An acquired brain injury is an injury to the brain that has occurred after birth. 


- "Their brain trauma has resulted in a condition that is disease causative and disease accelerative. As a result of their brain trauma, these individuals now have life-long brain injury disease."

- "Their disease should be reimbursed and managed on a par with all other diseases. Only then will the individuals with this disease get the medical surveillance, support and treatment they deserve."

- "Only then will brain injury research receive the funding it requires. Only then, will we be able to truly talk about a cure."
Types of Acquired Brain Injury

Non-Traumatic Brain Injury
- Anoxic/Hypoxic
- Encephalitis
- Drowning
- MI
- Hypoglycemia
- Hypertensive Encephalopathy

Traumatic Brain Injury (TBI)
- Males > Females

Open Head Injury
- Penetrating Injuries
- Skull Fracture

Closed Head Injury
- Internal Pressure & Shearing

Intentional Causes
- Suicide
- Homicide/Suicide attempts
- Domestic Violence and Child Abuse
- Military
- Assault/Criminal Behavior

Unintentional Causes
- Falls
- Transportation/MV Accidents
- Sports
- Industrial/work related

Infection
- Anoxia/Hypoxia
- Viral
- Encephalitis
- Malaria
- Herpes

CV A/A VM
- Stroke
- Embolism
- Thrombosis
- Aneurysm

Metabolic D/O
- Diabetic coma
- Metabolic Fluid

Hydrocephalus

TBI by Age and Cause

Mass. ED Visits for TBI 2002-2008

(Reason: Mass Injury Surveillance Program 2011)

(Reason: Mass Injury Surveillance Program 2011)
Mild-Severe TBI

Mild TBI = Unconscious ≤ 30 minutes

Moderate TBI = Unconscious 30 min-24hrs

Severe TBI = Unconscious ≥ 24 hrs

TBI ED Visits in MA

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<tr>
<th>Severity</th>
<th>Percentage</th>
<th>Number</th>
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<tr>
<td>Mild</td>
<td>80%</td>
<td>36,567</td>
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<tr>
<td>Moderate</td>
<td>15%</td>
<td>6,856</td>
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<tr>
<td>Severe</td>
<td>5%</td>
<td>2,285</td>
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Total = 45,709

Symptoms of Brain Injury

- **Physical Impairments** - speech, vision, hearing, headaches, motor coordination, spasticity of muscles, paresis or paralysis, seizure disorders, balance, and fatigue.

- **Cognitive Impairments** - short term memory deficits, impaired concentration, slowness of thinking, limited attention span, impairments of perception, communication skills, planning, writing, reading, and judgment.

- **Emotional Impairments** - mood swings, self-centeredness, anxiety, depression, lowered self-esteem, sexual dysfunction, restlessness, lack of motivation, and difficulty controlling emotions and behavior.
TBI Primary & Secondary Injury

**Primary Injury (at time of injury)**
- Axonal Shearing (axons [like little phone lines] torn)
- Contusion (bruising)
- Contra coup (brain bangs back and forth and opposite side gets bruised)
- Skull fracture

**Secondary Injury (after the trauma)**
- Hematomas (blood clots)
- Increased pressure (ICP)
- Shock (not enough blood supply)
- Anoxia (no oxygen)
- Seizures: Generalized, Partial [simple & complex] [behavior]
- Hydrocephalus (CSF buildup)

Spontaneous Recovery

- The natural healing of neuronal and vascular systems
- We now believe this can go on for up to 8 years post injury. Learning can go on forever
- More active treatment = faster/better recovery
- Animal studies show neuronal recovery driven by cognitive work and vascular by exercise

“Once you’ve seen one brain injury, you’ve seen one brain injury.”
Rancho Los Amigos Scale

**Level 1**
No Response: Patient appears to be in a deep sleep and does not respond to voices, sounds, light or touch.

**Level 2**
Generalized Response: Patient reacts inconsistently and non-purposely to stimuli; first reaction may be to deep pain; may open eyes, but will not seem to focus on anything in particular.

**Level 3**
Localized Response: Patient responses are purposeful, but inconsistent and are directly related to the type of stimuli presented, such as turning head toward a sound or focusing on a presented object; may follow simple commands in an inconsistent and delayed manner.

**Level 4**
Confused, Agitated: Patient is in a heightened state of activity; severely confused, disoriented and unaware of present events. Reacts to own inner confusion, fear or disorientation. Behavior is frequently bizarre and inappropriate to the immediate environment. Excessive behavior may be abusive or aggressive.

**Level 5**
Confused, Inappropriate, Non-Agitated: Patient appears alert; responds to simple commands. Follows tasks for two to three minutes, but easily distracted by environment; frustration, verbally inappropriate; does not learn new information.

**Level 6**
Confused-Appropriate: Patient follows simple directions consistently; needs cueing; can relearn old skills, such as activities of daily living, but memory problems interfere with new learning; some awareness of self and others.

**Level 7**
Automatic-Appropriate: If physically able, patient goes through daily routine automatically, but may have inflexible behavior and internal confusion, shallow recall of activities; poor insight into condition; initiates tasks, but needs structure, poor judgment, problem-solving and planning skills.

**Level 8**
Purposeful-Appropriate: Patient is alert, oriented; recalls and integrates past and recent events; learns new activities and can continue without supervision; independent in home and living skills; capable of driving; deficits in stress tolerance, judgment, abstract reasoning persists; may function at reduced social level.

**Level 9**
Patient independently shifts back and forth between tasks and completes them accurately for at least two consecutive hours; aware of and acknowledges impairments when they interfere with task completion; requires standby assistance to anticipate a problem before it occurs; depression may continue; patient may be easily irritable and have a low frustration tolerance.

**Level 10**
Patient is able to handle multiple tasks simultaneously in all environments but may require periodic breaks. Irritability and low frustration tolerance may persist when feeling sick, fatigued, or under emotional distress.

---

Glasgow Coma Score (GCS)

Scored between 3 and 15

The GCS measures the initial responses to determine the level of their brain injury.

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

**Best Verbal Response**
1. No verbal response
2. Incomprehensible sounds
3. Inappropriate sounds
4. Confused
5. Oriented

**Best Motor Response**
1. No motor response
2. Extension to pain
3. Flexion to pain
4. Withdrawal from pain
5. Localizing pain
6. Obey commands
### Coma, PVS, MCS

#### Minimally Conscious State
- Following simple commands
- Ostensibly or verbal yes/no responses (regardless of accuracy)
- Intelligible verbalization
- Purposeful behavior such as those that are contingent due to appropriate environmental stimuli and are not reflexive

#### Persistent Vegetative State
- Unresponsive to external stimuli and their conditions are associated with different levels of consciousness
- Person can still respond, in varying degrees, to stimulation
- Often open their eyes in response to feeding, and are capable of swallowing
- Have sleep/wake cycle

#### Coma
- Asleep
- Fail to respond normally to painful stimuli, light, or sound
- Does not initiate voluntary actions

### A Treatment Continuum

#### Ranchos Los Amigos Scale - Revised

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<th>1</th>
<th>2</th>
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- **Treatment**
  - Simple Strong Contingencies
  - Avoid (-) Reinforcement, CBT, Natural Contingencies
  - Teach Adaptive and Compensatory Skills
  - High Environmental Consistency
  - Lower Environmental Consistency

- More medication
- Taper medication
- Discontinue Medication

- Ongoing Positive Support (don't reinforce or imitate aggression)
- Crisis Management

**“Progress is not linear”**
Factors Contributing to Long-Term BI Recovery

- Pre-injury history (e.g., substance abuse, emotional adjustment problems, learning difficulties in school, or criminal history)
- Age at onset of injury
- Etiology, location, and severity of brain injury
- Coma depth and duration
- Post-traumatic amnesia
- Time elapsed since injury
- Level of education
- Nature and extent of financial resources
- Nature and extent of family and vocational support systems
- Amount of motivation to achieve goals
- Amount of self-awareness, self-control, and coping skills
- Religious or spiritual beliefs
- Employment history

Recovery Path

Onset

Acute Rehab
& hope
Recovery Path

Onset

Acute Rehab & hope

Adjustment to new self?

Post acute

Acute rehab & hope

Adjustment to new self?
Neuroplasticity

Brain cells (neurons) can grow around and replace other damaged neurons; or nearby neurons can take over the role of damaged cells.

Neuroplasticity video

Main Parts of the Brain (cont.)

1. The Brain Stem - keeps us alive
   • Controls breathing, heart rate, blood pressure, consciousness
Main Parts of the Brain (cont.)

2. Emotion and learning parts

- Sensory input to outer part of brain
- Encodes new learning and stores important memories
- Fight or flight
- Hunger, sex drive, temperature
- Smell - strong ties to memories

3. The Cerebrum (big wrinkly part)

Two halves (hemispheres)
- Left – logical, speech, math, reading, right – side movement
- Right – creativity, abstract, music, art, spatial perception, left-side movement

Four lobes – Frontal, Temporal, Parietal, Occipital

Left Brain
- Logic
- Analysis
- Organization
- Administration
- Maths & science
- Knowledge/facts
- Detail

Right Brain
- Emotion
- Intuition
- Spirituality
- Interpersonal skills
- Art & music
- Belief
  “Big picture”
Right vs. Left Hemisphere Brain Injury

Right Hemisphere Damage
- Hemianopsia, left hemispatial neglect or visual neglect.
- Spatial orientation, body position and nonverbal communications partial paralysis of the left side. Emotional and behavioral problems may occur.
- May appear confused, unmotivated, uncooperative or excessively dependent.
- May be unaware of the full extent of their impairment.
- May even deny they have a problem.

Left Hemisphere Damage
- Right hemianopsia
- May also impact mood and behavior.
- May appear compulsive, disorganized and easily frustrated.
- May demonstrate problems in memory, speech, writing, and cognitive processing.
- Reading ability may be impaired at a cognitive level.
- Often this loss of reading and speech can be rehabilitated with speech therapy, but in some cases this loss is permanent.

Parts of the Brain (cont.)

- **Frontal** (at front of brain over your eyes)
  - “The Mother of the Brain” controls:
    - Planning, sequencing, follow-up, reasoning
    - Voluntary movement (L→R, & R→L)
    - Speech/language
      - If damaged: can’t talk/write, impulsive, easily distracted, can’t stay on task or solve problems, movement problems

Cognitive Impairment and Social Skills

- **Insight**
  - Poor judgment in social situations
  - Development of unrealistic goals
  - Decreased ability to predict consequences of actions

- **Attention**
  - Tendency to drift off topic
    - Decreased awareness of other people’s nonverbal and verbal reactions
    - Decreased listening ability
    - Inter个人ly distracted, poor eye contact
    - Internally distracted: makes statements inappropriate to the situation
    - Decreased ability to shift attention from one topic to the next
    - Attention to only parts of the social situation

- **Memory**
  - Inability to accurately recall previous interactions with others, resulting in discontinuity of social relationships
  - Decreased recall of names, faces, conversations
  - Difficulty keeping track of conversations

- **Self-Monitoring**
  - Difficulty monitoring speed of reactions, tone of voice, emotions

- **Concrete**
  - Decreased empathy
  - Decreased self-reflection
  - Decreased ability to generalize experiences
  - Decreased ability to consider the consequences of actions
  - Appears insensitive and egocentric
Parts of the Brain (cont.)

- **Temporal** (behind ears) controls:
  - Hearing for that side, L = understanding language, reading, verbal memory, R = music comprehension, visual memory
  - If damaged: hallucinations [auditory/visual], hearing loss, can’t understand what’s said, can’t read

Parts of the Brain (cont.)

- **Parietal** (on sides above temporal) controls:
  - Integrating the senses, (e.g., finding keys in pocket w/o looking), putting the big picture together, recognizing things and people
  - If damaged: not knowing what things are, touch sensation on opposite side of body, memory

Parts of the Brain (cont.)

- **Occipital** (at the back of the brain) controls:
  - Vision, color, movement, shape, position
  - If damaged: can’t see even though eyes may be OK, can’t locate or place things down correctly
Parts of the Brain (cont.)

- **Cerebellum** (baby brain)

  Two plum size lobes at back under cerebrum
  - Controls: Balance & coordination, over-learned stuff like shoe tying, walking
  - If damaged: shakiness cause muscles aren’t coordinated, trouble standing, walking, balance, need help with automatic behaviors

ABI vs. DD

- Habilitate: To dress, clothe, make fit; i.e., to initially acquire and learn skills/behaviors
- Rehabilitate: To restore to a good and useful life; i.e., to reacquire and relearn skills and behaviors
- Neuro-rehabilitation
- Neuro-behavioral rehabilitation
Gradual vs. Sudden Onset

- Developmental disorders from birth such as Down Syndrome, Autism, William’s disease create a gradual process for adjustment.
- ABI/TBI results in an abrupt change in many areas of function, creating PTSD for families and strong identification with the pre-onset (pre-morbid) individual, who are often older, fully-functioning folks.
- Individual may experience ongoing anger/depression related to loss

Expectations of Community-Based Services

- Relief to be out of an institutional setting
- Opportunities to relearn skills that may have been stifled by “Excess Disability”
- Increased expectation to “return to normal”, including work, relationships and independence
- But also: increased opportunity for failure and disappointment
- Substance abuse may re-emerge having been suppressed by no access in institutional setting

Programming

- ABI/TBI folks:
  - Often don’t associate themselves with other ABI/TBI’s but rather with caregivers & pre-morbid self
  - Prefer vocational/rehab oriented day programs
  - Associate recovery with getting their vocation back
  - May want to return to school
  - May need ‘booster’ OT, PT, & SLP
  - Skills may be acquired more quickly and require refreshed STO’s
Philosophy of Care

The "No Blame" Approach (EBIG 2009)

People are predisposed to behave in certain ways that are shaped by:

- Cognition
- Perception
- Memory
- Pain/discomfort
- Embarrassment
- Fear
- Fatigue

These are the causes of brain-injured person's behavior, therefore we shouldn't blame the person themselves. As soon as we label or blame the person, we give ourselves permission to stop looking for the underlying cause of behavior (e.g., infection, pain, loss, cognition etc.)

Philosophy of Care

Can vs. Can't (EBIG 2009)

Rather than focus on what a person can't do (although this is often how problem behaviors are initially defined) try to find what they can or could do and set goals, objectives and treatment around those areas.

Protecting a person from harm shouldn't preclude them from being given opportunities to (safely) try or fail

Can vs. Can't can help increase new behaviors and improve dignity through risk-taking

A Can vs. Can't philosophy opens the door to creative and rewarding treatment opportunities, and develops care plans that promote individual strengths

Philosophy of Care

Active Treatment (EBIG 2009)

The concept of Active Treatment means providing interactions between staff and BI survivor that result in increased skills and independence for the person being assisted. An acronym to guide this approach is PEARL which stands for:

- Positive - Staff are up-beat, request [not demand], encourage and support [not demand, emotion]
- Early - Staff are on top of events, proactive, know individuals
- All - the time, across persons, places, materials
- Reinforcing - with sincere praise or individualized reinforcement
- Look - Staff look for opportunities to teach and support
Behavior

“Touch the brain; never the same.”

- ABI maladaptive behaviors are often similar to DD folks
- Other “behaviors” are related to memory and cognitive impairments, especially executive functions
- Positive Behavioral Supports including antecedent management are well suited to ABI/TBI due to impaired ability to learn from consequences

Positive Behavior Supports


DDS definition:
“Positive Behavioral Supports is a systematic, person-centered approach to understanding the reasons for behavior and applying evidence-based practices for prevention, proactive intervention, teaching and responding to behavior, with the goal of achieving meaningful social outcomes, increasing learning and enhancing the quality of life across the lifespan.”
Behavior Confounds & ABI

- Complex-partial seizure disorder. (a.k.a. temporal lobe epilepsy). Can manifest as aggression, paranoia, hallucinations, psychosis.
- Person may have declarative learning (know what's right), but not procedural (how to do what's right).

Right hemisphere damage

- Hemianopsia, left hemispatial inattention or visual neglect. Person may startle or aggress when approached from left.
- Spatial orientation, body position and nonverbal communications partial paralysis of the left side. Emotional and behavioral problems may occur.
- May appear confused, unmotivated, uncooperative or excessively dependent.
- May be unaware of the full extent of their impairment.
- May even deny they have a problem.

Anger

- Often caused by decreased:
  - Self-awareness
  - Self-monitoring
  - Problem solving ability

- Anger/aggression become very automatic
Keep things calm!

![Graph showing time, intensity, rationality, precursors, antecedents, recovery, crisis, and successful de-escalation]

Psychopharmacology

- There are no meds for brain injury
- Be open to paradoxical effects (e.g., anti-psychotics causing hallucinations)
- Try to change one at a time in small increments. As folks age try GDRs
- Collect data
- Watch for side-effects, EPS, Tardive Dyskinesia, Serotonin syndrome, NMS

Friendship, Intimacy, & Sexuality

- Society risks overstating sex versus friendship and intimacy
- Important issue not often addressed by rehab professionals
- Disinhibition and hypersexuality
Changes in Sexuality and Function after ABI

- Damage to parts of the brain involved in sexual functioning
- Changes in brain chemicals
- Hormonal changes
- Medication Side Effects
- Fatigue/Tiredness
- Problems with movement
- Changes in thinking abilities
- Changes in emotions/mood
- Changes in social communication abilities
- Loss of Self-Esteem
- Decreased Social Contacts
- Headaches
- Inability to control bowel or bladder
- Use of Alcohol and Drugs

Possible Reasons for Discomfort

- Lack of knowledge regarding TBI and sexuality
- Doesn’t seem important when there are so many other problems
- Belief that person with TBI is “child-like” and unlikely to be interested in sex
- Embarrassed and/or believe sex should not be discussed

Substance Abuse

TBI Alcohol and Drug Use

- [%] Alcohol
- [%] Illicit Drugs
- [%] Either

TBI Model Systems
OSU Outcome Study
Univ. Of Washington
Substance Abuse Affect on a Person with ABI

- People who use alcohol or other drugs after they have a brain injury:
  - Don’t recover as much.
  - Have more difficulty walking or talking.
  - Often say or do things without thinking first, a problem that is made worse by using alcohol and other drugs.
  - Have increased problems with thinking, like concentration or memory.
  - Alcohol and other drugs have a more powerful effect.
  - Are more likely to have times that they feel low or depressed.
  - Can increase risk of a seizure.
  - Are more likely to have another brain injury.

Neuro-physio-BCB-what?

- **Neurologist**: An MD who specializes in brain and CNS function; seizures, EEG’s, meds; usually a consultant and not PCP

- **Neuropsychologist**: a PhD psychologist with specialized training in evaluating cognitive functioning; testing, evaluations, recommendations for treatment & sometimes behavior plans

- **Neuropsychiatrist**: An MD psychiatrist with specialization in ABI and neuro-behavioral disorders

- **Physiatrist**: An MD with specialization in physical functioning; Baclofen pumps, contractures, spasticity, serial casting; sometimes psych meds; usually a consultant and not PCP

- **Board Certified Behavior Analyst (BCBA)**: a Master’s or PhD clinician trained and nationally certified in behavior analysis, FBA’s, behavior support plans, training, data analysis
Families

- The impact of a brain injury often alters the roles, principles or rules, and internal responsibilities of the family.
- All aspects of family life may be changed and major modifications in the structure and organization of the family should be anticipated.
- Family changes include routines, social status, family health, and behaviors of the individual who has been injured.
- The family may be unable or have difficulty adjusting to the “different” person with the brain injury.
- Type II Ambiguous Loss: physical presence and psychological absence
  “She’s gone, but still here”
  “God took my loved one and gave me another”

Stages of Adjustment

- Stage I 1-3 months: The shock of the injury dominates. Hopes for full recovery. Repressed feeling and denial of severity.
- Stage II 3-9 months: Recognition of the severity of the injury. Helplessness and frustration.
- Stage III 6 months-2 years: Start to get annoyed with individual. Family expects full independence. Start comparing ‘before & after’ realities. Start to recognize the reality of impairments. Start information seeking about brain injury.
- Stage IV 10 months-2 years: Realism of situation sets in. Family begins to get overwhelmed. Reduction of time with loved one. Bereavement-like emotions and stages occurring.
- Stage V 1-2 years: Profound sadness. Families grieve and can experience guilt with grieving. May feel the loss of loved one’s personality. This can occur as disenfranchised grief (unacknowledged by society) and/or ambiguous loss (no resolution, finality, ritual or clarity).
- Stage VI 2-3 years: Greater understanding of the situation. Understand the person may never be the same. Begins to accept loved one’s condition. Can now address needs of the entire family unit.

Strengths that can help families cope and adjust

1. Ability of the family to listen.
2. Shared and common perceptions of reality within the family, including the changes that often happen following a brain injury.
3. Spirituality of the family.
4. Ability of the family to realize the redemptive power of a seemingly tragic event.
5. Ability of family members to accept and pass on any disability-related problems, including education of the family about possible resolutions.
6. Ability of the family to compromise within the family unit.
7. Family members’ willingness to take good care of themselves.
8. Ability to focus on the present, rather than on past events or disappointments.
9. Ability of family members to reinforce each other.
10. Ability of family members to discuss concerns.
11. Ability of family members to provide an atmosphere of belonging.
12. Use of the family’s effective trans-generational coping strategies building on family strengths that have always been effective in solving problems within the family.

(Essential Brain Injury Guide 2009)
Families & PTSD

1. Vigilance and scanning: Constant checking on what is going on beyond the normal questions and answers from the professionals.

2. Elevated startle responses: Being overly jumpy when startled and surprised.

3. Blunted affect or psychic numbing: There is a reduction of loss of the ability to feel. This may include a reduced ability to bond with others, especially other family members. It is usually a form of distancing in preparation for experiencing more pain.

4. Aggressive, controlling behavior: The form of aggression is not usually from the survivor but from family members. The person acts somewhat viciously in response to people or situations.

5. Interruption of memory and concentration: Difficulty concentrating and remembering, even if just told about something.

6. Depression: Deep feelings of despondency, exhaustion, negative attitude, and apathy toward others.

7. Generalized anxiety: Tension in the body, cramps, headaches, stomachaches, etc., for no physical reason.

8. Episodes of rage: Not mild anger, this refers to violent eruptions to situations or people, often from a minor incident.

9. Substance abuse: In an attempt to reduce stress-related symptoms, the person may seek substances such as alcohol or narcotics.

10. Intrusive recall: Old and negative memories suddenly appear from the past. These are the same type of responses that a person experiences during a nightmare.

11. Dissociative “flashback” experiences: It is a form of intrusive recall where the person’s mind replays a particular form of action that feels like it is happening now.

12. Insomnia: Difficulty falling asleep or staying asleep.

13. Suicidal ideation: There are thoughts of not wanting to live should their loved one die. The person is at a very low point in life because of what has occurred.

14. Survivor guilt: A common “trade off” belief where the family member prays for God to take him instead of the loved one. This is a very control reaction when the survivor is a child.
Outcome Measures & Scales

- The Disability Rating Scale (DRS)
  - Can be used retrospectively by record review
  - Easy and quick
  - Can be done over the phone
  - Valid across all levels of recovery
  - 0 = no disability to 30 = death

- The Community Integration Questionnaire
  - Can be used retrospectively by record review
  - Easy and quick
  - Can be done over the phone
  - 0 = no integration; 29 = best integration

Outcome Measures & Scales

- Mayo Portland Adaptability Inventory (MPAI)
  - More sensitive to change than the DRS
  - More detailed items = better assessment tool to inform treatment including major obstacles to community integration
  - National data base, used in research and clinical application
  - And many others at: The Center for Outcome Measures in Brain Injury
    www.tbims.org/combi

Resources

- Brain Injury Association of MA
  www.biama.org

- Brain Injury Association of America
  www.biausa.org

- The Academy of Certified Brain Injury Specialists
  www.acbis.org

- The North American Brain Injury Society
  www.nabis.org

- ABI Glossary
  http://www.neuroskills.com/resources/glossary.php