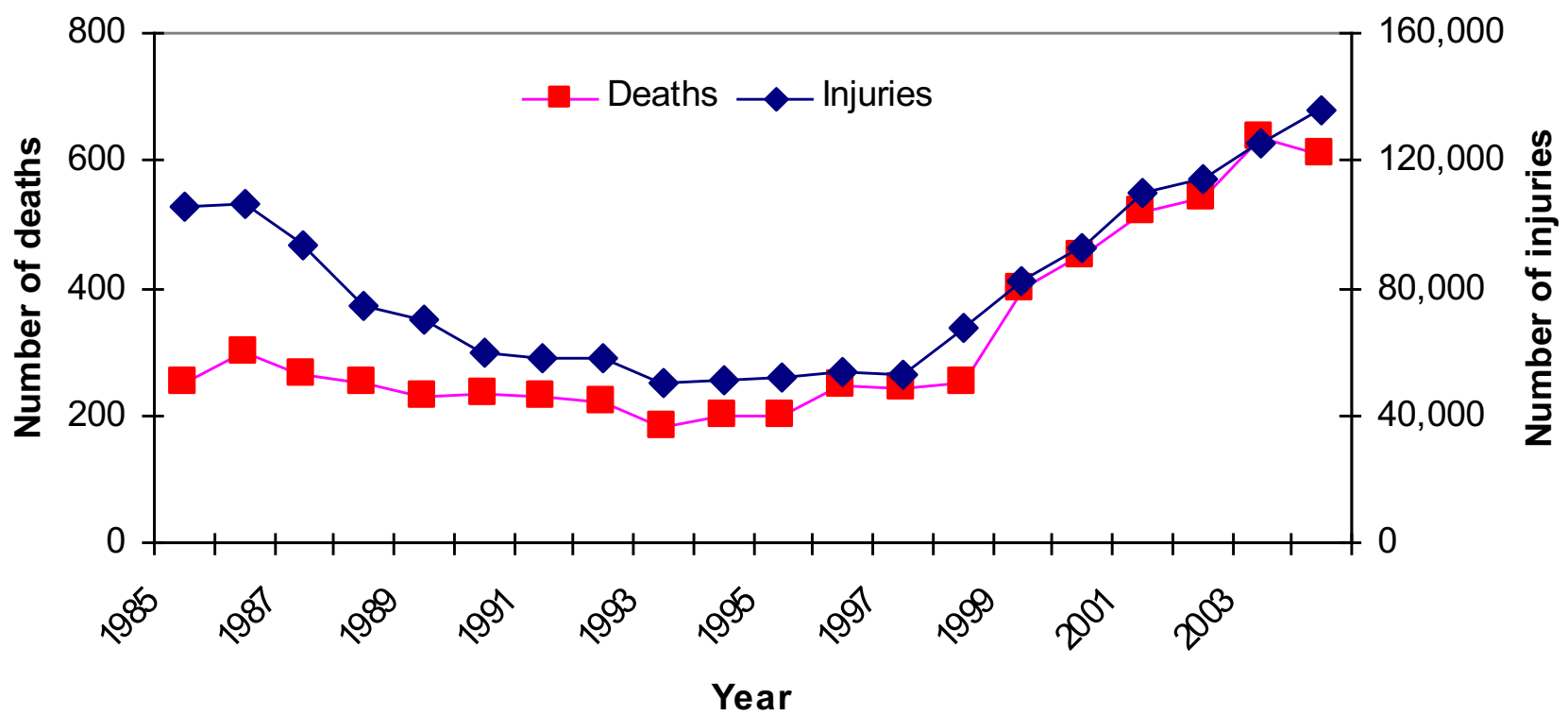
Dairy farmer died 15 days after ATV rolled over him

Source: NIOSH FACE Report, 2003 WI 059

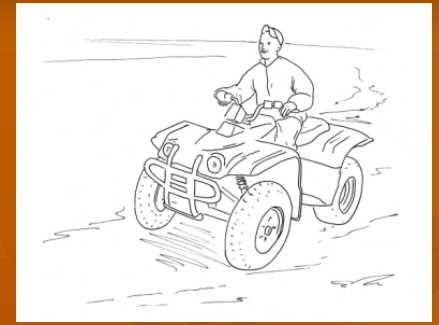# Beef farmer pinned under overturned ATV in Wisconsin

Source: NIOSH FACE Report, 2000 WI 039

Teenager drowned when pinned under an overturned ATV in a pond

Source: OSHA Investigation

Background

- 1970: ATVs were introduced into the US
- 2001: 5.6 million ATVs in use
- 2004:
  - 767 ATV-related deaths: an increase from 183 (419%) in 1993
  - 136,100 emergency-room-treated injuries: an increase from 49,800 (273%) in 1993
- Number of head injuries is high
- Helmets are effective at reducing head injuries

Objective

- Determine the cost-effectiveness of wearing a helmet while driving an ATV.
  - Cost (or savings) per injury averted by helmet use
    - Decision analysis with a decision tree to find injuries averted
    - Cost-effectiveness analysis using automobile crash cost data
- Based upon a narrative used for changing the attitudes of ATV drivers
  - Similar to previous analyses based upon other narratives
  - This narrative was *Brad's Last Ride*
    - involved a youth who suffered a serious head injury as a result of an ATV collision with a fence post
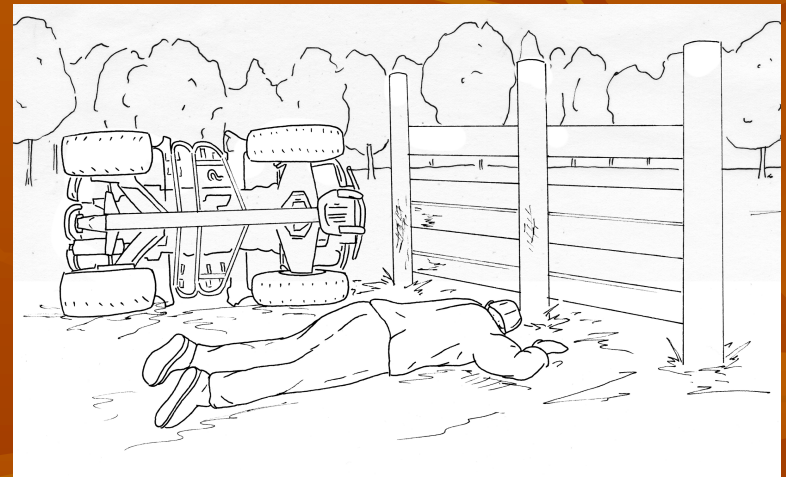
Brad's Last Ride

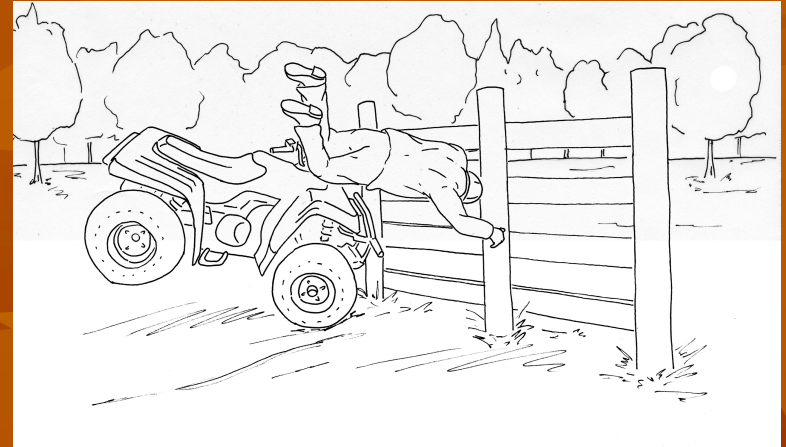- Intervention cost
  - Helmet: $53
  - 4 years adult supervision $1,680/year = $6,720
  - Total: $6,773
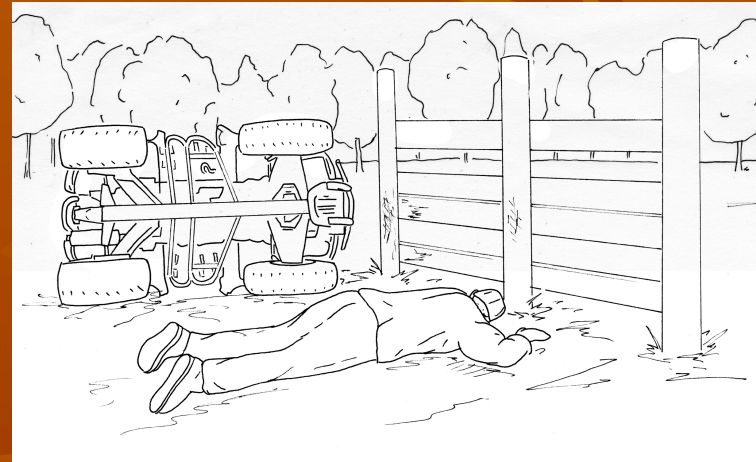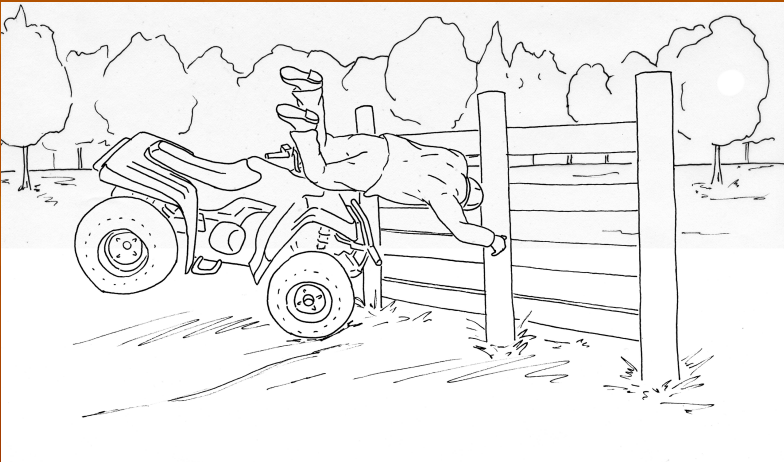
Questions

- What is the probability of an ATV crash?
- What is the probability of a head injury from an ATV crash?
    - Without a safety helmet
    - With a safety helmet
- How many injuries can be averted when a helmet is worn?

Decision Analysis

- Determine the increment of injuries averted during an ATV crash by comparing outcomes
  - wearing
  - not wearing a helmet

- An ATV crash
  - Collision with another object
  - An overturn
  - An ejection from the ATV (fall)
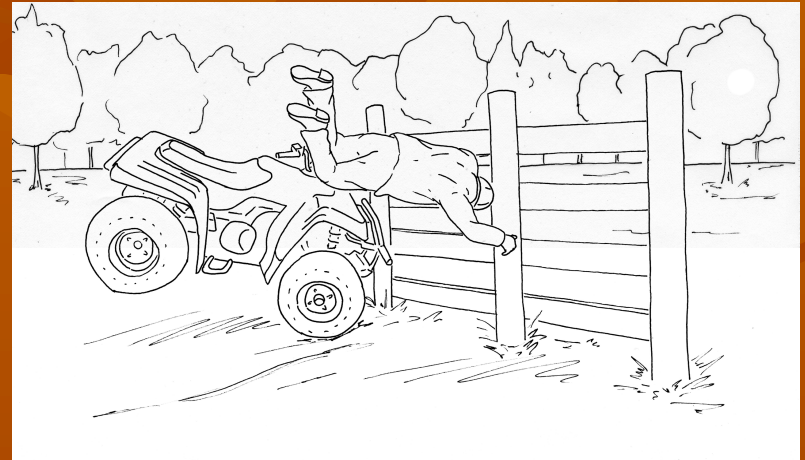
Decision Tree

Wear a helmet

CHOICE

Don't wear a helmet
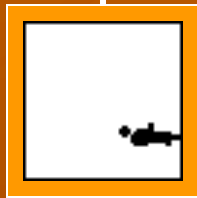
Decision Tree

Crash

Wear a helmet

No crash

Crash

Don't wear
a helmet

No crash
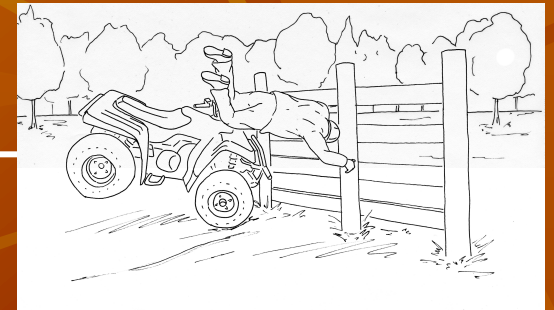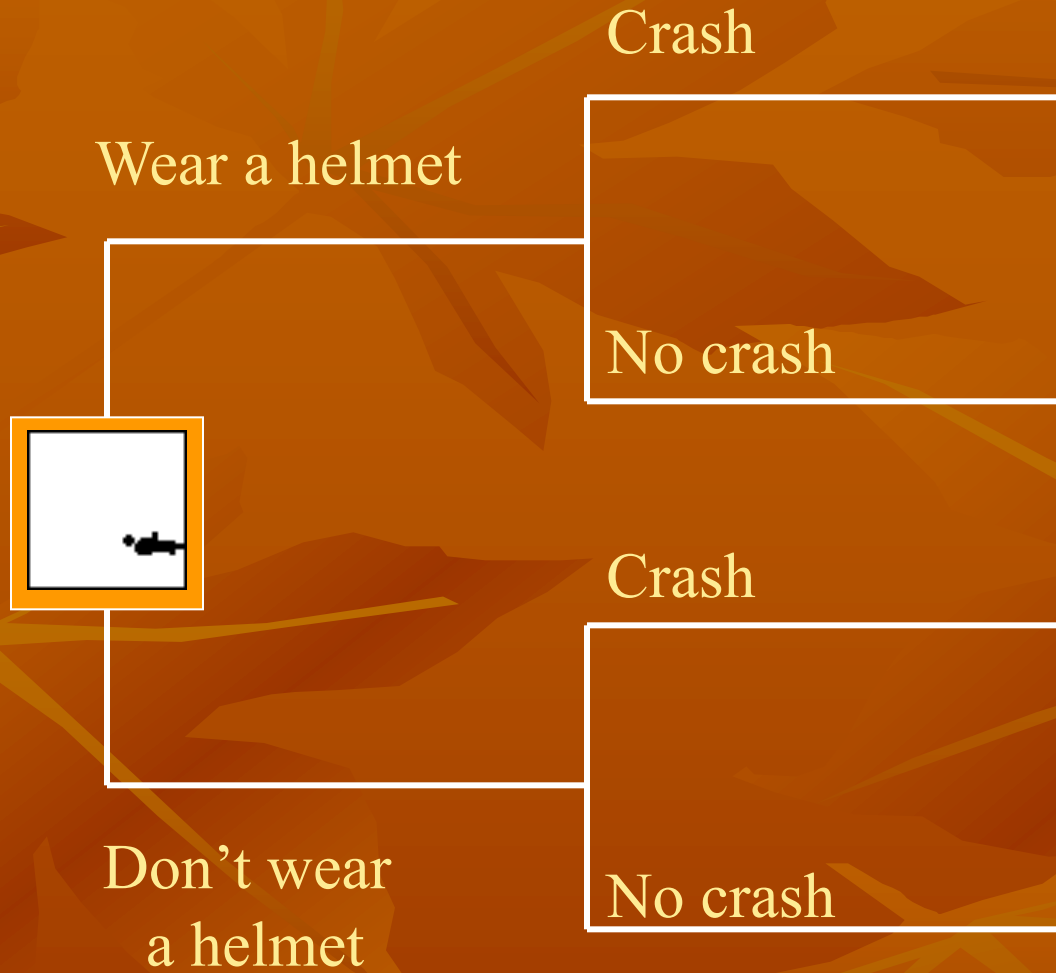
What is the probability of an ATV crash (per year)?

- Crash
  - 37.4 hospital emergency department (ED) visits per million hours (Levenson 2003)
  - 252 average annual hours driving time (Rodgers 1999)
  - 13.7% hospital visits/crash (Lower et al. 2005)
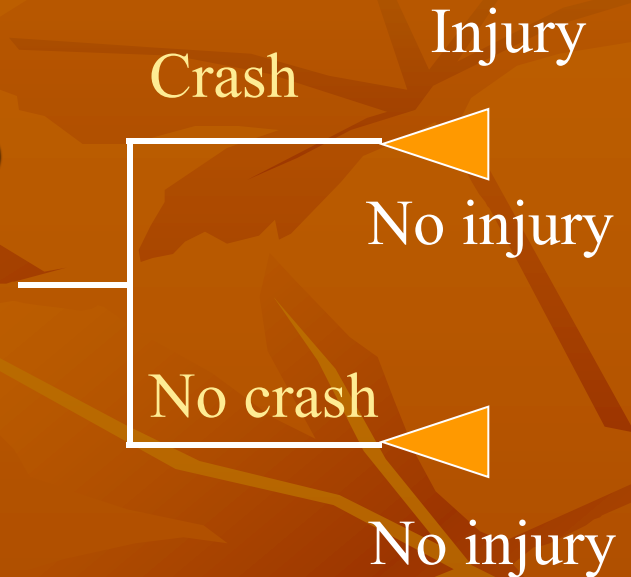
- Probability of a crash
  - = hospital visits + no hospital visits
  - 37.4 hospital visits (crashes) /1 million hrs * 252 hrs/yr = 0.01192
  - 0.01192 hospital visits/yr * 1/0.137 hospital visits/crash = 0.08960
  - Probability of an ATV crash per driver per year = 0.10152 (10.15%)

Crash
Injury
No injury

No crash
No injury

What is the probability of a head injury from a crash?

Wear a helmet

- Crash
  - Injury
  - No injury
- No crash
  - No injury

Don't wear a helmet

- Crash
  - Injury
  - No injury
- No crash
  - No injury
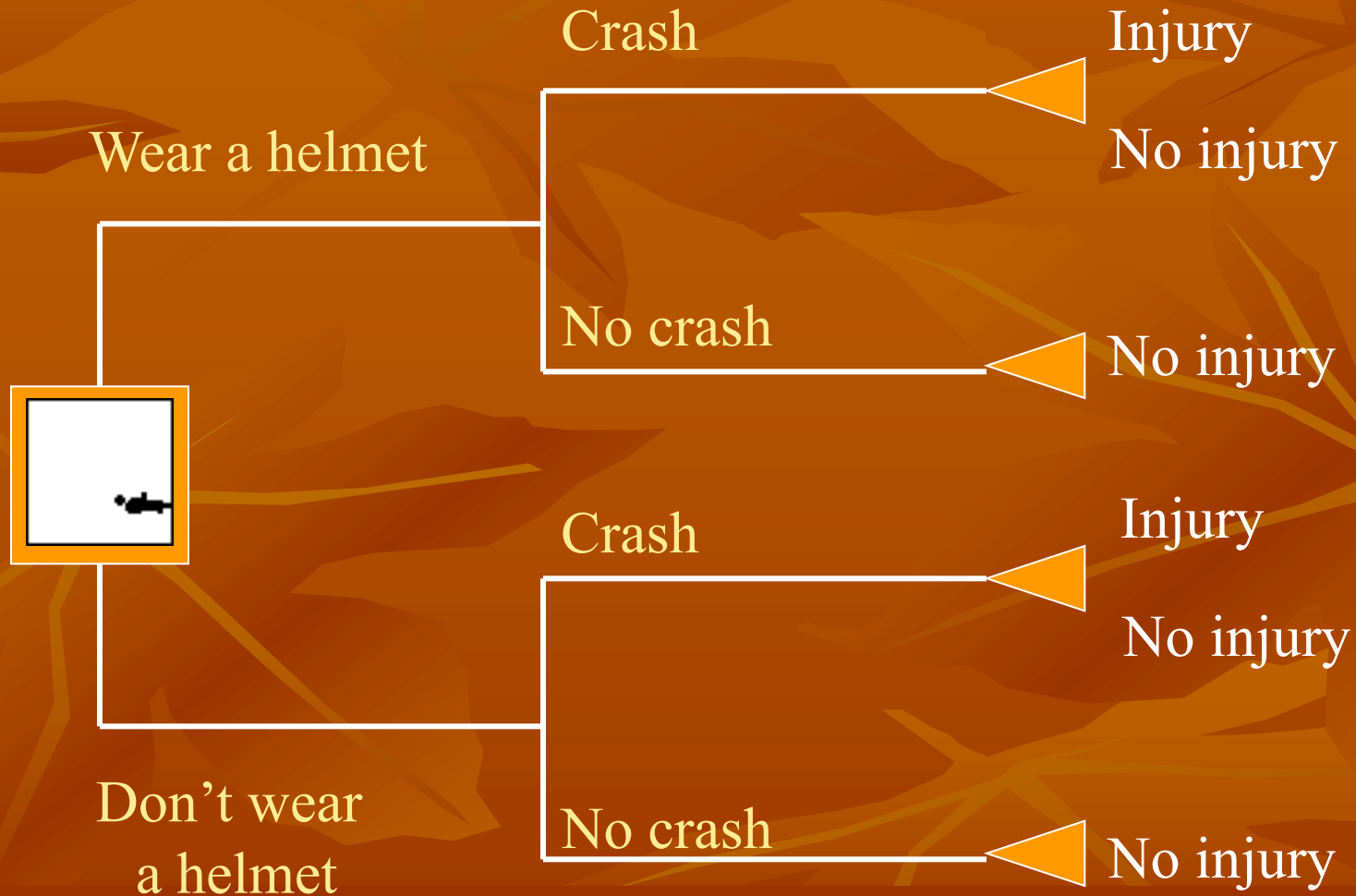
Abbreviated Injury Scale (AIS)

- 6 Untreatable
  - Death
  - e.g., Massive skull destruction
- 5 Critical
  - Loss of Consciousness (LOC): 6 to > 24 hours
  - e.g., Brain stem contusion
- 4 Severe
  - LOC: < 24 hours
  - e.g., Artery occlusion

- 3 Serious
  - LOC: < 6 hours
  - e.g., Traumatic aneurysm
- 2 Moderate
  - LOC: < 1 hour
  - e.g., Skull fracture
- 1 Minor
  - LOC: None
  - e.g., Cerebral concussion

What is the probability of a head injury from an ATV crash?

- Wear a safety helmet (Rodgers 1990)
  - Fatal: risk reduced by 42%
  - Nonfatal: risk reduced by 64%
- Don't wear a safety helmet

Wear a helmet

Don't wear a helmet

What is the probability of a head injury from an ATV crash?

- Index Value
  - 577,800 ED-treated ATV injuries, 2000-2004 (Elder & Streeter 2007)
- Traumatic Brain Injury (TBI)
  - 85.4% taken to ED (Walker et al. 2004)
  - 20% of ATV-related injuries were to the head (Helmkamp et al. 2008)
- Helmet usage
  - 51.8% usage on ATVs in 1997 (Rodgers 1999)

Crash ———————◁ Injury

- AIS
  - Death (Elder & Streeter 2007)
    - 2,753 deaths from ATV injuries, 2000-2004
  - Critical (Demetriades et al. 2004)
    - 8.3% of head injuries at a trauma center
  - Severe (Demetriades et al. 2004)
    - 14.4% of head injuries at a trauma center
  - Serious (Demetriades et al. 2004)
    - 16.3% of head injuries at a trauma center
  - Moderate (Brooks et al. 1995)
    - 67.3% of 2 through 6
  - Minor (Walker et al. 2004)
    - 55.5% of head injuries/no coma

How many injuries can be averted when a helmet is worn?

Crash

Wear a helmet

"Don't wear a helmet" minus "Wear a helmet"

Injury

6
5
4
3
2
1

Don't wear a helmet

Crash

Injury

6
5
4
3
2
1

Per 100,000 drivers/year

- 6 Untreatable   10
- 5 Critical   260
- 4 Severe   452
- 3 Serious   511
- 2 Moderate   952
- 1 Minor   <u>883</u>
- TOTAL   3,068

More Questions

- What is the expected value of wearing a helmet?

- What is the social cost or savings associated with using a safety helmet during a crash?
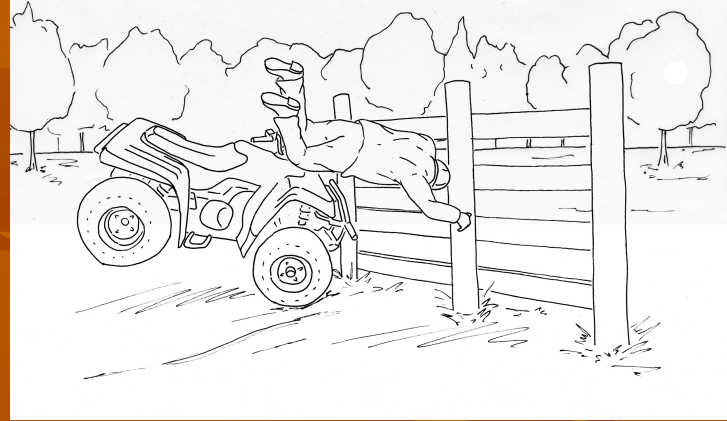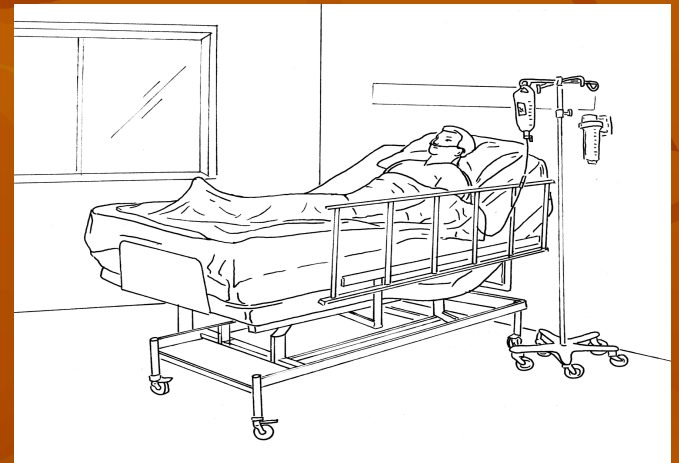
What is the expected value of wearing a helmet?

Cost Factors (2008 dollars)

- 6 Untreatable $4,300,140
- 5 Critical $3,069,529
- 4 Severe $934,438
- 3 Serious $401,356
- 2 Moderate $201,772
- 1 Minor $19,182
- Intervention: $6,773

Source: Blincoe L 2002

What is the expected value of wearing a helmet?

AIS	Probability	Cost	Product*
6 Untreatable	0.000097	$4,300,140	$7,623
5 Critical	0.002603	$3,069,529	$145,859
4 Severe	0.004516	$934,438	$77,036
3 Serious	0.005112	$401,356	$37,454
2 Moderate	0.009521	$201,772	$35,070
1 Minor	0.008832	$19,182	$3,093
50-year Expected Value (includes intervention cost)			$299,361

* 5% discount rate

What is the expected value of wearing a helmet?

Discount Rate	Analytic Time Horizon (Includes intervention cost)		
	50 years	25 years	10 years
0%	$831,678	$412,453	$160,917
5%	$299,361	$229,569	$122,713

What is the savings associated with using a safety helmet during a crash?

Discount Rate	Cost-Effectiveness [savings per injury averted; Includes intervention cost]		
	50 years	**25 years**	**10 years**
0%	$542,164	$537,748	$524,503
5%	$534,486	$530,915	$517,989

Intervention Cost

- Assumed cost
  - Helmet price = $53.00
  - Adult supervision (4 years) = $6,720
- Sensitivity Analysis
  - Helmet price only = $53.00
- Cost-effectiveness results (50-year horizon at 5% discount rate)
  - At the assumed cost: $546,484
  - At the helmet price only: $544,868
  - A difference of 2%

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