Cost-effectiveness of Wearing Head Protection on ATVs

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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

![Graph showing the number of deaths and injuries from 1985 to 2003. The number of deaths and injuries increases over time.]

- **Deaths**
- **Injuries**
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

Don’t wear a helmet
Decision Tree

Wear a helmet

Crash

No crash

Don’t wear a helmet

Crash

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%)
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
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)

- **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?

<table>
<thead>
<tr>
<th>Injury</th>
<th>Wear a helmet</th>
<th>“Don’t wear a helmet” minus “Wear a helmet”</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td></td>
<td></td>
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<tr>
<td>5</td>
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<td>1</td>
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</tbody>
</table>

Per 100,000 drivers/year

- 6 Untreatable: 10
- 5 Critical: 260
- 4 Severe: 452
- 3 Serious: 511
- 2 Moderate: 952
- 1 Minor: 883
- 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?

<table>
<thead>
<tr>
<th>AIS</th>
<th>Probability</th>
<th>Cost</th>
<th>Product*</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 Untreatable</td>
<td>0.000097</td>
<td>$4,300,140</td>
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<td>5 Critical</td>
<td>0.002603</td>
<td>$3,069,529</td>
<td>$145,859</td>
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<td>4 Severe</td>
<td>0.004516</td>
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<td>$77,036</td>
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<td>3 Serious</td>
<td>0.005112</td>
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<td>$37,454</td>
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<td>2 Moderate</td>
<td>0.009521</td>
<td>$201,772</td>
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<td>1 Minor</td>
<td>0.008832</td>
<td>$19,182</td>
<td>$3,093</td>
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</table>

50-year Expected Value (includes intervention cost) $299,361

* 5% discount rate
What is the expected value of wearing a helmet?

<table>
<thead>
<tr>
<th>Discount Rate</th>
<th>Analytic Time Horizon (Includes intervention cost)</th>
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<td>50 years</td>
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<tr>
<td>0%</td>
<td>$831,678</td>
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<tr>
<td>5%</td>
<td>$299,361</td>
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</table>
What is the savings associated with using a safety helmet during a crash?

<table>
<thead>
<tr>
<th>Discount Rate</th>
<th>Cost-Effectiveness [savings per injury averted; Includes intervention cost]</th>
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<tbody>
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<td>50 years</td>
<td>25 years</td>
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<td>10 years</td>
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<td>0%</td>
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<td>$524,503</td>
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<td>5%</td>
<td>$534,486</td>
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<td>$530,915</td>
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<td>$517,989</td>
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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%
References