EPIDEMIOLOGY OF TRAUMATIC BRAIN INJURY

Brain Injury Conference
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Kyle Muus, Ph.D.
Center for Rural Health
School of Medicine & Health Sciences
University of North Dakota
http://medicine.nodak.edu/crh

Where: Grand Forks, ND
When: Established over 20 years ago

Focused on Access, Financing & Quality Through:
➢ Health services research
➢ Health policy
➢ Education
➢ State & community health services development
➢ Information Resource

How: Through partnerships
OBJECTIVES

• Basic Understanding of The Role & Importance of Data/Surveillance
• Review of the Prevalence, Incidence and Causes of TBI
• Recognize the Main Risk Factors for TBI
• Know the Fundamental Strategies for Reducing the Burden of TBI
• Overview of the Continued Administrative Challenges regarding TBI

Brain Injury

- Congenital and Perinatal (no period of normal development)
- Acquired (following a period of normal development)
- Perinatal (e.g., birth stroke)
- Congenital (e.g., PKU)
- Non-traumatic (internal occurrence e.g., tumor)
- Traumatic (external physical force)
- Open (e.g., gunshot)
- Closed (e.g., fall)
TERMS & DEFINITIONS

TRAUMATIC BRAIN INJURY (TBI)

• rapid acceleration & deceleration, including tearing of nerve fibers, bruising of the brain tissue, brain stem injuries and swelling; or, when an external physical force hits the brain, producing an altered state of consciousness, resulting in impaired cognitive abilities, physical/behavioral/emotional functioning, language and/or memory (CDC, 1999)
### EPIDEMIOLOGY

- Study of the distribution & determinants of diseases & *injuries* in human populations
  - frequencies and types of *injuries* and illness in groups of people
  - factors that influence the distribution of illness and *injuries*


### DATA = Pieces of information

### SURVEILLANCE

- “..has a public health emphasis, containing only descriptive information to assess the magnitude of a disease/injury problem..”

### REGISTRY

- “..a clinical or service oriented system used to identify patients eligible for services, evaluate treatment methods and monitor patient outcome…”

Sources: Harrison & Dijkers, 1992; CO Dept. of Public Health & Environment, 2003
INCIDENCE

# of **new** cases of a disease or injury at a specific time

# of people in the population-at-risk at the specified time

PREVALENCE

# of existing cases of a disease or injury at a specific time

# of people in the population at the specified time
IMPORTANCE OF DATA & SURVEILLANCE

WHY COLLECT HEALTH DATA?

- Stimulate new organizational ideas
- Improve quality of health care and procedures
- Draw public/media attention to a community issue
- Influence legislative policies and regulations
- Provide justification for an existing program or illustrate a need for a new program
- Help provide grant funding
- Communicate the importance of data collection to providers and administrators
- Provide initial and continuing education
- Allocate state/agency resources effectively
- Help those in the health care community see the value of their work
DATA → POLICY → FUNDING

LEVELS OF IMPACT

Level 1: Data/Research Findings
Level 2: Policies
Level 3: Clinical Practice
Level 4: Health Outcomes
TBI REGISTRIES

- 32 states: Alaska, Arizona, Arkansas, California, Colorado, Florida, Georgia, Illinois, Iowa, Kansas, Kentucky, Louisiana, Maryland, Minnesota, Mississippi, Missouri, Nebraska, Nevada, New Mexico, New York, North Carolina, North Dakota, Oklahoma, Rhode Island, South Carolina, Tennessee, Texas, Utah, Vermont, Virginia, West Virginia.

Source: BIA, 2000
EXAMPLE: MN’s TBI REGISTRY

DATA & SELECTION CRITERIA: Inpat. Hosp. – TBI ICDs

MAINTAINED BY: MN Dept. of Health

USES:

- Extent of TBI problem, Costs, Patient Outcomes
- Linking to Medicaid data illustrates how persons with TBI migrate into Medicaid over time
- Linking Persons with Information & Resources (state BIA, etc.) ~ mailings/phone calls at 6wks, 6mos, 12mos & 18mos
- Health & Social Service Planning
TBI-RELATED ICD CODES

- 800.0-801.9 - Fracture of the vault or base of the skull
- 803.0-804.9 - Other and unqualified and multiple fractures of the skull
- 850.0-854.1 - Intracranial injury, including concussion, contusion, laceration, and hemorrhage

AN ENVISIONED METHOD FOR IMPROVING SERVICES COORDINATION FOR NORTH DAKOTANS WITH TBI
► No TBI Registry in ND
► ND does have a Cancer Registry, which addresses questions such as:
  • Which cancers are most common in our state?
  • Who is at greatest risk for developing cancer?
  • Which cancers are the deadliest?
  • What are the societal costs of cancer in ND?
  • How does ND compare to other states & national prevention standards?

TBI DISABLED PERSONS

[Image of brain with thinking lines]
Estimate of TBI-Disabled Persons in ND: 12,844*

*Based on National prevalence estimate of 2%
TBI COSTS

• NO WAY TO MEASURE OR DESCRIBE THE FULL RANGE OF HUMAN COSTS

• In the U.S. in 1995, direct & indirect costs ~ $56.3 Billion

Source: Thurman, 2000

TBI COSTS (Cont.)

• Individual lifetime care costs ~ approx. $4.1-$9 million

• Average hospital stay ~ 45-60 days at approx. $324K (severe)

• Post-hospital rehab services ~ approx. $125,000 per year

Source: Thurman, 2000; Family Caregiver Alliance, 2003
Causes of Traumatic Brain Injury

Motor Vehicle Crashes 50%
Falls 21%
Firearms 12%
Sports/Recreation 10%
Other 7%

TBI INCIDENCE
TBI INCIDENCE in the U.S.

- 1 Million ~ treated & released from hospital EDs
- 230,000 ~ hospitalized & survive
- 50,000 ~ die

Sources: Guerrero et al., 2000; Thurman & Guerrero, 1999; Sosin et al., 1995
**ESTIMATED TBI INCIDENCE RATES IN ND**

![Graph showing estimated TBI incidence rates per 100,000 population for ED Visits, Hospitalization, Disability, and Fatality.]

Source: CDC, 2003

**ESTIMATED NUMBER OF TBI INCIDENTS IN ND**

![Graph showing estimated number of TBI incidents per year for ED Visits, Hospitalizations, Disabilities, and Fatalities.]

Source: CDC, 2003
TBI RISK FACTORS

TBI RISK FACTOR: GENDER

• more common in males across all age groups
TBI RISK FACTOR: AGE

- Adolescents & young adults (ages 15 to 24)
- Older adults (ages 65+)

TBI INCIDENCE, by Age & Gender

- Male
- Female
- Total
CHILDREN & TBI

TBI INCIDENCE among U.S. Children

• 400,000 ~ treated in EDs
• 29,000 ~ hospitalized
• 3,000 ~ die

TBI Fatality Rates, U.S. Children (1994), by Age

Figure 1. TBI-associated mortality rates by age group, ages 0-19 years, U.S., 1980-94

Deaths per 100,000

Dunn et al., 1998
Figure 2. TBI-associated mortality rates by sex, ages 0-19 years, U.S., 1980-94

TBI Fatality Rates, U.S. Children (1994), by Gender

Dunn et al., 1998
TBI Fatality Rates, U.S. Children (1994), by Race

Dunn et al., 1998

Figure 3. TBI-associated mortality rates by race, ages 0-19 years, U.S., 1980-94

Dunn et al., 1998
TBI Fatality Rates, U.S. Children (1994), by Cause

Dunn et al., 1998

Figure 4. TBI-associated mortality rates by cause, ages 0-19 years, U.S., 1980-94

Dunn et al., 1998
TBI Fatality Rates, U.S. Children (1994), by Transport Cause

Figure 5. Transport-related TBI-associated mortality rates, ages 0-19 years, U.S., 1980-94

Dunn et al., 1998
Figure 6. Weapons and violence-related TBI-associated mortality rates, ages 0-19 years, U.S., 1980-94

Dunn et al., 1998
TBI RISK FACTOR: RACE/ETHNICITY

• Black & other nonwhite races

**TBI Risk Factor: Geographic Location**

- Rural (esp. males)
- TBI

**Rural Trauma Issues**

- Higher Injury Mortality Rates
- Reduced Access to Trauma Centers, Physicians, Surgeons, ALS-Trained EMS Personnel
- Longer EMS Response Times (17 vs. 8 min.); Beyond 30 min. Mortality Rate increases
- Health Personnel Have Decreased Access to Trauma Education/Training

Sources: Baker et al., 1987; Grossman et al., 1997.
TBI RISK FACTOR: EDUCATION/INCOME

EDUCATION/INCOME

TBI
TBI RISK FACTOR: SEASONALITY

- Late spring & summer months

TBI RISK FACTOR: WORK-RELATED

- Farming
- Construction
- Roofers

TBI
TBI RISK FACTOR: ALCOHOL

ALCOHOL USE → TBI

TBI RISK FACTOR: PREVIOUS TBI

- 3 times the risk vs. those without previous TBI
SEVERITY

TBI PREVALENCE, by SEVERITY CLASSIFICATION

- Mild
- Moderate
- Severe
GCS

**Best Eye Response (4)**
1. No eye opening.
2. Eye opening to pain.
3. Eye opening to verbal command
4. Eyes open spontaneously.

**Best Motor Response (6)**
1. No motor response.
2. Extension to pain.
3. Flexion to pain.
5. Localizing pain.
6. Obeys Commands.

**Best Verbal Response (5)**
1. No verbal response
2. Incomprehensible sounds.
3. Inappropriate words.
4. Confused
5. Orientated

GCS score = E + M + V → 3 to 15 range

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**GCS Score**

Colorado TBI Surveillance, 1994-1999

Source: CO Dept. of Public Health & Environment

Note: Weighted N=13,158  Missing 26.7%
Glasgow Outcome Scale

- Functional Outcome of TBI
- 5-Point Scale
  1. Death
  2. Persistent vegetative state or continued coma
  3. Severe disability
  4. Moderate disability
  5. Good recovery

Source: CO Dept. of Public Health & Environment

Glasgow Outcome Scale
Colorado Residents discharged with a TBI in 1994-1999

GOS score

Source: CO Dept. of Public Health & Environment
Note: Weighted N=17,962
MILD TBI

“MILD” BRAIN INJURY

- Brief or no loss of consciousness
- Signs of concussion
  - Nausea and vomiting
  - Headache
  - Fatigue
  - Dizziness
  - Poor memory
- PTA less than 1 hour
- GCS of 13-15
MILD BRAIN INJURIES

• 80-90% of all brain injuries
• Symptoms usually resolve within three months, but can persist and be life-long
• Symptoms can significantly interfere with academic school performance
• If ignored, symptoms may lead to more lasting problems

PROBLEMS OF STUDENTS WITH MILD TBI

• Memory
• Fatigue
• Inattention
• Slow performance
• Incomplete work
• Organizational problems
• Frustration
• Depression
• Disorganization
• School absences
• Conflict with peers and teachers
• Falling grades
TBI OUTCOME MEASURES

MEASUREMENT SCALES FOR TBI OUTCOMES

- Agitated Behavior Scale (ABS)
- Awareness Questionnaire (AQ)
- Coma/Near Coma Scale (CNC)
- Community Integration Questionnaire (CIQ)
- Craig Handicap Assessment and Reporting Technique (CHART)
- Craig Handicap Assessment and Reporting Technique Short Form (CHART SF)
- Craig Hospital Inventory of Environmental Factors (CHIEF)
- Disability Rating Scale (DRS)
- Family Needs Questionnaire (FNQ)
- Functional Assessment Measure (FAM)
- Functional Independence Measure (FIM)
- Glasgow Outcome Scale (GOS)
- Extended Glasgow Outcome Scale (GOS-E)
- Level of Cognitive Functioning Scale (LCFS)
- Mayo Portland Adaptability Inventory (MPAI)
- Neurobehavioral Functioning Inventory (NFI)
- The Orientation Log (O-Log)
- Patient Competency Rating Scale (PCRS)
- Satisfaction With Life Scale (SWLS)
- Service Obstacle Scale (SOS)
- Supervision Rating Scale (SRS)

Source: http://www.tbims.org/combi/list.html
USE OF MEASURES OF INJURY AND DISABILITY IN PHASES OF RECOVERY FROM TBI

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<thead>
<tr>
<th>Scale or Measure</th>
<th>Phase of Treatment and Recovery</th>
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<td></td>
<td>Acute</td>
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<td>Intra-cranial pressure</td>
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<td>Brain scans</td>
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<td>Duration of coma</td>
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<td>Duration of post-traumatic amnesia</td>
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<td>Glasgow Coma Score (GCS)</td>
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<td>Galveston Orientation and Amnesia Test (GOAT)</td>
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<td>Rancho Los Amigos Scale</td>
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<td>Physical Impairment measures</td>
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<td>Injury Severity Scale</td>
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<td>Bond Neurophysical Scale (BNS)</td>
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<td>Disability Rating Scale (DRS)</td>
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<td>Functional Assessment Measure (FAM)</td>
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<td>Portland Adaptability Inventory (PAI)</td>
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<td>Community Integration Questionnaire (CIQ)</td>
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Table 22.1 Disability Rating Scale (Kapoor et al., 1982)

Scoring in eight categories with high indicating maximum disability.

- Eye opening: 0–3
- Verbal: 0–4
- Motor response: 0–4
- Toileting: 0–3
- Feeding: 0–3
- Grooming: 0–3
- Dependence: 0–5
- Employability: 0–3

Maximum disability: 30

This gives ten degrees of disability:

- 0: Nil
- 1: Mild disability
- 2–3: Partial disability
- 4–6: Moderate disability
- 7–11: Moderate/severe disability
- 12–16: Severe disability
- 17–21: Extremely severe disability
- 22–24: Vegetative state
- 25–29: Extreme vegetative state
- 30: Death
STRATEGIES

to Prevent Future TBIs, Reduce Disabilities & Improve Outcomes

• Increase helmet use during recreation/sports activities
• Improve use of seat belts/child safety seats & reducing DUI
• Prevent falls among children & elders

Sources: Thurman, 1998; 2001
STRATEGIES (Cont.)

- Enhance violence prevention programs

- Keep firearms unloaded in locked cabinet or safe. Store bullets in separate location

Sources: Thurman, 1999, 2001; Pollock, 2001

STRATEGIES (Cont.)

- Enhance trauma care surveillance systems & clinical preventive services

- Improve data collection for TBI incidence

Sources: Thurman, 2001; Pickelsimer, 2002
STRATEGIES (Cont.)

• Conduct follow-up studies of persons with TBI to assess outcomes & identify service needs
• Educate persons with TBI about steps for recovery & service availability

Sources: Thurman, 2001; Pickelsimer, 2002

CONTINUED CHALLENGES

Increased/Improved Efforts Toward:

♦ Surveillance & Epidemiology
♦ Public Education
♦ Prevention
♦ Research on Impact of Health Care & Rehab on Patient Outcomes
♦ Access to & Coordination of Services
FEDERAL GRANT

► ND TBI Grant Planning Committee with representation from: Dept. of Human Services; Dept. of Health; Open Door Center; UND School of Medicine & Health Sciences

► Committee’s purpose: Develop a grant proposal to seek funding for (a) conducting a statewide TBI needs assessment & (b) improving service coordination for persons with TBI & their families

► 2002 - Grant proposal was submitted to the federal Maternal Child Health Bureau

► March 2003 - Approved for Funding

(Cont.)

TBI Planning Grant Goals (tentative)

GOAL 1: Create, appoint, and activate a statewide North Dakota TBI Advisory Board

GOAL 2: Solidify the role of the Division of Aging as lead coordinating agency for TBI service systems development

GOAL 3: Complete a thorough statewide assessment of needs and resources

GOAL 4: Develop a statewide action plan
PRIORITIZED SERVICES FOR PERSONS WITH PHYSICAL, COGNITIVE & SENSORY IMPAIRMENT

ADVOCACY

INCOME SUPPORT

VOCATIONAL TRAINING

PERSONAL ASSISTANCE SERVICES

SPECIALIZED MEDICAL TRAINING

ASSISTIVE TECHNOLOGY

FAMILY SUPPORT SERVICES

PROFESSIONAL TRAINING

CASE MANAGEMENT

BASIC NEEDS:
HOUSING
EDUCATION
TRANSPORTATION
EMPLOYMENT
RECREATION

INDEPENDENT LIVING SKILLS

REFERENCES


CDC. Recommended framework for presenting injury mortality data. MMWR 1997;46 (No. RR-14):1-30


Gabella, B. Colorado Traumatic Brain Injury Surveillance, Colorado Dept. of Public Health & Environment barbara.gabella@state.co.us 303/692-3003 FAX:303/691-7720

REFERENCES (Cont.)


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For more information contact:

Center for Rural Health
School of Medicine and Health Sciences
Grand Forks, ND 58202-9037
701-777-3848
http://www.medicine.nodak.edu/crh