IMPROVING THE OUTCOMES OF INJURED CHILDREN

New Challenges and Opportunities

Randall S. Burd, MD, PhD
Disability  

Death
inflection point

transform

stagnate
CALL FOR A NATIONAL TRAUMA CARE SYSTEM

ACHIEVING ZERO PREVENTABLE DEATHS

MINIMIZING DISABILITY
PREVENTABLE DEATH
SAVED BY APPROPRIATE AND TIMELY CARE
MINIMIZING DISABILITY
ENSURING FUNCTIONAL RECOVERY AND QUALITY OF LIFE
INJURY
Years Life Lost (YLL) = N \times L

N = Number of deaths
L = Life expectancy at age of death in years
1-4 years

5-9 years

10-14 years

15-19 years

Global Burden of Disease (GBD) Study (2017)
10 Leading Causes of Death by Age Group, United States 2017
Causes of Death in Children and Adolescents, United States 2017

40%
25%
20%
15%
60%

Other
Injury related

MVC
Firearm
Other

Trends in Injury Causation in United States

Pediatric Trauma
Continuum of Care

- Injury prevention
- Pre-hospital care
- Hospital based trauma care
- Rehab care
OUT-OF-HOSPITAL AND IN-HOSPITAL TRAUMA DEATHS BY AGE

DEATHS BASED ON LOCATION

- Pre-hospital
- Hospital

PROPORTION OF PREHOSPITAL AND HOSPITAL DEATHS BY CAUSE IN ADULTS

- **Penetrating Injury**: Out of hospital and in hospital deaths.
- **Other Fall**: Out of hospital and in hospital deaths.
- **Other Crushing/Threat to Breathing**: Out of hospital and in hospital deaths.
- **Transport Event**: Out of hospital and in hospital deaths.
- **Thermal Mechanism**: Out of hospital and in hospital deaths.
- **High Fall**: Out of hospital and in hospital deaths.
- **Contact with Person**: Out of hospital and in hospital deaths.
- **Low Fall**: Out of hospital and in hospital deaths.

PREVENTABLE DEATHS BASED ON LOCATION

Preventable  Not preventable

PRE-HOSPITAL

HOSPITAL

OVERALL

PREVENTABLE DEATHS

CAUSES OF PREVENTABLE DEATHS

Hemorrhage control
TBI management
Airway management
PREVENTABLE DEATHS

INSIGHTS FROM ADULT STUDIES

1:5 deaths
1:5 preventable deaths = pre-hospital
Proportion not decreasing over time
Most in-hospital deaths during resuscitation
12,000 annual injury-related deaths

2,400 preventable deaths
SO WHAT ARE WE GOING TO DO ABOUT IT?
Levels of Prevention

- Primary prevention
  - Non-preventable deaths
  - Preventable deaths
- Secondary prevention
PTS Actions Based on Preventability

Non-preventable deaths

Preventable deaths

Primary prevention
Injury Prevention Committee
Research Committee
Program Committee

Secondary prevention
Guidelines Committee
Research Committee
Program Committee
CHALLENGES

IDENTIFYING PREVENTABLE DEATHS

Data internal not shared
Lack of standard classification
Effort needed for classification
Difficulty of accessing out of hospital data
Quality of outside of out of hospital data
REducing Mortality FROM Pediatric Trauma
Steps to Improve Pediatric Trauma Care

Identify
Identify priorities based on causation, prevalence along the continuum of care, and preventability of pediatric injuries.

Intervene
Use data to intervene in two areas: injury prevention and changes in the care process and structure.

Evaluate
Evaluate the impact of your interventions to assess its efficacy.

"Care is an absolute. Prevention is the key." - Christopher Hawkes

By Randall S. Burd, MD, PhD
HEMORRHAGE CONTROL

Secondary Prevention

Decrease transport time
Use strategic hemostatic approaches
Improve resuscitation efficiency
TRAUMATIC BRAIN INJURY MANAGEMENT

Secondary Prevention

Minimize secondary injury
Prevent:
  Hypoxia
  Hypotension
  Hyperventilation
Decrease time to intervention
AIRWAY MANAGEMENT

Ensure available pediatric equipment
Monitor ETCO₂
Establish airway management registry
This is where you lost your wallet?

No, I lost it in the park. But this is where the light is.
CALL FOR A NATIONAL TRAUMA CARE SYSTEM

ACHIEVING ZERO PREVENTABLE DEATHS

MINIMIZING DISABILITY
Limitations of Mortality as a Quality Metric

Pediatric Trauma Quality Improvement Program-2019

Odds Ratios (90%) by TQIP Hospital; Mortality

OR Ranges:
- Low = 0.25-0.43
- Average = 0.53-2.36
- High = 2.03-3.96

Cohort = All Patients
NEED FOR NON-MORTALITY OUTCOMES

TRAUMA REGISTRY

PUBLICATIONS
Healthy life

Disease or disability

YLD
Years Lived Disability

Early death

Expected life years
Years Lived Disability (YLD) = I \times W \times L

I = Number of incident cases
W = Disability weight
L = Average duration until remission or death
Years of Life Lived with Disability, United States 2017

Global Burden of Disease (GBD) Study (2017)
Impacted populations

> 5 million children with injury in ED
> 50,000 admitted to a trauma center

Functional status

Residual limitation children treated in ED

20% at 4 months
8% at 9 months

Long-term impairment in hospitalized children

3X higher risk
>50% with impairment at 12 months

Health-related quality of life

Slower in hospitalized children
Severe injury lower than population at 1 year
Implementing Outcome Assessment in Trauma

1. Define objective
2. Select metric(s)
3. Define population
4. Determine timing of evaluation
5. Implement modes data capture
6. Analyze data

CHOOSING A METRIC FOR MEASURING OUTCOME

Ideal Features

- Reliability and validity
- Ability to detect differences over time
- Brief time required for administration
- Applicability for all ages
- Availability for self- or proxy-report
Functional Status Scale

- Sensory function
- Feeding function
- Mental Status
- Communication
- Motor function
- Respiratory status

FSS

<5 minutes to obtain
Obtain from parent/caregiver/chart
Validated Adaptive Behavior Assessment Scale II
Correlates with physiological morbidity
FUNCTIONAL STATUS OF INJURED CHILDREN ADMITTED TO INTENSIVE CARE

Overview

553 children
Secondary data analysis
NIH CPCCRN
69% with ISS > 9
Body regions with injury
43% head
19% upper/lower extremity
13% abdomen

Years of Life Lived with Disability, United States 2017

Functional Status at Discharge
*Functional Status Scale (FSS)*

- **Normal**

More body regions with serious injury

Serious injuries to:
- Head
- Spine
- Extremities
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<tr>
<th>Area</th>
<th>Rehabilitation</th>
<th>Mortality</th>
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<tr>
<td>Head</td>
<td>18%</td>
<td>80%</td>
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<tr>
<td>Thorax</td>
<td>9%</td>
<td>2%</td>
</tr>
<tr>
<td>Abdomen</td>
<td>1%</td>
<td>4%</td>
</tr>
<tr>
<td>Spine</td>
<td>22%</td>
<td>7%</td>
</tr>
<tr>
<td>Extremity</td>
<td>50%</td>
<td>6%</td>
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</tbody>
</table>
Major trauma patients
Since 2010
Follow-up: 87% at 12 months, 83% at 2 years

Metrics
Functional status: GOS, KOSCHI
Quality of life: EQ-5D

Demographics
Single payer
Population ~ 6 million
>85% at one hospital
Victorian State Trauma Registry Outcomes, 2011

% of normal

- Functional status motor
- Functional status cognitive
- HRQoL physical
- HRQoL psychosocial

MODES OF DATA CAPTURE

EMAIL

TEXT

PHONE

IN PERSON
OUTCOME AFTER CHILDHOOD INJURY STUDY

3 year study

Demographics
- 840 patients
- Age <15 years
- >1 serious injury, injury AIS >3

Discharge and 6 month assessment
- Family function: Family Assessment Device
- Functional status: FSS, GOS-EP, POPC/PCPC
- Health related QOL: PEDsQL
Outcome After Childhood Injury Study Enrollment

Injury with AIS ≥3

- Spine
- Thorax
- Abdomen
- Lower extremity
- Head

Recruitment priority
IDENTIFYING AND TRACKING CHILDREN AT RISK FOR IMPAIRMENT

Need for easy injury severity assessment or other metrics

Finding admissions/transfer to other services
Availability of parents/guardians
Obtaining post-discharge contact information
Implementing electronic data capture
SO WHAT ARE WE GOING TO DO ABOUT IT?
Levels of Prevention - Non-Mortality Outcomes

Prevention
- Prevent initial events

Secondary prevention
- Minimize impact when not preventable

Tertiary prevention
- Optimize long-term function and QOL
PTS Actions Based on Preventability

Primary prevention

Non-preventable disability

Secondary prevention

Preventable disability

Tertiary prevention

Non-preventable disability

Preventable disability
6 out of 10 Pediatric deaths are from injury

- 33% injury deaths from MVC
- 25% injury deaths from firearms
- 40% injury deaths occur outside hospital
- 20% injury deaths are preventable
- 20% injured children treated in ED continue to have functional limitation at 5 months
MORE DIFFICULT
LESS DIFFICULT
THANK YOU