THE EPIDEMIOLOGY OF TRAUMATIC BRAIN INJURIES IN NEW YORK STATE

Michael Bauer, Sarah Sperry, Kainan Sun, Susan Hardman
New York State Department of Health, Bureau of Injury Prevention
What is Traumatic Brain Injury?

- Damage to the brain that results from:
  - Violent shaking
  - Striking a stationary object
  - Being struck by a moving object

- Prevention is the ONLY cure!
Injuries are not Accidents

- Traumatic Brain Injuries are not random, uncontrollable acts of fate but rather occur:
  - In highly predictable patterns
  - With recognizable risk factors
  - Among identifiable populations

A TBI is a predictable and preventable event!

- This presentation will demonstrate some of these patterns in NYS.
Traumatic Brain Injury

- TBI data is like an iceberg.
  - Death data is just the tip of the problem
  - Hospitalization Discharge Data
  - Emergency Department (ED) Visit Data
  - Other medical treatment, or Untreated?
Traumatic Brain Injury
New York State, 2006-2008

- Deaths
  - 11.1/100,000 New Yorkers

- Hospitalizations
  - 96.2/100,000 New Yorkers
  - Average stay of 7 days
  - Average charge of $37,839

- ED Visits
  - 425.4/100,000 New Yorkers
  - Average charge of $1,909

µ = mean annual frequency
The rate of Traumatic Brain Injury (TBI) hospitalizations have been increasing over time.

→ The rate of TBI hospitalizations have been increasing over time.
The rate of TBI ED Visits have increased each year since the data has been collected.
Gender Differences with TBI

- **73% of deaths were males**
  - Mean annual frequency male = 1,569 (16.7 per 100,000)
  - Mean annual frequency female = 585 (5.9 per 100,000)

- **62% of hospitalized TBI patients were male**
  - Mean annual frequency male = 11,526 (122.7 per 100,000)
  - Mean annual frequency female = 7,103 (71.2 per 100,000)

- **55% of ED Visits TBI patients were male**
  - Mean annual frequency male = 45,190 (481.1 per 100,000)
  - Mean annual frequency female = 37,192 (373.0 per 100,000)
Incidence of Unintentional Traumatic Brain Injuries Hospitalizations
New York State Residents, 2006-2008

Legend
New York State Counties
Age-Adjusted Rate per 100,000 County Residents
Quartiles

- 36.8 - 65.9
- 66.0 - 87.8
- 87.9 - 111.1
- 111.2 - 186.5

Source: NYSDOH, Bureau of Injury Prevention
www.health.ny.gov/injury_prevention
SPARCS January 2010

This data does not include patients that were treated in hospitals outside of NYS, therefore, the burden of injuries in border counties may be underestimated.
Incidence of Unintentional Traumatic Brain Injuries
Emergency Department Visits†
New York State Residents§, 2006-2008

Legend
New York State Counties
Age-Adjusted Rate per 100,000 County Residents
Quartiles
- 200.1 - 420.0
- 420.1 - 592.4
- 592.5 - 811.4
- 811.5 - 1013.6

†The incidence of ED visits does not include patients who were subsequently admitted into the hospital.
§This data does not include patients that were treated in hospitals outside of NYS; therefore, the burden of injuries in border counties may be underrepresented.

Source: NYSDOH, Bureau of Injury Prevention
www.health.ny.gov/injury_prevention
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Traumatic Brain Injury- Charge Information
New York State, 2006-2008

- Mean charge for hospitalizations = $37,839
  - Mean charge for non-TBI hospitalizations = $28,502
- Mean length of stay = 7 days

→ Yearly average hospitalization charges
  = $700 Million

- Mean charge for ED Visits = $1,909
  - Mean charge for non-TBI ED Visit = $1,044

→ Yearly average ED charges = $160 Million
Traumatic Brain Injury - Deaths
New York State Residents, 2007-2008

Early twenties and adults older than 65 have the highest rates.
Traumatic Brain Injury - Hospitalizations
New York State Residents, 2006-2008

Children less than one and adults older than 65 have the highest rates.

→ Children less than one and adults older than 65 have the highest rates.
Children 0-4 and 15-19 have the highest rates.
TBIs Disproportionately Impact Vulnerable New Yorkers:

- **Older Adults**
  - Highest death rate 30.5/100,000
    - Death rate is 3x higher than any other age group!
  - Highest rate of hospitalization (266.3/100,000)

- **Children**
  - Children less than one have the second highest hospitalization rate (179.7)
  - Children less than 1 and 1-4 have the highest ED treatment rates (1,447.0 & 973.6 /100,000, respectively)
## Deaths Due to Traumatic Brain Injury
### Leading Causes by Age Group
#### New York State Residents, 2007-2008

<table>
<thead>
<tr>
<th>Rank</th>
<th>&lt;1</th>
<th>1-4</th>
<th>5-9</th>
<th>10-14</th>
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<th>20-24</th>
<th>25-44</th>
<th>45-64</th>
<th>65+</th>
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<td>MVT^, Unspecified $\mu=34$</td>
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<td>Fall $\mu=118$</td>
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<td>*</td>
<td>MVT^, Pedal Cyclists $\mu=6$</td>
<td>Transport, Non-Traffic $\mu=8$</td>
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$\mu =$ Mean Annual Frequency

MVT^ = Motor Vehicle Traffic

* Means less than 3 are not reported

Source: NYSDOH, Bureau of Injury Prevention

# Hospitalizations Due to Traumatic Brain Injury
## Leading Causes by Age Group
### New York State Residents, 2006-2008

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<tr>
<th>Rank</th>
<th>&lt;1</th>
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<th>45-64</th>
<th>65+</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fall</td>
<td>Fall</td>
<td>Fall</td>
<td>MVT(^\wedge), Occupant</td>
<td>MVT(^\wedge), Occupant</td>
<td>Fall</td>
<td>Fall</td>
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<td>MVT(^\wedge), Pedestrian</td>
<td>Assault</td>
<td>MVT(^\wedge), Occupant</td>
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<td>MVT(^\wedge), Pedestrian</td>
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<td>Assault</td>
<td>MVT(^\wedge), Pedestrian</td>
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<td>MVT(^\wedge), Pedestrian</td>
<td>MVT(^\wedge), Pedestrian</td>
<td>Struck By, Against</td>
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<td>MVT(^\wedge), Motorcyclist</td>
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<td>Struck By, Against</td>
<td>Struck By, Against</td>
<td>Assault</td>
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<td>(\mu = 9)</td>
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<td>Transport, Non-Traffic</td>
<td>MVT(^\wedge), Pedal Cyclist</td>
<td>MVT(^\wedge), Pedal Cyclist</td>
<td>Struck By, Against</td>
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<td>Pedal Cyclist, Non-Traffic</td>
<td>Transport, Non-Traffic</td>
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<tr>
<td></td>
<td>(\mu = 5)</td>
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<td>Assault</td>
<td>Transport, Non-Traffic</td>
<td>MVT(^\wedge), Pedal Cyclist</td>
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<td>MVT(^\wedge), Unspecified</td>
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<td>MVT(^\wedge), Unspecified</td>
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<td>MVT(^\wedge), Pedal Cyclist</td>
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<td>(\mu = 43)</td>
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\(\mu\) = Mean Annual Frequency

*MVT\(^\wedge\) = Motor Vehicle Traffic

*Means less than 2 are not reported

Source: NYSDOH, Bureau of Injury Prevention

www.nyhealth.gov/prevention/injury_prevention/

SPARCS January 2010
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<tr>
<td>1</td>
<td>Fall</td>
<td>Fall</td>
<td>Fall</td>
<td>Struck By, Against</td>
<td>Struck By, Against</td>
<td>Assault</td>
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<td>Pedal Cyclist, Non-Traffic</td>
<td>Transport, Non-Traffic</td>
<td>MVT(^*), Pedestrian</td>
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<td>MVT(^*), Pedestrian</td>
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<td>Transport, Non-Traffic</td>
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<td>Cut/Pierce</td>
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<td>MVT(^*), Pedestrian</td>
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<td>MVT(^*), Pedestrian</td>
<td>MVT(^*), Unspecified</td>
<td>MVT(^*), Unspecified</td>
<td>MVT(^*), Unspecified</td>
<td>MVT(^*), Unspecified</td>
<td>Pedal Cyclist, Non-Traffic</td>
</tr>
<tr>
<td></td>
<td>(\mu=2)</td>
<td>(\mu=26)</td>
<td>(\mu=21)</td>
<td>(\mu=45)</td>
<td>(\mu=68)</td>
<td>(\mu=73)</td>
<td>(\mu=182)</td>
<td>(\mu=104)</td>
<td>(\mu=29)</td>
</tr>
<tr>
<td>10</td>
<td>Pedal Cyclist, Non-Traffic</td>
<td>Pedestrian, Non-Traffic</td>
<td>MVT(^*), Pedestrian</td>
<td>Overexertion</td>
<td>MVT(^*), Pedestrian</td>
<td>MVT(^*), Motorcyclist</td>
<td>MVT(^*), Motorcyclist</td>
<td>MVT(^*), Motorcyclist</td>
<td>Cut/Pierce</td>
</tr>
<tr>
<td></td>
<td>(\mu=2)</td>
<td>(\mu=16)</td>
<td>(\mu=19)</td>
<td>(\mu=18)</td>
<td>(\mu=57)</td>
<td>(\mu=56)</td>
<td>(\mu=124)</td>
<td>(\mu=77)</td>
<td>(\mu=23)</td>
</tr>
</tbody>
</table>

† The incidence of Emergency Department visits does not include patients that were subsequently admitted into the hospital.

\(\mu\) = Annual Frequency

MVT\(^*\) = Motor Vehicle Traffic

*Means less than 2 are not reported

Source: NYSDOH, Bureau of Injury Prevention

www.nyhealth.gov/prevention/injury_prevention/
SPARCS January 2010
Percent of Deaths by Intent with Traumatic Brain Injury
New York State Residents, All Ages, 2007-2008
Percent of Hospitalizations by Intent with Traumatic Brain Injury
New York State Residents, All Ages, 2006-2008

- Unintentional
- Assault
- Self inflicted

Age group

Males
Females
Percent of ED Visits* by Intent with Traumatic Brain Injury
New York State Residents, All Ages, 2006-2008

*Does not include patients admitted into hospital
TBI Hospitalizations - Place of Injury
NYS Residents, 2006-2008

**Ages 0-64 Years**
- Home: 31%
- Unspecified: 16%
- Other: 20%
- Residential Institution: 4%
- Public Building: 6%
- Place for Sports and Recreation: 6%
- Street of Highway: 17%

**Ages 65+ Years**
- Home: 55%
- Unspecified: 9%
- Other: 11%
- Residential Institution: 14%
- Public Building: 3%
- Street and Highway: 7%
- Place for Sport and Recreation: 1%
TBI Patient Hospital Discharge Location
NYS Residents, 2006-2008

**Ages 0-64 Years**
- Hospital: 9%
- Nursing Facility: 3%
- Died: 3%
- Against Medical Advice: 4%
- Home: 81%

**Ages 65+ Years**
- Home: 46%
- Nursing Facility: 32%
- Died: 10%
- Against Medical Advice: 1%
- Hospital: 11%
# Leading Causes of TBI in Older Adults, 65+

New York State, 2006-2008

<table>
<thead>
<tr>
<th>Deaths</th>
<th>Hospitalizations</th>
<th>ED Visits*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall μ=504</td>
<td>Fall μ=5,762</td>
<td>Fall μ=10,529</td>
</tr>
<tr>
<td>Suicide μ=98</td>
<td>MVT(^\wedge), Occupant μ=407</td>
<td>Struck By, Against μ=755</td>
</tr>
<tr>
<td>MVT(^\wedge), Pedestrian μ=53</td>
<td>MVT(^\wedge), Pedestrian μ=224</td>
<td>MVT(^\wedge), Occupant μ=517</td>
</tr>
<tr>
<td>MVT(^\wedge), Unspecified μ=22</td>
<td>Struck By, Against μ=93</td>
<td>Unspecified μ=301</td>
</tr>
<tr>
<td>MVT(^\wedge), Occupant μ=21</td>
<td>Unspecified μ=74</td>
<td>Assault μ=151</td>
</tr>
</tbody>
</table>

*Does not include patients admitted into hospital
Percent of Deaths Due to Fall Injury with Traumatic Brain Injury
New York State Residents, Ages 65+, 2007-2008
Incidence of Fall Injuries
Percent of Hospitalizations with Traumatic Brain Injury
New York State Residents, Ages 65+ 2006-2008

![Bar chart showing the incidence of fall injuries with traumatic brain injury for New York State residents aged 65+ from 2006 to 2008. The chart compares males and females across three age groups: 65-74 years, 75-84 years, and 85+ years.](chart.png)
Incidence of Fall Injuries
Percent of ED Visits* with Traumatic Brain Injury
New York State Residents, Ages 65+ 2006-2008

*Does not include patients admitted into hospital
TBI Deaths Due to MVT Injuries
NYS Residents, 2007-2008

- **Gender**
  - Males: Yearly Average of 342 rate of 3.6 per 100,000 residents
  - Females: Yearly Average of 148 rate of 1.5 per 100,000 residents

→ **490 New Yorkers** died as a result of a MVT-related TBI
→ An average of over 1 death per day!
NYS DOH, BIP
Injury Surveillance System

- **Crash Outcome Data Evaluation System (CODES)** is a linked database
  - Matches individual records from Accident Information System data to Pre-Hospital Care Report data
  - Matches individual records from Accident Information System data to Hospital Discharge and Emergency Department data
Percent of TBI Hospitalizations Following a Traffic Crash
New York State Residents, 2006-2008

*Data based on frequencies of less than six are not reported.
Hospitalizations Due to MVT Injuries on NYS Roadways, 2008

- **Gender**
  - **Males:** 7,523 hospitalizations
    - 31.8% diagnosed with TBI while hospitalized
  - **Females:** 4,664 hospitalizations
    - 27.7% diagnosed with TBI while hospitalized

⇒ 12,187 people were injured severely enough to require hospitalization
  - 30.2% were diagnosed with a TBI

⇒ An average of over 33 people hospitalized, including 11 TBI each day!
Percent of TBI ED Visits Following a Traffic Crash
New York State Roadways, 2008
Emergency Department Visits Due to MVT Injuries on NYS Roadways, 2008

**Gender**
- **Males:** 72,545 ED Visits
  - 6.9% diagnosed with TBI while being treated
- **Females:** 68,257 ED Visits
  - 7.1% diagnosed with TBI while being treated

→ **140,816** people were injured severely enough to require treatment at EDs
  - 7.0 % were diagnosed with a TBI

→ **An average of over 386** people treated at EDs, including 27 TBIs every day!
## Selected Risk Factors

### Crash Types and Contributing Factors

<table>
<thead>
<tr>
<th>Type of Crash or Contributing Factor</th>
<th>Total Number of People Involved</th>
<th>Number of People Hospitalized</th>
<th>TBI (Percent of Hospitalizations)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol-Related</td>
<td>20,255</td>
<td>1,000</td>
<td>40.7%</td>
</tr>
<tr>
<td>Speed-Related</td>
<td>68,762</td>
<td>2,040</td>
<td>36.5%</td>
</tr>
<tr>
<td>Driver Distraction</td>
<td>132,251</td>
<td>1,811</td>
<td>28.0%</td>
</tr>
<tr>
<td>Failure to Yield</td>
<td>106,273</td>
<td>1,889</td>
<td>28.7%</td>
</tr>
<tr>
<td>Following Too Closely</td>
<td>116,355</td>
<td>773</td>
<td>22.7%</td>
</tr>
<tr>
<td>Passing / Lane Violations</td>
<td>51,922</td>
<td>872</td>
<td>31.9%</td>
</tr>
<tr>
<td>Traffic Control Disregarded</td>
<td>31,734</td>
<td>738</td>
<td>33.9%</td>
</tr>
</tbody>
</table>
## Selected Risk Factors – Traffic Injuries

### Role Types

<table>
<thead>
<tr>
<th>Type of Crash or Contributing Factor</th>
<th>Total Number of People Involved</th>
<th>Number of People Hospitalized</th>
<th>TBI (Percent of Hospitalizations)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bicyclists</td>
<td>5,745</td>
<td>413</td>
<td>44.9%</td>
</tr>
<tr>
<td>Motorcyclists</td>
<td>5,845</td>
<td>1,101</td>
<td>29.4%</td>
</tr>
<tr>
<td>Motor Vehicle Occupants</td>
<td>719,548</td>
<td>8,696</td>
<td>28.2%</td>
</tr>
<tr>
<td>Pedestrians</td>
<td>16,415</td>
<td>1,810</td>
<td>38.4%</td>
</tr>
<tr>
<td>Other</td>
<td>35,265</td>
<td>170</td>
<td>15.1%</td>
</tr>
</tbody>
</table>

- **NYS Helmet Laws:**
  - Bicyclists under the age 14 must wear an approved helmet
  - All motorcycle riders (drivers and passengers) must wear a DOT-approved helmet
## Selected Risk Factors – Traffic Injuries

### Restraint Use

<table>
<thead>
<tr>
<th>Type of Crash or Contributing Factor</th>
<th>Total Number of People Involved</th>
<th>Number of People Hospitalized</th>
<th>TBI (Percent of Hospitalizations)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Restraint Used</td>
<td>24,357</td>
<td>1,040</td>
<td>41.1%</td>
</tr>
<tr>
<td>Restraint Used</td>
<td>563,621</td>
<td>6,611</td>
<td>26.7%</td>
</tr>
<tr>
<td>Unknown</td>
<td>131,570</td>
<td>1,044</td>
<td>25.1%</td>
</tr>
</tbody>
</table>

- Occupants that did not use restraints:
  - Were almost 4 times more likely to require hospitalization
    - The average hospital charge was over $20,000 higher!
  - Were almost 3 times more likely to be diagnosed with a TBI

- NYS seat belt law:
  - Every occupant in the front seats, the driver and each passenger must wear a seat belt.
  - Every occupant of a motor vehicle being operated by the holder of a Learner Permit, or Junior Driver License must be restrained by a safety restraint.
  - Each passenger under age 16 must wear a seat belt or use an appropriate child safety restraint system.
Conclusions

Annually in NYS, TBIs result in:

- 2,100 deaths
- 18,500 hospitalizations
- 82,000 emergency department visits
- $860 million in hospital charges
- Motor vehicle crashes, falls, and assaults are the leading causes of TBI
Conclusions

Who is at greatest risks:

- Males are more likely to sustain a TBI.
- Adults 65 years and older have the highest rate of TBI deaths.
- Children under the age of one and adults 65 years and older are most likely to sustain a TBI severe enough to require hospitalization; 15-19 year olds have the third highest rate.
- Children four years and younger are the most likely to be treated in an emergency department for a TBI; 15-19 year olds have the third highest rate.
Conclusions

- While it is difficult to grasp the extent of TBI incidence and prevalence, the data does show patterns in the occurrence of TBI.
- Continued surveillance efforts will increase our knowledge of TBI occurrence.
- Prevention programs focused on evidence-based strategies and best practices will help to prevent traumatic brain injuries among New Yorkers!
Questions?

- For additional questions please contact me:

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  http://www.health.state.ny.us/prevention/injury_prevention/