

Brain Injury 101

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Outline

- Overview of Acquired Brain Injury
 - Epidemiology
 - Common Consequences – physical/medical, cognitive, emotional, social, vocational
- Determinants of Recovery
 - Brain Injury as a Chronic Condition
- Rehabilitation Interventions across the Continuum of Care



Epidemiology

- In 2010, about 2.5 million emergency department (ED) visits, hospitalizations, or deaths were associated with TBI in the United States.
- Over the past decade (2001–2010), while rates of TBI-related ED visits increased by 70%, hospitalization rates only increased by 11% and death rates decreased by 7%.

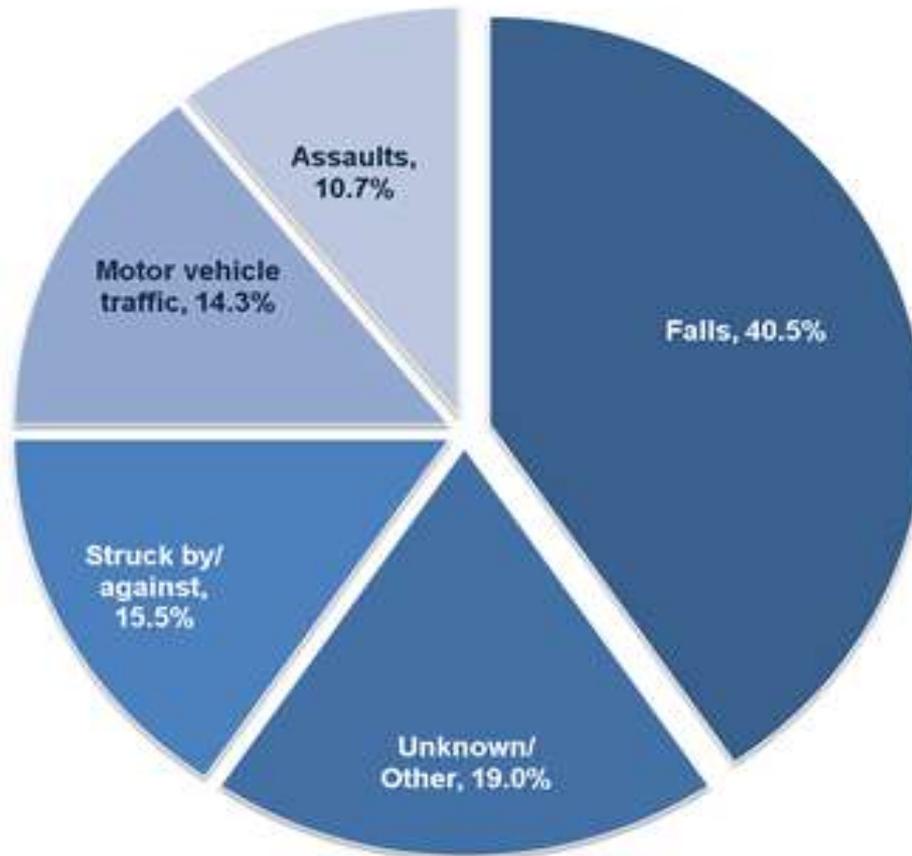


So what does that mean?



Epidemiology

Leading Causes of TBI

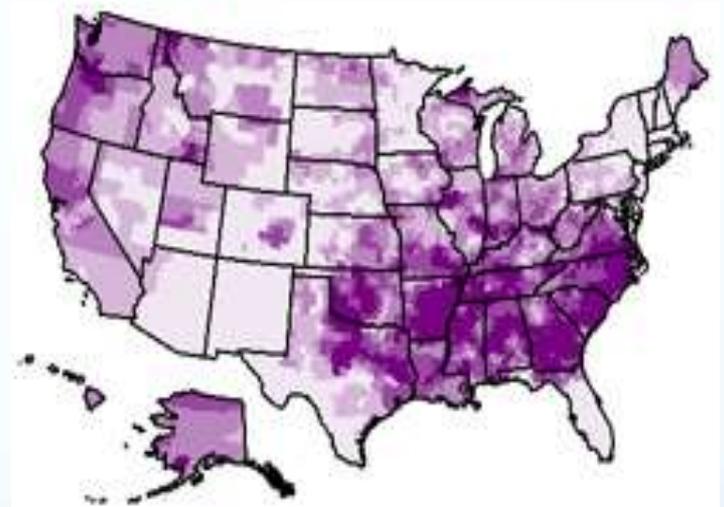


U.S. 2006-2010

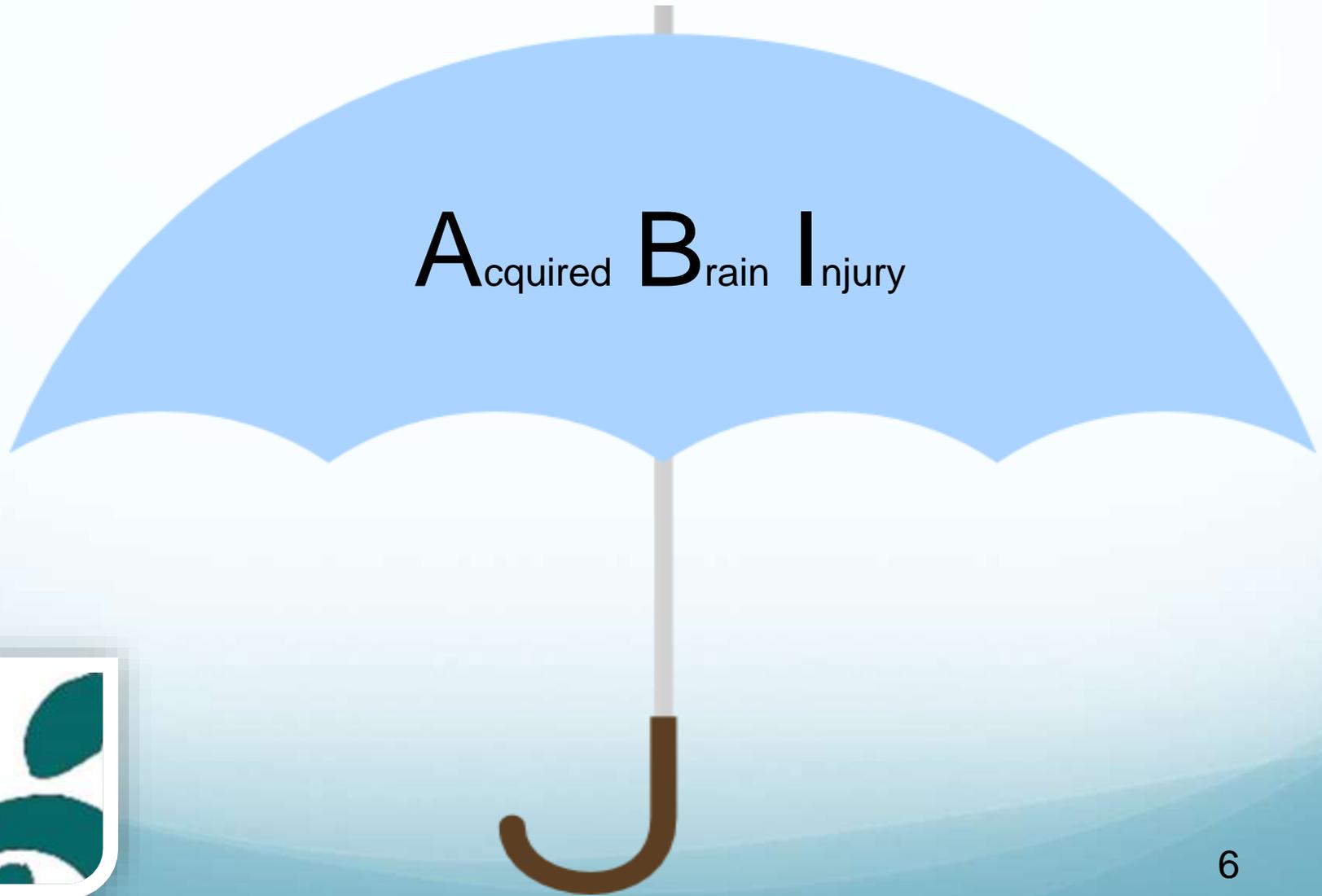


Epidemiology

- Stroke is the leading cause of serious, long-term disability in the United States.
- Strokes can and do occur at ANY age. Nearly one fourth of strokes occur in people under the age of 65.



The “Umbrella” of Acquired Brain Injury



Acquired Brain Injury



ABI

- There are two categories of ABI, *traumatic* and *non-traumatic*.
- Traumatic
 - Contusion
 - Diffuse Axonal Injury (DAI)
- Non-traumatic
 - Stroke
 - Anoxic / Hypoxic
 - Brain Tumor
 - Brain Surgery
 - Infection
 - Toxic / Metabolic Injury
 - Electrocutation / Struck by lightning



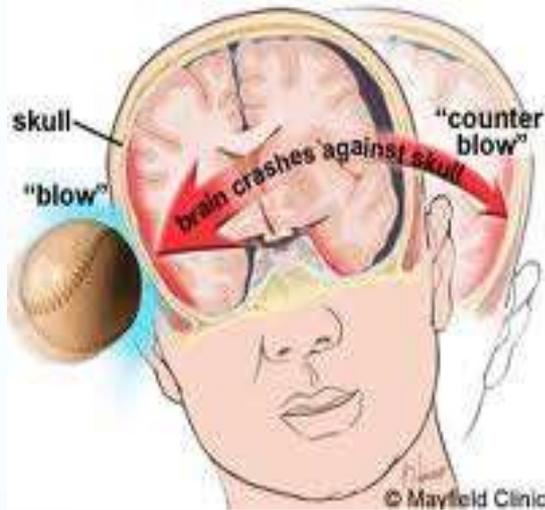
Traumatic Brain Injury (TBI)

- “TBI occurs when an external mechanical force causes brain dysfunction.” (Mayo Clinic)
- **“Traumatic brain injury (TBI)** is a nondegenerative, noncongenital insult to the brain from an external mechanical force, possibly leading to permanent or temporary impairment of cognitive, physical, and psychosocial functions, with an associated diminished or altered state of consciousness.”

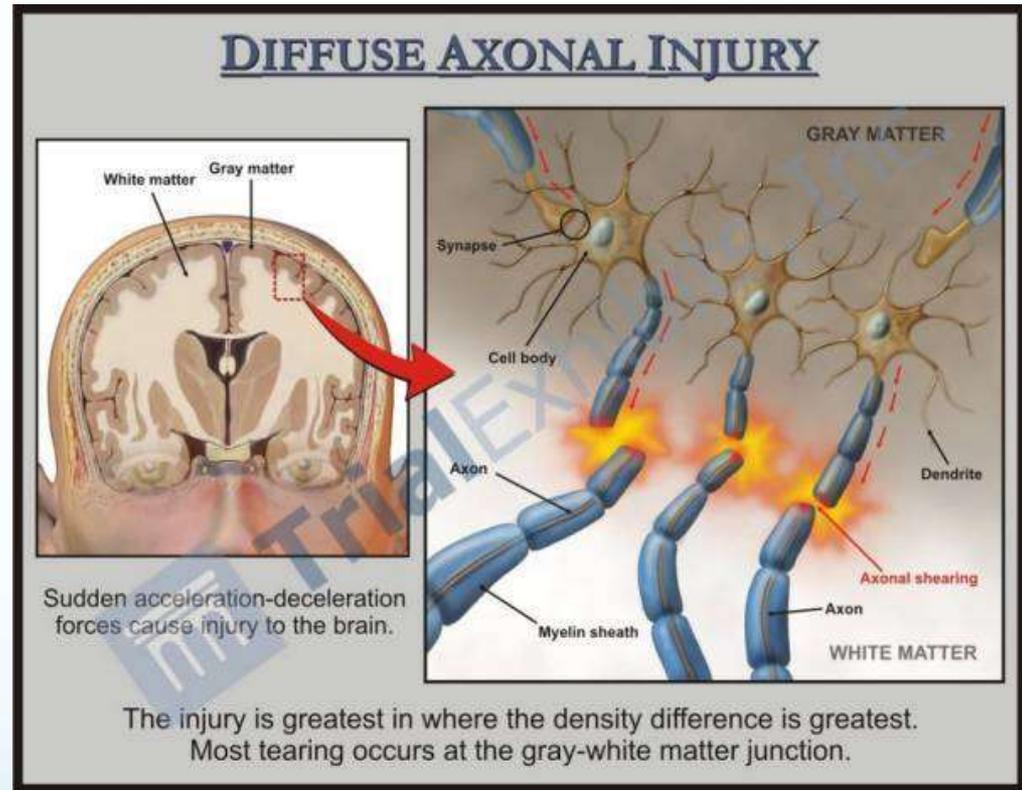


Mechanisms of Traumatic Injuries

Coup – Contrecoup injury



Diffuse Axonal Injury



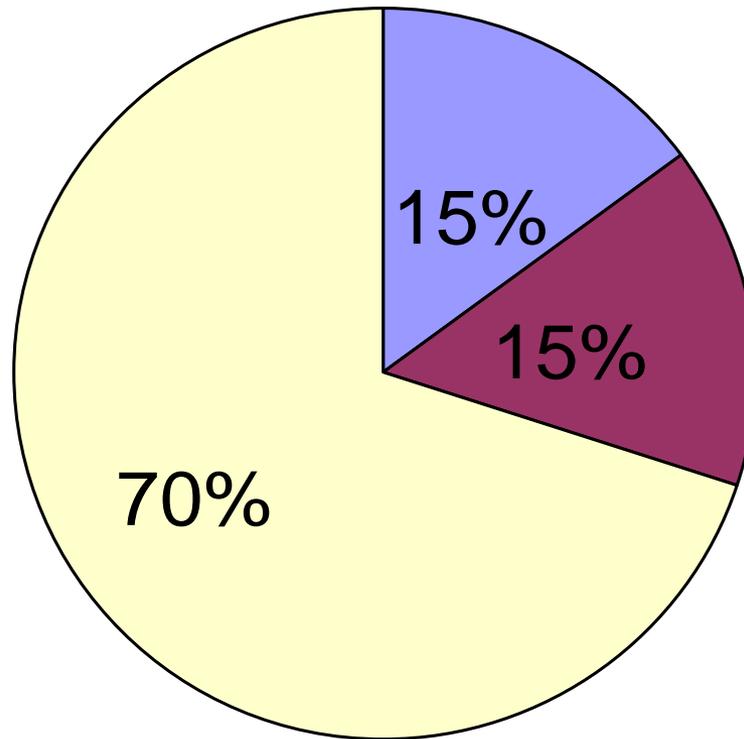
Severity of TBI

	Mild	Moderate	Severe
Imaging	Normal	Normal / Abnormal	Normal / Abnormal
LOC	0-30 minutes	> 30 minutes < 24 hours	> 24 hours
AOC	A moment up to 24 hours	> 24 hours	Severity based on other criteria
PTA	0-1 day	> 1 and < 7 days	> 7 days
GCS	13-15	9-12	3-8

Classification based on 2009 VA/DoD Clinical Practice Guidelines for Management of Concussion/Mild Traumatic Brain Injury



- *LOC = loss of consciousness
- *AOC = alteration of consciousness / mental state
- *PTA = post-traumatic amnesia
- *GCS = Glasgow Coma Scale



- Moderate to Severe TBI
- Mild with Persisting Sx
- Mild w/o Persisting Symptoms

Moderate to Severe TBI

- Basic cognitive skills may be disrupted:
 - Sustaining attention
 - Concentrating on tasks at hand
 - Remembering newly learned material
 - Processing of information
 - Solving problems / making decisions
- Neurobehavioral changes are common:
 - Decreased inhibition and impulsivity
 - Difficulty with initiation
 - Diminished awareness of weaknesses / limitations
 - Social inappropriateness
- Possible emotional & social consequences:
 - Increased irritability / aggression
 - Depression & anxiety
 - Mood lability
 - Social withdrawal

*** Can also experience physical & other medical complications related to the TBI



TBI Consequence		Functional Impact on Behavior
Attention deficit	→	Difficulty focusing on or responding to required tasks or directions on the job or in the classroom
Memory deficit	→	Difficulty understanding or remembering new information or directions
Irritability or Anger	→	Incidents with co-workers / supervisors
Uninhibited or Impulsive Behavior	→	Poor Inhibition of emotions or desires (e.g., making inappropriate jokes, drug use, rage)
Executive Function deficit	→	Difficulty organizing behavior to execute stated intentions or goals (e.g., don't actually do what they wanted or said they would do)

Mild TBI (mTBI)

- mTBI and concussion are often thought of as interchangeable terms
- Diagnostic Criteria for MTBI by the American Congress of Rehabilitation Medicine

A traumatically induced physiological disruption of brain function, as manifested by at least one of the following:

- Any loss of consciousness
- Any loss of memory before or after injury
- Any alteration of mental state
- Focal neurological deficit that may or may not be transient
- Severity of Injury does not exceed the following:
 - LOC \leq 30 minutes
 - After 30 minutes, an initial GCS score of 13-15
 - PTA \leq 24 hours



Common Consequences of mTBI

Physical

- Headache
- Nausea
- Vomiting
- Blurred or Double Vision
- Seeing Stars or lights
- Dizziness
- Sensitivity to light or noise
- Tinnitus

Behavioral - Emotional

- Drowsiness
- Fatigue/Lethargy
- Irritability
- Anxiety
- Depression
- Sleeping more than Usual
- Difficulty Falling Asleep

Cognitive

- Feeling “Slowed Down”
- Feeling “in a Fog” or “dazed”
- Difficulty Concentrating
- Difficulty Remembering

mTBI and Post-concussive syndrome (PCS)

- Diagnosed concussion
- PCS is a “hot topic” and heavily debated
- Diagnostic criteria can vary
 - Symptoms appearing within one week
 - Symptoms of at least 3 months duration
- Symptoms typically resolve within 3-6 months
 - Roughly 10-20% have continued symptoms
- Persistent Post-Concussive Syndrome (PPCS)
 - Symptoms lasting longer than 3 or 6 months
- “Permanent” PCS???



Non-traumatic Brain Injuries

- **Stroke**
- Anoxic / Hypoxic
- Brain Tumor
- Brain Surgery
- Infection
- Toxic / Metabolic Injury
- Electrocution / Struck by lightning
- Hydrocephalus

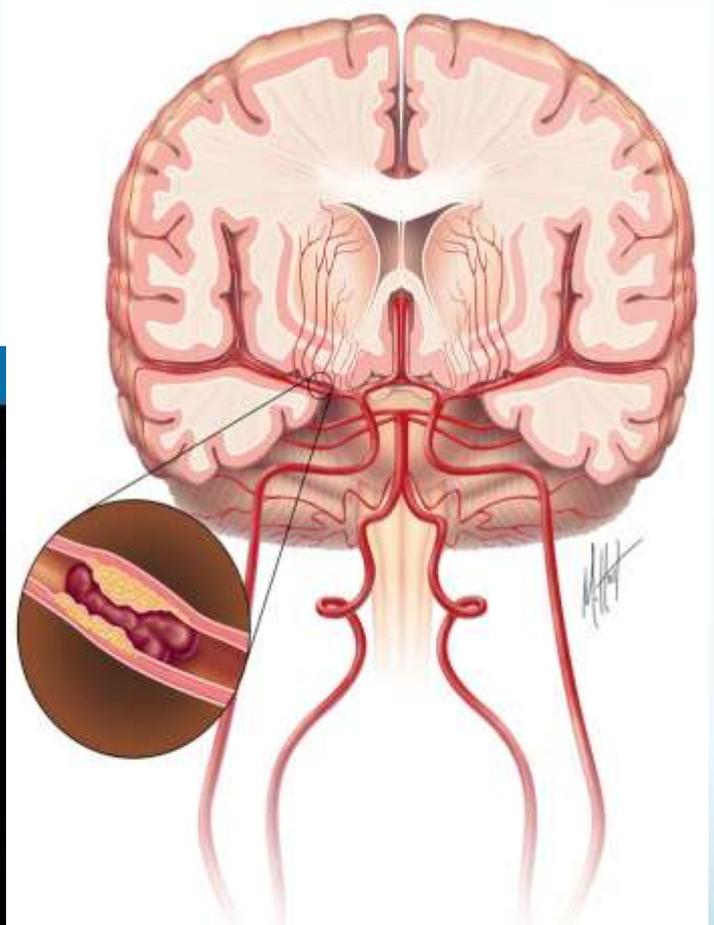


Stroke

- Ischemic Stroke
 - Most common type of stroke



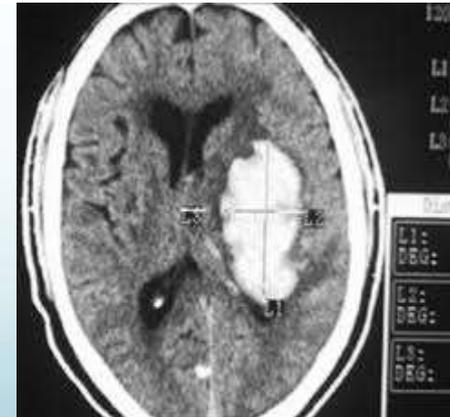
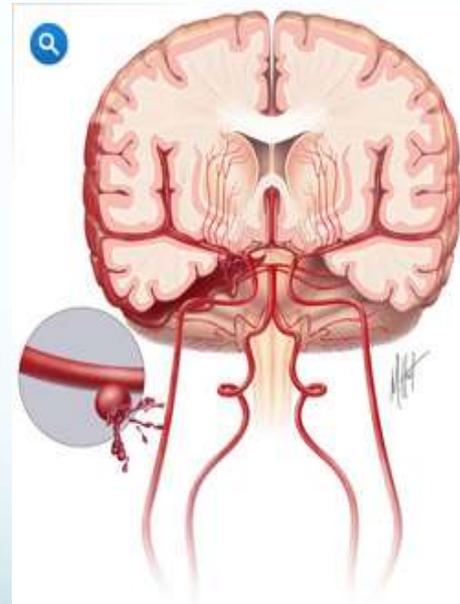
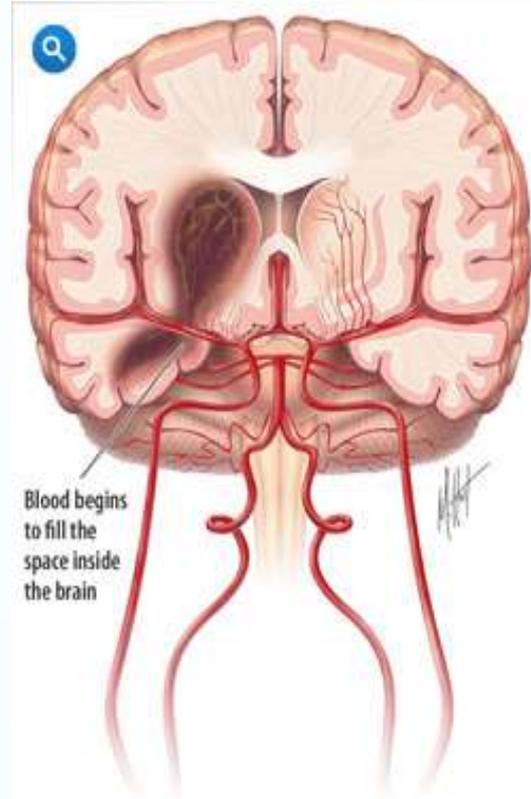
DWI = Diffusion-weighted imaging



The Internet Stroke Center

Stroke

- Intracerebral Hemorrhage →
- Subarachnoid Hemorrhage



The Internet Stroke Center

Recovery Post-Brain Injury

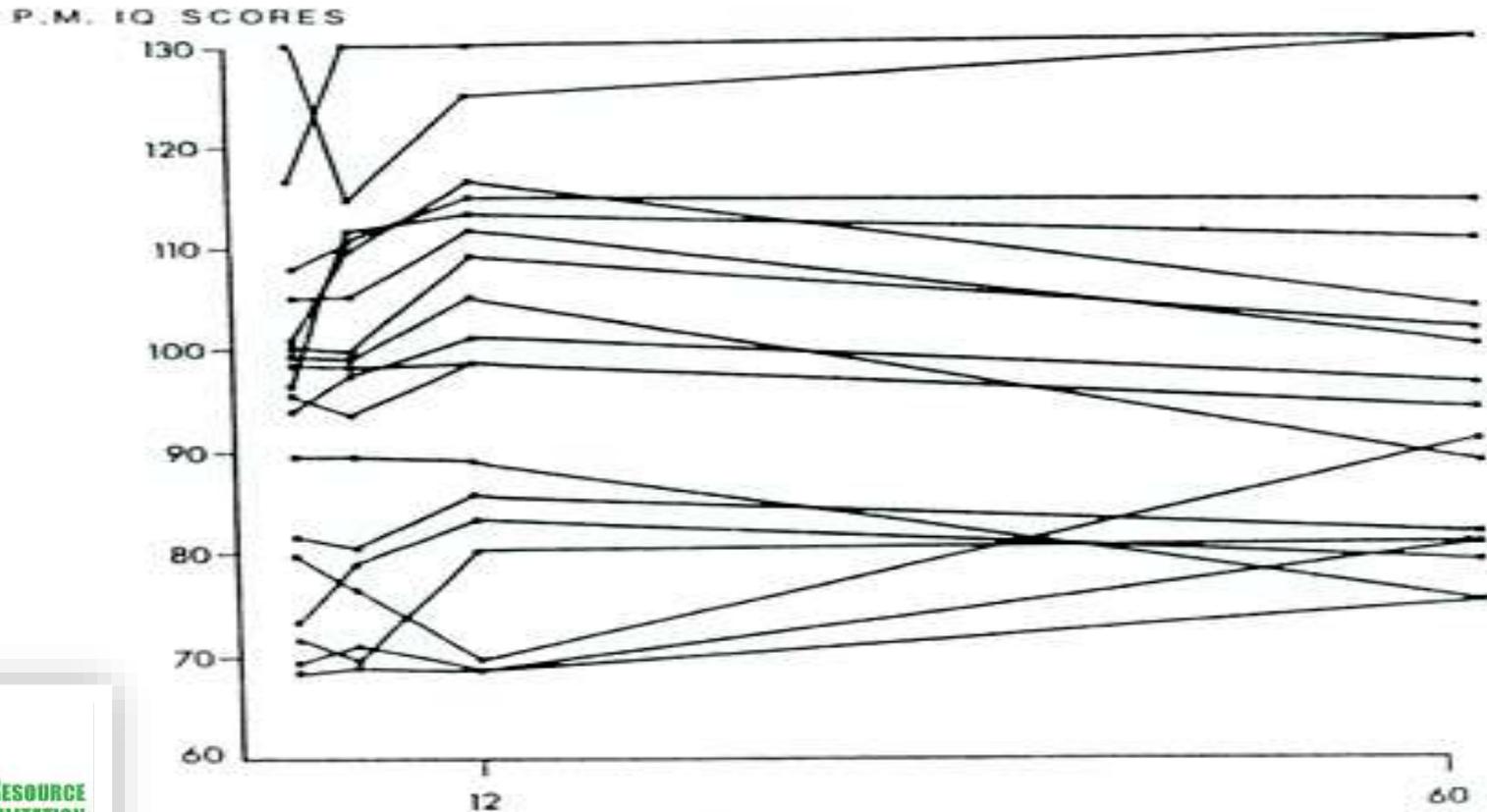
Myth or Fact?

1. Acute severity can accurately predict post-acute severity. **MYTH**
2. The amount of time the person with a brain injury remains in a coma is one of the factors that affects recovery. **FACT**
3. Knowing which parts of the brain have been injured will tell you the specific challenges to expect. **MYTH**
4. Most recoveries for brain injury show steady improvement up until 2 years when recovery is complete. **MYTH**
5. With support, many people can change behavior after a brain injury. **FACT**

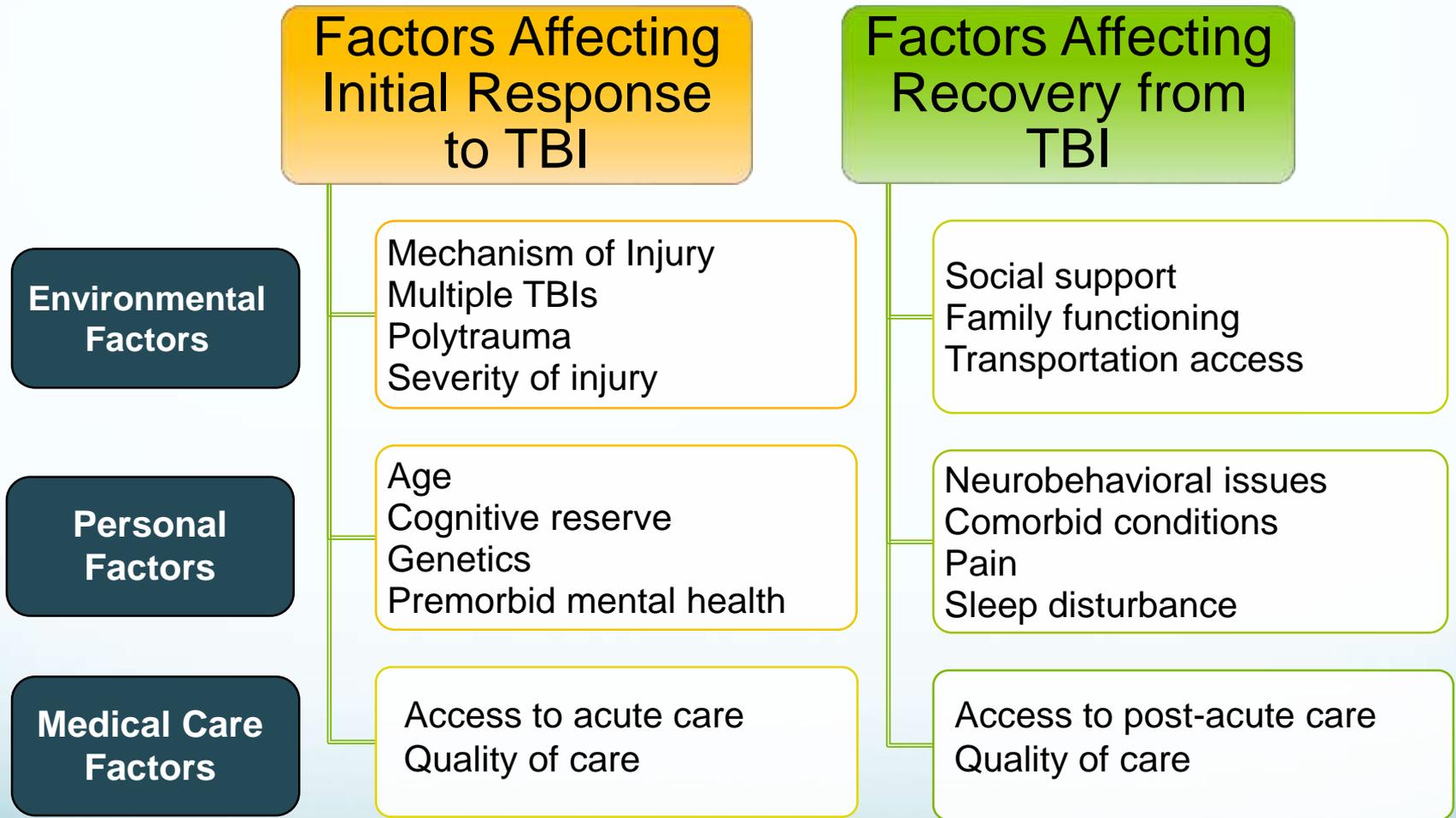


“Recovery” after TBI

(Brooks, 1984)



Determinants of Recovery



Determinants of Recovery

- Factors affecting cognitive and functional recovery from TBI:
 - Premorbid Conditions
 - Comorbidities
 - Contextual Factors

<https://www.nap.edu/read/13220/chapter/6>



Determinants of Recovery

Premorbid Conditions

- ADHD, learning disabilities, developmental disabilities, syndrome on the Autism spectrum
- Pre-injury psychiatric conditions including personality and substance use disorders
- Lack of social support systems
- Low socioeconomic status
 - Uninsured / Underinsured
 - Low educational status
 - Low IQ



Determinants of Recovery

Comorbidities

- Can include behavioral, psychiatric, physical, or cognitive disorders – mostly causal associations
- E.g.
 - Depression and anxiety related to the effects of the injury
 - Post-traumatic seizure disorder
 - Neurobehavioral syndromes
 - Vision impairment
 - Fatigue
 - Headache / pain
 - Sleep disturbance

Co-occurring injuries may include multi-trauma such as broken bones



Determinants of Recovery

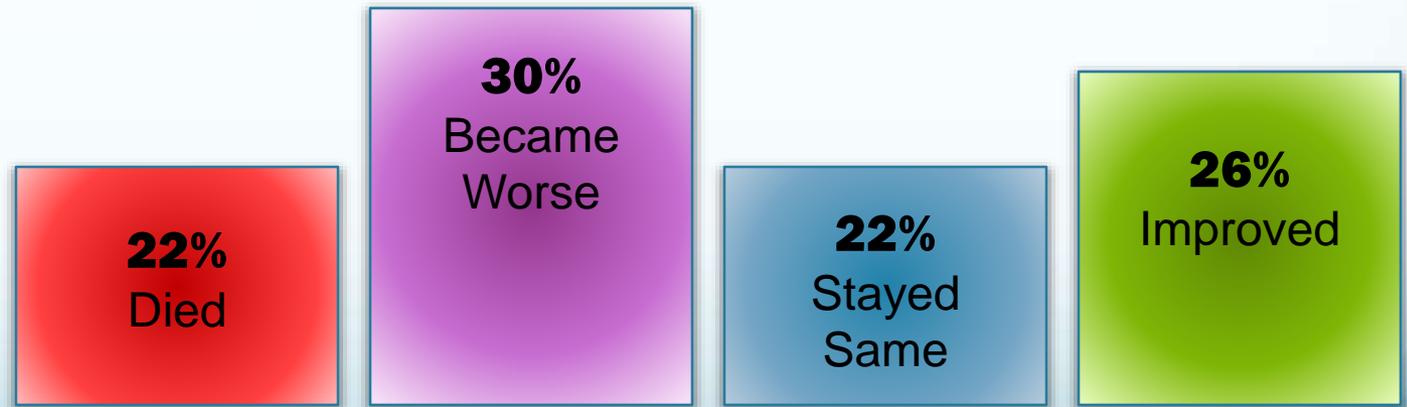
Contextual Factors

- Family and social support play a key role in recovery post-TBI
- The dynamic of family functioning (poor and good) can directly affect one's potential for optimal recovery
- Access to appropriate rehabilitation resources may be limited due to geographical restrictions and/or limited funding

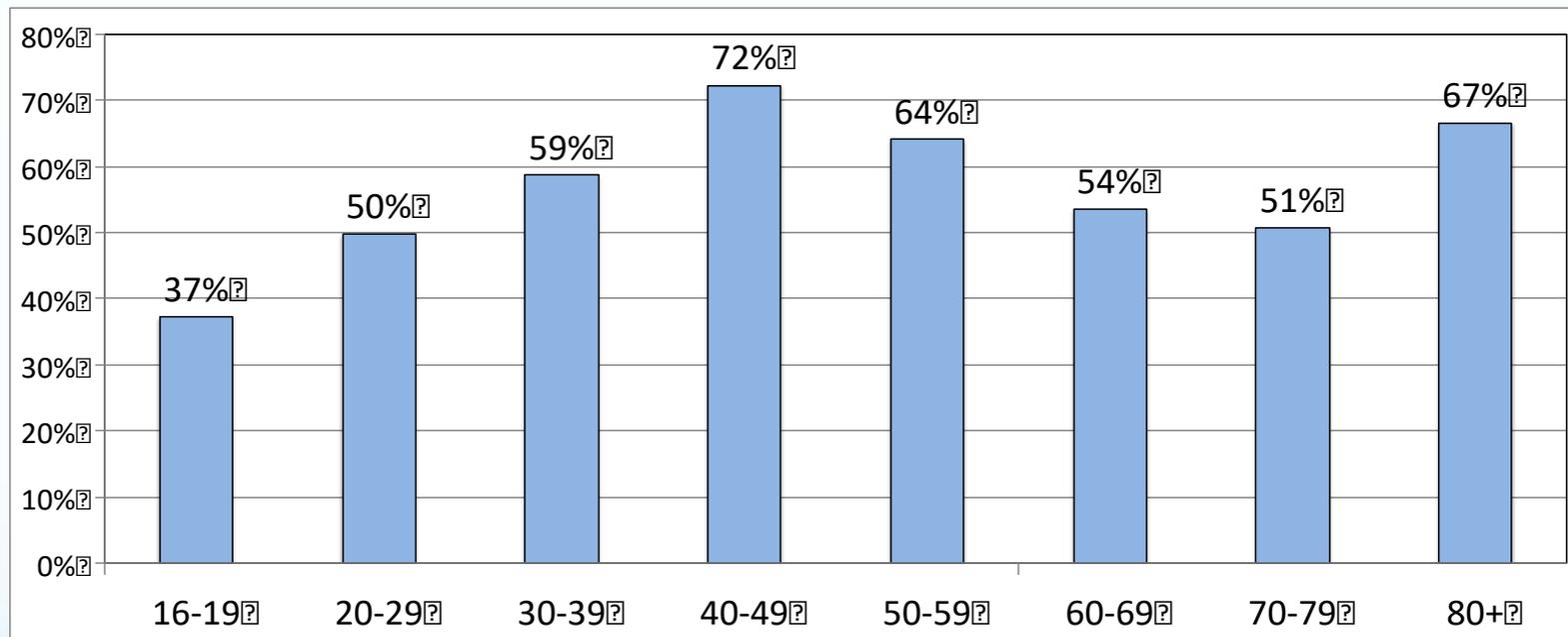


5-Year Outcomes of Persons with TBI

- Data are US population estimates based on the TBIMS National Database.
- Data refer to people 16 years of age and older who received inpatient rehabilitation services for a primary diagnosis of TBI.



58% have moderate or severe disability at 5 years since injury (GOS-E)



Of the average annual 13,700 admissions to U.S. IRF's* with a primary diagnosis of TBI, an estimated annual average of more than 7,920 had moderate or severe disability 5 years after injury.

*October 1, 2001 and December 31, 2007

POSSIBLE SOURCES OF DETERIORATION?

- **TBI triggers a progressive, degenerative process** (i.e., Parkinson's Disease, Alzheimer's Disease, Chronic Traumatic Encephalopathy).
- **TBI causes loss of functional independence** which interacts with normal aging to increase poor health.
- Frontal lobe damage endemic to TBI causes changes in **self-regulation** which lead to death and disability from risky behaviors.
- Other (lack PCP, substance use, liver disease, ...)
- Normal aging
- Some or all of the above.



Chronic Brain Injury

2012 GBIC definition

“Injury to the brain can evolve into a lifelong health condition termed chronic brain injury (CBI). CBI impairs the brain and other organ systems and may persist or progress over an individual’s life span. CBI must be identified and proactively managed as a lifelong condition to improve health, independent function and participation in society.”

Vision: Brain Injury Chronic Disease Mgmt 2013 GBIC

Brain injury will be identified and proactively managed as a life-long chronic disease that will result in improvements in longevity, level of disability, expense to society, and quality of life. This will be achieved through modification of our medical and psychosocial health care delivery systems, health care education curricula, research agenda, and legislative/health care policy.



Questions?

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THANK YOU!

