



Rehabilitation in the Setting of Pediatric Trauma

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Disclosures:

- I have nothing to disclose relevant to today's discussion.
 - No conflicts of interest
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 - No product off label use



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Objectives

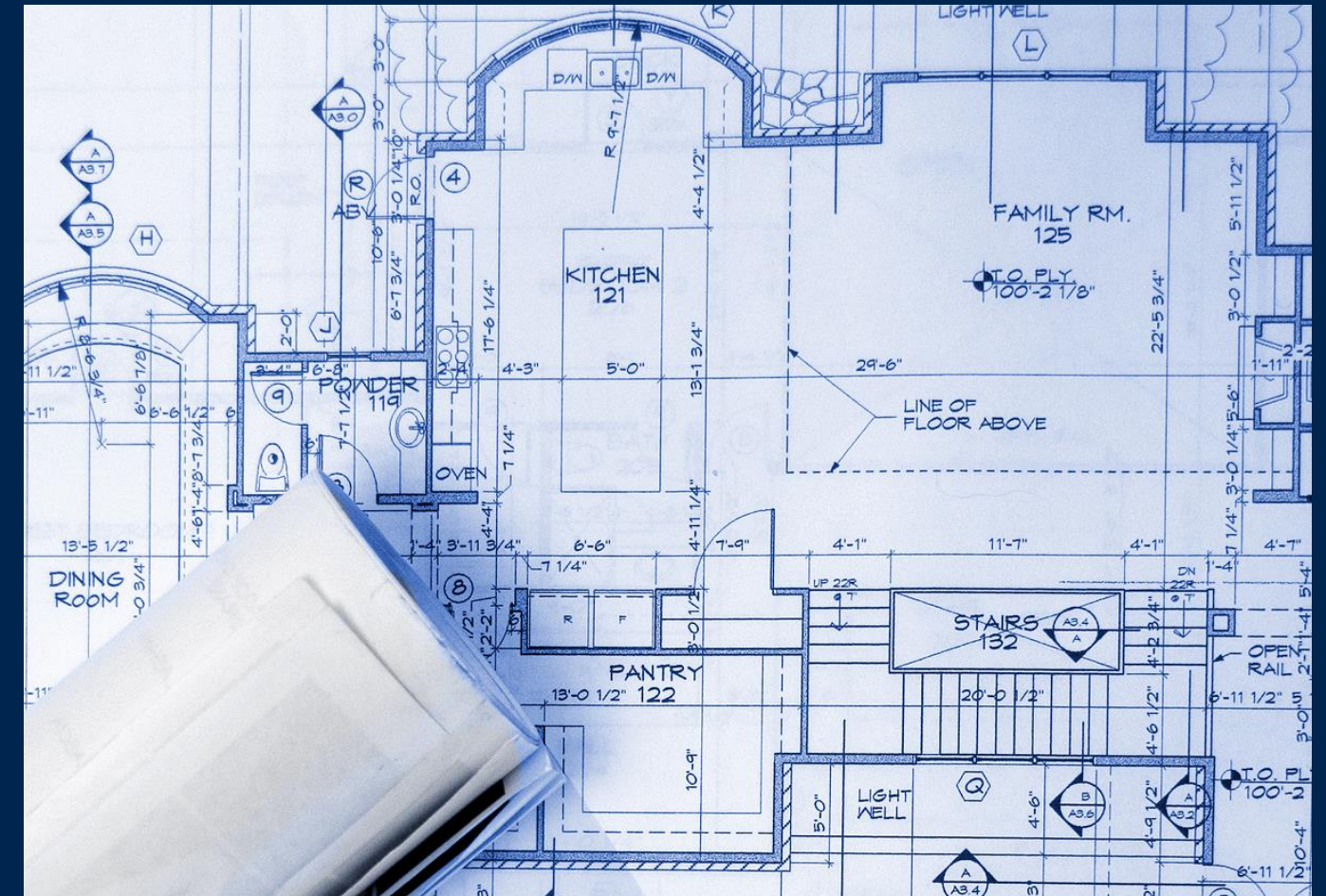
- To appreciate the differences between a medical/ surgical assessment and a rehabilitation assessment
- To determine the severity of a pediatric Traumatic Brain Injury (TBI)
- To understand long term outcomes of pediatric TBI
- To reinforce the concept of rehabilitation as a continuum



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Outline

- Patient Overview/ Case Study
 - Medical Assessments
 - Rehabilitation Assessments
- Content overview
 - Markers of TBI Severity
 - Brain Region Vulnerability
 - Common Impairments
 - Long-term Implications
 - Rehabilitation as a Continuum



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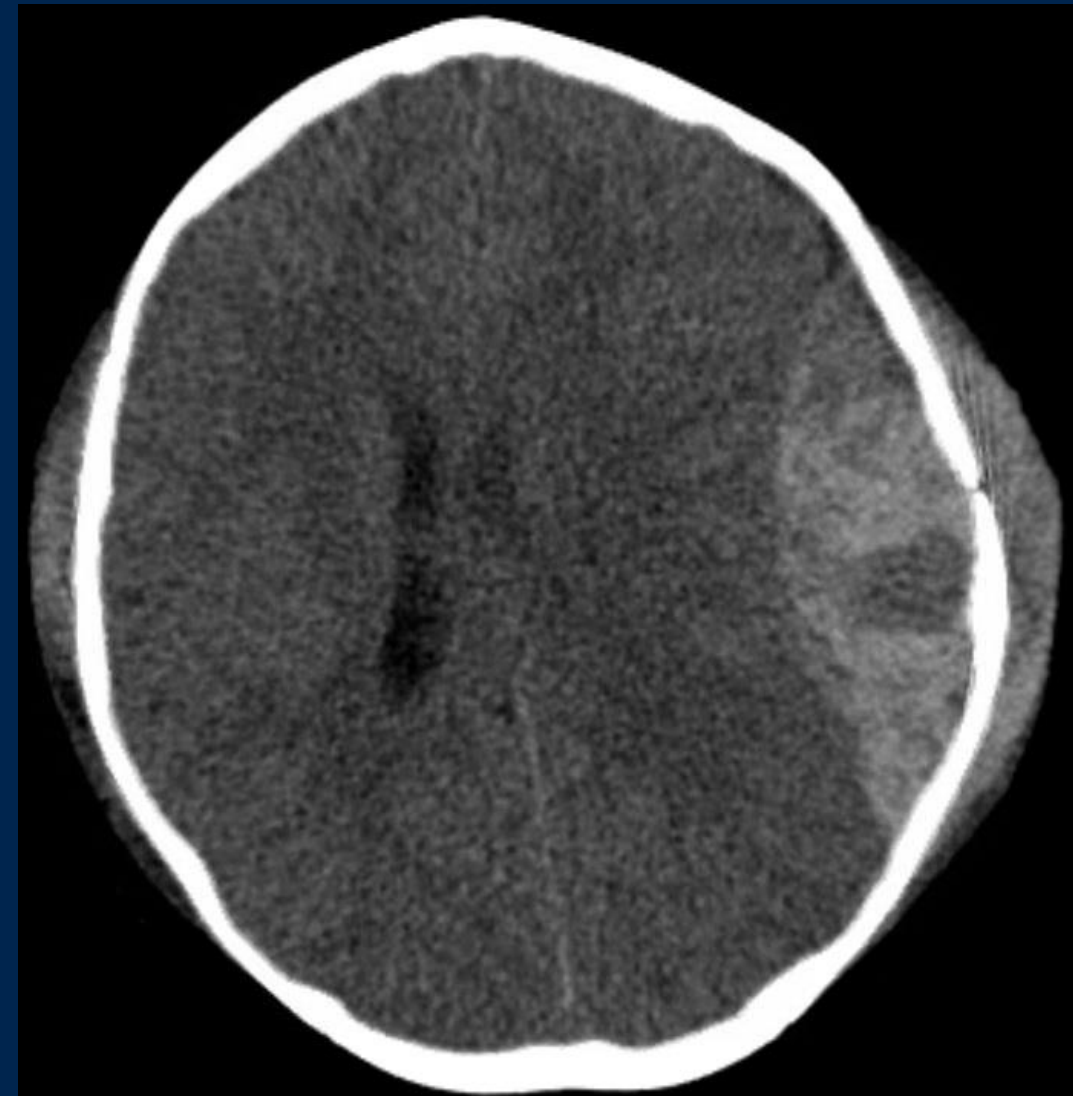


Patient Overview

Content Overview

Report

- 7 yo M who had an MVC with multiple complications:
 - Head laceration L temporal region s/p repair
 - Hemo-peritoneum (non-surgical)
 - Tension pneumothorax s/p Chest tubes
 - Pelvic fracture s/p internal fixation
 - Femur fracture s/p ORIF
 - Compartment syndrome s/p fasciotomy
 - Pulmonary contusion s/p intubation
 - Hypovolemia s/p multiple transfusions
 - L EDH with midline shift s/p L Decompressive craniotomy
- Now: “extubated and has had favorable neuro exams since the craniotomy. GCS is 14”



Questions for thought:

- Does this child have a Traumatic Brain Injury?
- Does this child have a Spinal Cord Injury?
- Is this child ready for Inpatient Rehabilitation?

Assessment

- Traumatic Brain Injury (TBI)
 - Markers of severity
 - GCS: 3 (now 14)
 - Loss of Consciousness: Positive
 - Injury: L EDH with midline shift s/p L Decompressive craniectomy
 - Cognitive status
 - “favorable neuro exams”
 - Post Traumatic Amnesia: Unknown
 - Rancho Los Amigos Scale: Unknown
 - Seizures
 - Seizures: Unknown
- Spinal Cord Injury (SCI)
 - ? Bowel function
 - ? Bladder function
 - ? Sensation
- Mobility:
 - ? Weight bearing restrictions
- Rehabilitation
 - ? Are therapies engaged
 - ? Which therapies (PT/OT/SLP)
 - ? Neuropsychology engaged
 - ? Psychology engaged
 - ? Equipment needs

Assessment

- TBI:
 - Children's Orientation and Amnesia Scale (COAT): measures Post traumatic amnesia
 - Ranchos Los Amigos Scale: measures stage of brain recovery
- SCI
 - American Spinal Cord Injury Association (ASIA) examination: measures extent of spinal cord injury
- Chart review:
 - Seizure reports/ medications
 - Weight bearing restrictions
 - Therapy notes

Interventions

- Begin therapies as indicated
 - Physical Therapy
 - Occupational Therapy
 - Speech and Language Pathology Therapy
 - Neuropsychological assessment
 - Psychological assessments
- Determine best Rehabilitation setting to meet the child's needs

Typical Admission Criteria for Inpatient Rehabilitation

- General Criteria:
 - Functional decline (i.e. Physical, Cognitive)
 - Medical Stability
 - Require at least 2 of 3 of the main therapies (Physical Therapy, Occupational Therapy, and/or Speech Therapy)
 - Participate and Tolerate 3 hours of therapy a day
 - Viable Discharge disposition
 - Insurance approval
- Additional Criteria (after 6 years of experience at TCH):
 - At least a 2 week window between major medical procedures (i.e. Chemotherapy, Surgery)
 - 24 hour family supervision
 - Other Inpatient Rehabilitation options offered
 - Bed available

Reassessment

- Child is participating and tolerating in 3 hours of therapy a day
- Child is still not physically or cognitively at baseline
- Recommendation is admission to a Pediatric Inpatient Rehabilitation Unit



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Patient Overview

Content Overview

Items for review... Markers of Severity in regard to TBI



http://www.thehealthjournals.com/images/features/2009_03/2009_03_Shattered_490X327.jpg

Severity Vignette

- Things may not always be as direct as our current vignette
- 5 yo M admitted to Trauma Service s/p fall from bed of pick-up truck and hit trailer hitch on the way down. HCT (-), persistent vomiting.
 - TBI diagnosis: ?
 - TBI severity:
 - D/C in 24 hrs = mild concussion
 - D/C in 5 days, not intracranial procedure = mild concussion?

TBI Severity Grading: GCS

GCS Grade	GCS Score
Mild	13-15
Moderate	9-12
Severe	3-8

- Teasdale G, Jennett B. Assessment of Coma and Impaired consciousness: a practical scale. *Lancet* 2: 81-84, 1974
- Morray JP et al: Coma scale for use in brain-injured children. *Critical Care Medicine* 12:1018, 1984.

Other Severity Markers

Severity	Loss of Consciousness (LOC)	Post Traumatic Amnesia (PTA)		Radiology and Physical Examination
Mild	< 30 min	< 24 hrs	<1hr	Head CT: NL Neuro exam: NL
Moderate	31 min – 6hrs	1-7 days	1-24hr	Head CT: Abnl Neuro exam: NL/ Combative/ Lethargic
Severe	> 6hrs	> 7 days	>24hr	Head CT: Abnl Coma

- McDonald CM, Jaffe KM, Fay GC, Polissar NL, Martin KM, Liao S, Rivara JB. *Comparison of indices of traumatic brain injury severity as a predictor of neurobehavioral outcome in children.* Arch Phys Med Rehabil. 1994 Mar;75(3):328-37.
- Suskauer SJ, Slomine BS, Inscore AB, Lewelt AJ, Kirk JW, Salorio CF. *Injury severity variables as predictors of WeeFIM scores in pediatric TBI: Time to follow commands is best.* J Peadiatr Rehabil Med. 2009; 2(4): 297-307

Which Assessment and Why?

Measure	Thoughts
LOC	Weakest measure due to poor report
Neurologic Exam	Minimal assistance while sedated or in coma. Good for diagnosis if focal deficits.
Head CT	Good for blood, focal lesions. Not good for Diffuse Axonal Injury
GCS	Best when used for mortality
PTA	Best of the 5 markers in regards to morbidity.

PTA

- Galveston Orientation and Amnesia Test

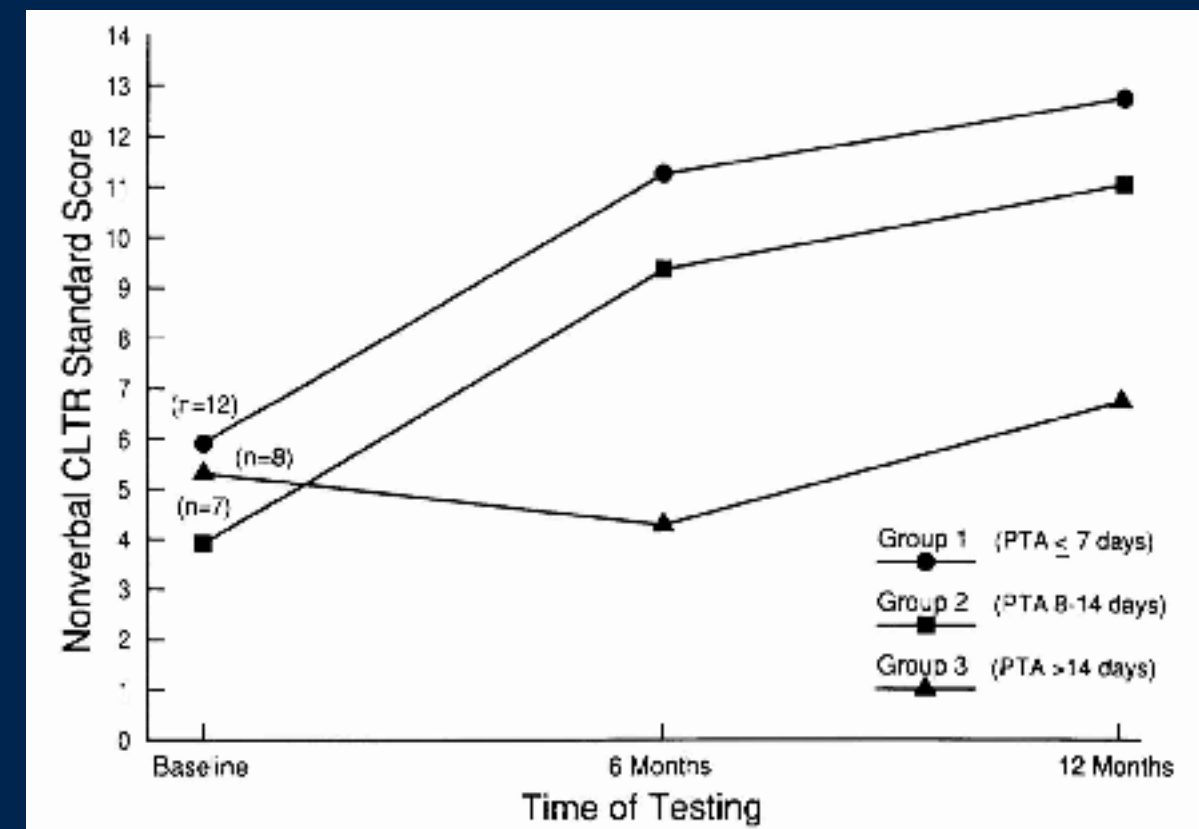
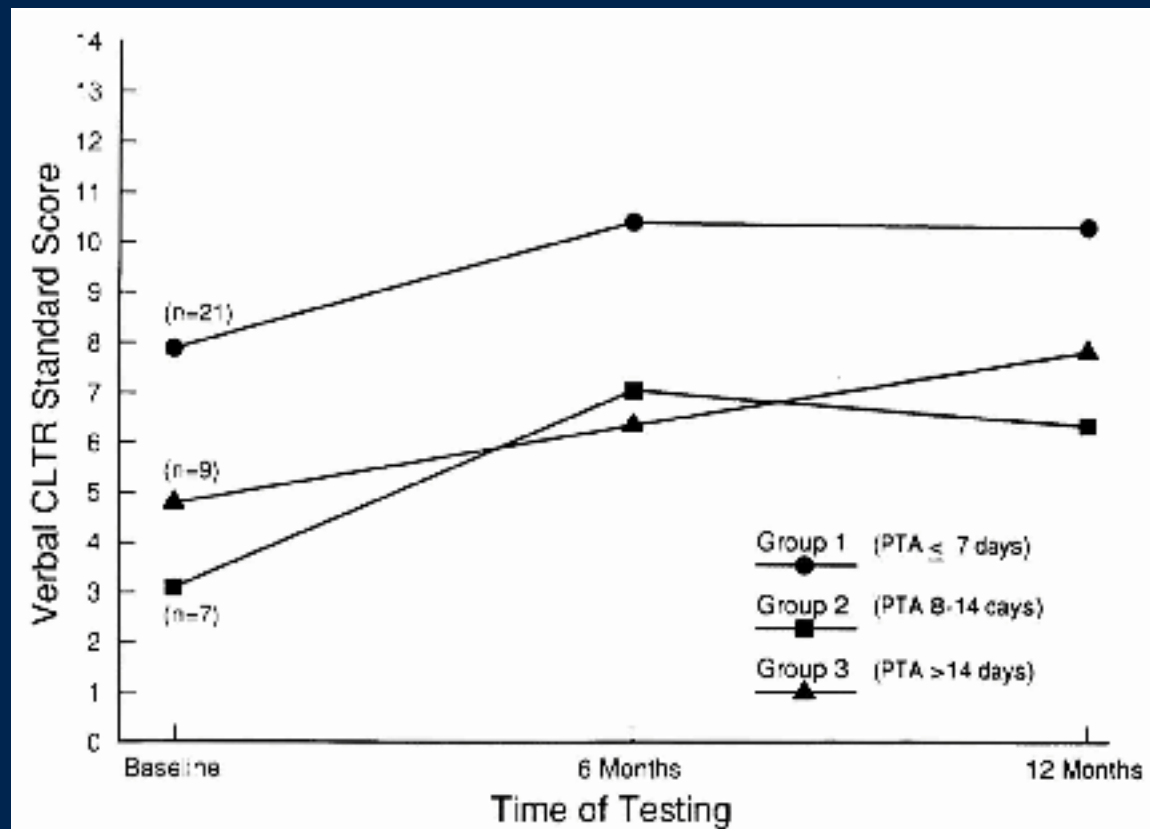
- Developed in adults
- Levin HS. Et al. 1979.

- Children's Orientation and Amnesia Test

- Developed in children (3-15 years of age)
- Ewing-Cobbs L, et al. 1990.

- Levin HS, O'Donnell VM, Grossman RG. The Galveston Orientation and Amnesia Test. A practical scale to assess cognition after head injury. J Nerv Ment Dis. 1979 Nov; 167 (11):675-84.
- Ewing-Cobbs L, Levin HS, Fletcher JM, Miner ME, Eisenberg HM. The children's orientation and amnesia test: Relationship to severity of acute head injury and to recovery of memory. Neurosurgery 1990; 27(5), 683-691

PTA predicts long term outcome



- Ewing-Cobbs L, Levin HS, Fletcher JM, Miner ME, Eisenberg HM. The children's orientation and amnesia test: Relationship to severity of acute head injury and to recovery of memory. Neurosurgery 1990; 27(5), 683-691.

Children's Orientation and Amnesia Test

General Orientation	Temporal Orientation (>7 yo)	Memory
1. What is your name?	8. What time is it now?	13. Say these numbers after me in the same order.
2. How old are you?	9. What day of the week is it?	14. How many fingers am I holding up?
3. Where do you live?	10. What day of the month is it?	15. Who is on Sesame Street?
4. What is your father's and mother's name?	11. What month is it?	16. What is my name?
5. What school do you go to?	12. What is the year?	
6. Where are you now?		
7. Is it daytime or night-time?		

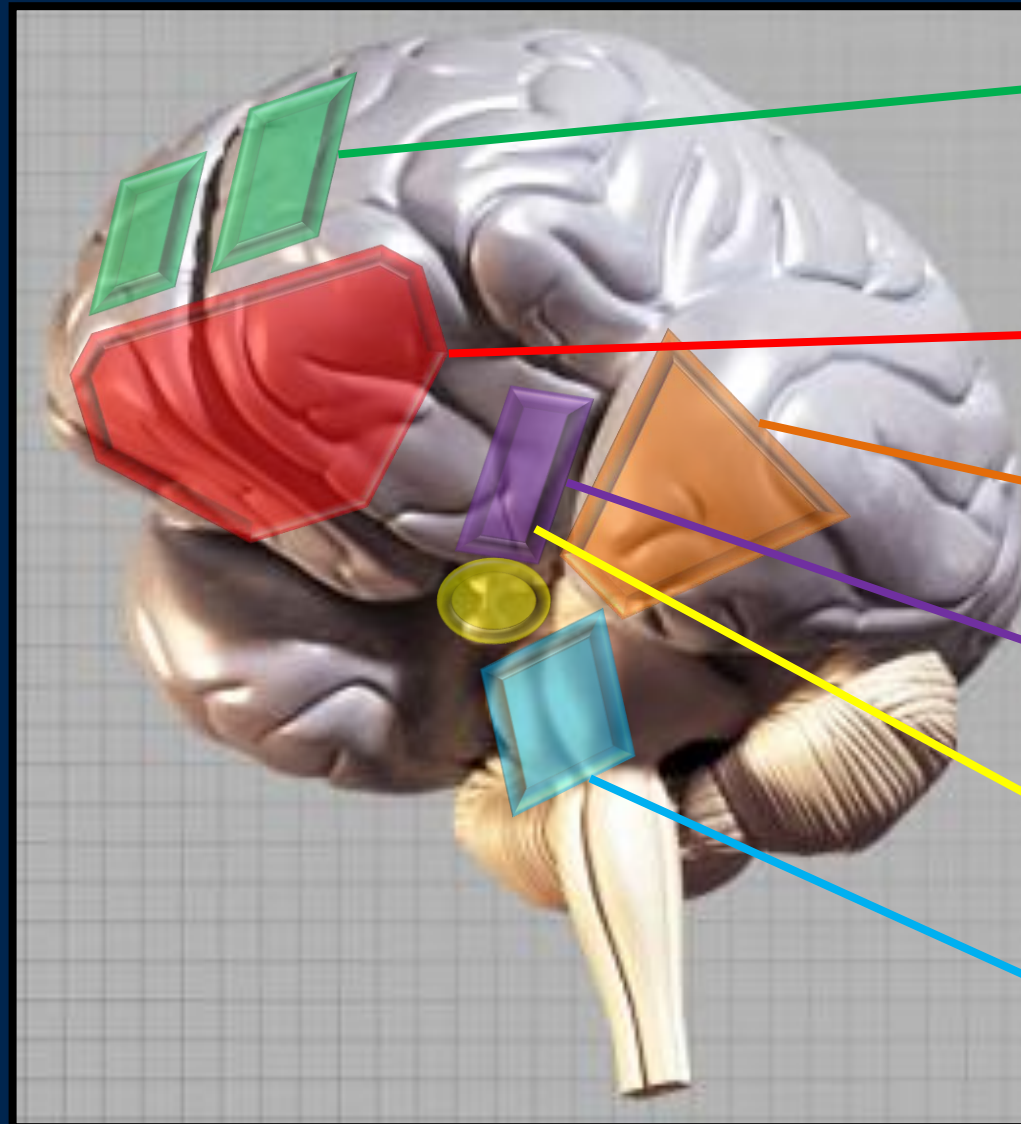
- Ewing-Cobbs L, Levin HS, Fletcher JM, Miner ME, Eisenberg HM. The children's orientation and amnesia test: Relationship to severity of acute head injury and to recovery of memory. Neurosurgery 1990; 27(5), 683-691.

COAT Norms

Age (yr)	N	Mean	Standard Deviation
3	16	46.8	12.6
4	26	59.4	8.5
5	25	61.6	6.3
6	12	64.1	8.5
7	10	68.3	6.1
8	17	114.8	5.6
9	8	113.3	7.4
10	14	117.6	5.7
11	10	116.4	4.1
12-15	8	119.8	1.5

- Iverson GL, Woodward TS, Iverson AM. Regression-predicted age norms for the Children's Orientation and Amnesia Test. Archives of Clinical Neuropsychology 17 (2002) 131–142

Brain Regional Vulnerability + Behavior



Dorsolateral prefrontal cortex:

Executive function, including sustained and complex attention, memory retrieval, abstraction, judgment, insight, problem solving

Orbitofrontal cortex: emotional and social responding

Anterior temporal cortex: memory retrieval, sensory-limbic integration

Amygdala: emotional learning and conditioning

Hippocampal-Endorhinal Complex: declarative memory

Ventral Brainstem: arousal, ascending modulatory neurotransmitter systems

- 3D model by: 3D Models – Anatomy Planet, Authors: Claudia Morelli, Riccardo Russi
- Information display concept adapted from: Arciniegas and Bresford 2001

Items for review... Common Impairments

- Physical:
 - Headaches; Nausea
 - Dizziness/Balance problems
 - Coordination/Speed of response
 - Spasticity/Dystonia
 - Vision changes/hearing impairments
 - Sensitivity to light/noise; Fatigue



Items for review... Common Impairments

- Psychological:
 - Anxiety
 - Mood Swings/abnormal emotional expression
 - Irritability/agitation
 - Depression
 - Sleep Problems; Impulsivity; Fatigue



Items for review... Common Impairments

- Cognitive:
 - Reduced attention/concentration
 - Slowed thinking/processing
 - Poor memory for new information
 - Inefficient storage/retrieval of information
 - Fatigue



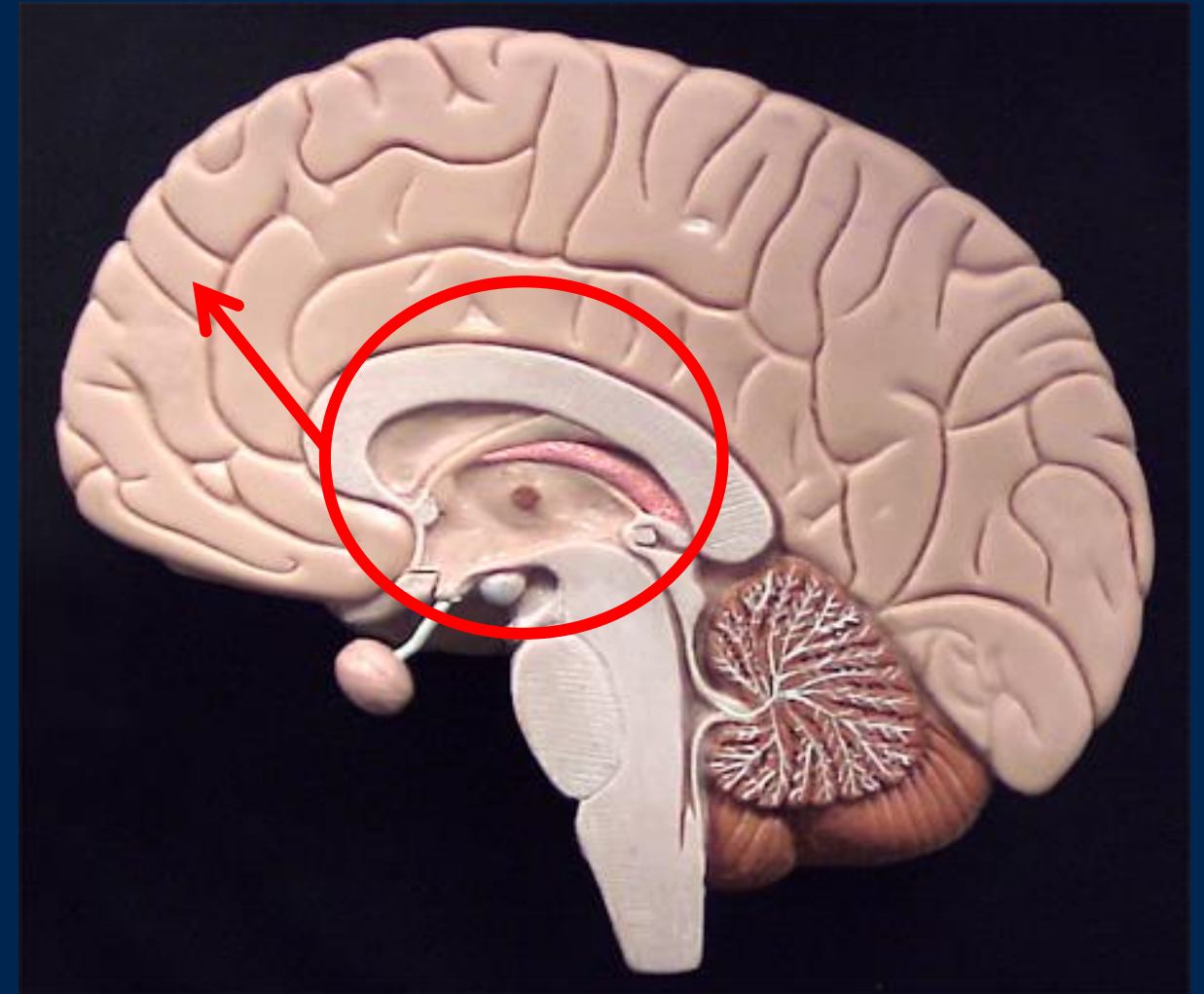
Items for review... Common Impairments

- School Performance:
 - Unexpected absences
 - Inattentiveness
 - Poor comprehension of large chunks of information
 - Conflicts with peers
 - Disrespectful behavior
 - Excessive tiredness
 - Failures



Items for review... Long-term implications

- Children injured at young age may not demonstrate cognitive deficits until much later in life.
- Improvements may continue for a significant period of time.
- Alternative programs and living situations may be needed as child and parents age.



Items for review... Rehabilitation as a continuum

Stage	Goals	Tasks
Acute	Maintenance of basic functions	<ul style="list-style-type: none"> • Sensory Stimulation • Balancing Arousal and Overstimulation • Containing Behavioral Challenges • Prevent complications of immobility: <ul style="list-style-type: none"> • Ischemic ulcers • Compression neuropathy • Contractures • Constipation
Inpatient	<p>Facilitate recovery</p> <p>Compensate for impairments</p>	<ul style="list-style-type: none"> • Intensive Intervention: <ul style="list-style-type: none"> • Physical Therapy • Occupational Therapy • Speech Therapy • Therapeutic Recreation • Nursing • Family support and education • Discharge planning
Outpatient	<p>Acquisition of independence</p> <p>Reintegration into the community</p>	<ul style="list-style-type: none"> • Return to school • Reestablish social networks • Developmental transitions • Ongoing review and therapy maintenance

Question for the audience

- Thank you for your time and patience.
- Questions?

References:

- Teasdale G, Jennett B. Assessment of Coma and Impaired consciousness: a practical scale. *Lancet* 2: 81-84, 1974
- Morray JP et al: Coma scale for use in brain-injured children. *Critical Care Medicine* 12:1018, 1984.
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- [Anderson V](#), [Catroppa C](#), [Morse S](#), [Haritou F](#), [Rosenfeld JV](#). Intellectual outcome from preschool traumatic brain injury: a 5-year prospective, longitudinal study. *Pediatrics.* 2009 Dec;124(6):e1064-71