1. Develop a reading list that will help you understand more in depth the following topics related to your chosen diagnosis/condition:
* Epidemiology

The leading causes for TBI are falls, motor vehicle accidents (MVA), and impact trauma/blast events.1 All of these modes of trauma can create brain damage via mechanisms such as:2

* Acceleration/deceleration
* Coup-Contrecoup
* Blunt or penetrating injury
* Scalp lacerations
* Closed head injury

Traumatic brain injury (TBI) can lead to lifelong hardship and detriment in physical, cognitive, behavioral and emotional contexts.1 Research shows that a mild TBI, such as a concussion, can lead to long-term cognitive problems affecting daily activities and ‘normal’ functioning.1 Primary injuries are localized tissue impairments resulting from direct impact forces and can include laceration of brain tissue, or diffuse lesions (diffuse axonal injury – the shearing of neuronal axons and subsequent necrosis).3 Secondary issues arise from tissue response to the primary injury/systemic assault. Inflammation, ischemia, decreased blood flow auto regulation, and glial cell proliferation are all examples of secondary pathological injuries.3 Prompt and efficient early diagnosis and intervention, based on changing neurological signs or emotional/behavioral disturbances after an insult, can limit the development and consequences associated with secondary tissue damage.3

* Pathology and pathophysiology of disorder/condition

Typically, behavioral deficits resulting from a TBI are associated with primary and secondary tissue damage to the frontal cortex.2,3,4 Injury to the frontal lobes is very common during an accident because of their proximity to the frontal bone of the skull. Damage occurs when the lobes are pushed up against the internal ridges of the frontal bone.2 Specifically, increased expression of ‘negative’ emotion and impulsivity, associated with pseudopsychopathic behavior, comes from damage to the right frontal cortex, whereas left frontal cortex damage typically produces behavioral and cognitive deficits associated with pseudodepression.4 Some examples of psuedopsychopathic behavior that occur with right frontal lobe damage include impulsivity, increased anger and agitation, flat affect, anosgonosia, left-sided neglect.2 Psudeodepressive behavioral/cognitive deficits encompass difficulty processing and retaining new information, decreased engagement, reduced fluency of speech, and increased apathy.2

TBIs which result in purely frontal lobe damage with resulting deficits in behavior/cognition as well as task engagement are rare. Oftentimes there is damage to other parts of the brain, due to its’ complexity and interconnectedness. These additional deficits may also exacerbate existing pseudopsychopathic or psuedodepressive behavioral responses associated with a TBI. For example, research indicates that clients with a TBI will require additional time for information processing and adequate task production.5 This increase in processing time and subsequent lack of activity performance may increase frustration in the client and therefore increase the frequency and amplitude of negative emotional responses. Similarly, distractors can pose an additional challenge to patients with a TBI with regard to task performance.6 The presence of distractors may also amplify behavioral issues leading to increased disinterest in an activity or increased agitation. There has also been research conducted to suggest that clients with a TBI may lack the ability to achieve an appropriate night’s rest.7,8,9 Fatigue is higher in individuals with a TBI and the lack of ability to achieve restful sleep may further increase fatigue levels and amplify agitation, inattention and other behavioral/cognitive issues.

Whether a client presents with pseudopsychopathic or pseudodepressive symptoms will alter the course of PT with respect to interventions for functional improvement, motivation, and safety.

* Disease progression – effects on systems: CNS/PNS, musculoskeletal, cardiopulmonary, integumentary – what are the resultant impairments or effects on body function and structure?

In addition to the aforementioned emotional and behavioral problems, a TBI can have many drastic effects on other body systems and client functional capabilities. For this reason I will highlight a few of what I consider the most interesting topics.

Disease Progression:

* One review study showed a 27.5% pooled prevalence (19 studies, 1137 patients) of hypopituitarism in the chronic phase after a TBI.10 TBI ‘induced’ hypopituitarinism can lead to further deficits associated with temporary or permanent diabetes insipidus, weight loss, fatigue, syncopal episodes, loss of libido and impotence.11
* “Post-concussion syndrome” can also occur after a TBI and occurs in 30% of cases in a short period after a TBI. This syndrome can lead to manifestations that include headache, irritability, loss of memory and attentional deficit, low working capability.11
* Other CNS manifestations include the potential for coma and development of post-traumatic amnesia.12
* Hyperadrenergia leading to autonomic dysfunction and increased sympathetic tone – this can lead to changes in vital signs, and organ dysfunction such as heart failure.13
* Fracture healing rate and new bone formation is increased in individuals who have sustained a TBI. Callus overgrowth and ectopic ossification rates are increased, even in muscle.14,15
* A sustained TBI can lead to many auditory and vestibular symptoms which can include:16
	+ Ear ache
	+ Aural fullness
	+ Tinnitus
	+ Dizziness and vertigo
	+ Distorted hearing
	+ Hearing impairment
* TBI can lead to many motor disturbances such as hemiplegia, paraplegia and tetraplegia. Abnormal reflexes may also be present in patients who have sustained a low level TBI.17
* Tone is commonly affected in individuals who have suffered a TBI. Muscle tone can be lower than normal (hypotonia) or higher than normal (hypertonia). This can lead to issues with muscle flaccidity and spasticity, respectively. 17
* Muscle weakness can lead to decreased muscle strength which can affect posture and motor control. Ataxia is also common and occurs with insult to the cerebellum or sensory pathways – truncal ataxia is often observed and leads to poor trunk control (exacerbated by tonal dysfunction) 17
* Tonal dysfunction can lead to restricted range of motion, contractures, bony malalignment (scoliosis), fractures, and increased pain. 17
* Tonal dysfunction and associated bony malalignment can lead to cardiopulmonary compromise (reduced capacity of the chest to expand) and increased rate of lung infection/mucus build-up. 17
* A TBI can create a multitude of sensory disturbances which can lead to vision and visual perception deficits in addition to spatial relation deficits such as impaired figure-ground, depth perception and proprioception17
* Patients who have sustained a TBI are likely to sustain integumentary deficits such as increased rate of ulcer formation and contracted skin as secondary effects from decreased mobility and range of motion.18
* How does the disorder affect activity, participation and quality of life? Here we are integrating the ICF model into how you’re characterizing the effects of the disorder – so make sure you’re clear with the terminology.

Scarponi et al, found that individuals who have suffered a TBI are most likely to suffer major limitations in the mobility, communication, work and domestic life sub-categories of the activities and participation sections of the ICF model.19

Below is a compiled list of difficulties a client who has sustained a TBI with associated behavioral/cognitive deficits may face under the activities and participation section of the ICF:

Activity and Participation Limitations:20

* Impaired ability for socialization, participate in leisure activities and formation/maintenance of relationships due to visual deficits (cannot focus/make visual eye contact) and listening/speaking communication deficits (unable to sustain attention, produce intelligible speech, or appropriately interpret incoming audio information)
* Decreased ability for problem solving and decision making deficits (cannot perform mental arithmetic/presents with acalculia and is unable to formulate cogent arguments/decisions) leading to impaired ability to manage finances for the family
* Decreased ability to drive and maintain personal health/hygiene (due to restrictions in range of motion, visual processing and cognition) leading to a consequent loss of ability to attend social events and decreased interaction with members of the community
* Decreased ability to acquire, keep, terminate a job or enroll/achieve higher education or vocational training subsequent to mobility, cognitive and communication deficits (cannot ambulate at a safe and efficient speed, unable to perform higher mental processing needed for adequate job/higher education performance).
* Difficulty in performing transfers/mobility in the environment (decreased speed and efficiency of ambulation, decreased ability to cross thresholds and limited ability to perform ambulation over uneven ground) leading to decreased ability to attend Church/social gatherings, health appointments, and leisure activities

Quality of Life (QOL):

Due to the varied and potentially profound activity and participation limitations that can occur in the TBI population, deterioration of quality of life is a very important factor.19 Quality of life can mean different things to different people. Djikers notes that quality of life can change based on disease progression/regression but is also affected by factors outside of the disease process.21 For example, Djikers found that quality of life is a non-static phenomenon that can be affected by societal expectations (a shift from ‘man as producer’ to ‘man as a consumer’), individual expectations and priorities, actual statuses (changes due to ageing and events in the outside world), and the changing of an individual’s subjective reasons (individuals tend to experience less well-being in the face of constant achievements – each accomplishment becomes less personally gratifying with increasing levels of success).21 Interestingly, Scarponi et al. found that initial injury severity is not a predictor of quality of life.19 Unfortunately, there remains a lack of comprehensive assessment measures for tracking quality of life as it relates specifically to the TBI population.19 Scarponi et al. believe the ICF tool can be used to set appropriate goals and direct resources for improving quality of life, no matter the extent of the an individual’s deficits.19

Fortunately, there are a lot of resources available on the internet that can be used to provide guidance to families and people with a TBI. The National Resource Center for TBI is an excellent web based resource that provides ample amounts of information pertaining to quality of life for persons with brain injury and their family members.22 There are multiple links to employment resources, legal issues rehabilitation resources, support groups and many more.22 Brainline.org is another fantastic resource that can be provided to clients to assist them in all aspects of improved quality of life. This website provides more information on the etiology of TBI and provides other resources on items including support groups, how to deal with the consequences of a TBI (patient and family), other issues related to side effects (depression), personal stories, technology resources, FAQs and even information on “life-changing Android Apps for people with brain injury.”23

* What outcome measures are most appropriate to characterize body structure/function, activity limitations and participation restrictions?

Polinder et al. performed a systematic review of commonly used quality of life measures with the TBI population. These outcome measures relate most closely to the activity limitations and participation restrictions section of the ICF. The most statistically valid and clinically useful measures were as follows:24

* SF-36
* The Quality of Life after Brain Injury Instrument (QOLIBRI)
* European Brain Injury Questionnaire (EBIQ)
* World Health Organization of Quality of Life short version (WHOQOL-BREF)

Other useful outcome measures appropriate to categorize activity and participation restrictions in persons with a TBI include:25,26

* Functional Independence Measure
* Functional Assessment Measure
* Community Integration Questionnaire
* Barthel Index
* 6 Minute walk test
* Dizziness Handicap Inventory

Outcome measures appropriate to categorize body structure/function in persons with a TBI include:25,26

* Modified Ashworth Scale
* Glasgow Coma Scale
* Coma Recovery Scale
* Moss Attention Rating Scale
* Trail Making Test Part B
* Manual Muscle Testing
* Goniometry
* High level mobility assessment (outpatient only)
* Berg Balance Scale
* Galveston Orientation and Amnesia Test (GOAT)
* Orientation Log
* Supervision Rating Scale
* Agitated Behavioral Scale

It is important to note that although there are clear distinctions between the body structure/function and activity/participation limitation sections of the ICF, some of the outcome measures utilized can incorporate elements reflective of both sections.

* Read on intervention for a **focused area** for the disorder you’ve chosen – a particular intervention approach or innovative treatment that you want to know more about. [See the example posted – she reviewed recent literature about locomotor training for ambulation]

My focused area for the disorder will focus on techniques to improve ambulation in patients who have sustained a TBI and have attentional deficits.

Inattention is a deficit related to frontal lobe damage, but can also be influenced by damage to the posterior parietal cortex, cingulate gyrus, striatum, and thalamus.27 Increased inattention can lead to an increased fall risk with ambulation and ADL performance. Up to 30% of all individuals who have suffered a TBI present with inattention deficits.3 The higher a patients’ perception of their limitations and of their environment, the better the prognosis for rehabilitation.3

How does inattention affect PT treatment?

* Increased fall risk (decreased safety)
* Impaired judgment and unpredictable behavior
* Potential for resistance to participation in PT
* Potential for unilateral spatial neglect
* Appropriate guarding for client safety
* Non-fluid gait mechanics
* Development of treatment techniques to increase attention of client to task/neglected task components

In clients with a right frontal lobe deficit and additional left unilateral neglect deficits, Swan found that asking clients to visually scan to the affected side helped increase attention levels and improve ambulation.27 Requiring a client to scan the environment while ambulating may decrease the risk of walking into an obstacle and therefore improve safety with ambulation. Clients could also be provided with extrinsic verbal input to attend to individual components of the walking/gait task. By questioning the client on which step of the gait/ambulation technique comes next, PTs may be able to increase selective attention to task, although increased cognitive processing time will need to be provided.28 PTs can also provide other physical sensory inputs to improve client attention to limb advancement during gait, such as tapping utilizing Rood’s theory, encouraging trunk rotation to the neglected side, and/or physically assisting with limb advancement.26,27,28 Sensory afferent feedback is a very important concept in supporting cortical plasticity with resulting functional improvements after gait training.28 For this reason, the potential use of electrical stimulation to assist in locomotor muscle contraction on the affected side of the body and consequent improved ambulation may provide a two-fold benefit by improving gait mechanics and providing sensory input.28

PTs could also utilize ‘auditory reminders’ to increase attention in a client with a TBI. As ambulation is performed the PT could provide simple, one word commands such as ‘left’ or ‘right’ when attempting to have the client attend to selective limb advancement.27 Visualization and use of visual representation tasks could also increase attention to specific tasks.27 The PT could ask the client to visualize walking to assist in performance of the technique and increase gait fluidity. Swan found that a combination of visual scanning, sensory awareness and spatial organization training (estimating size of objects/distance covered) was effective in increasing awareness in patients with right hemisphere lesions and may help to improve ambulation performance.27

However, deficits related to delayed information processing and increased mental fatigability may limit the effectiveness of PT supplied external feedback with respect to improved carry-over and long-term ambulation performance.5,8,9 Therefore, improvements in ambulation, when neglect is present, may be better elicited with training that relies less on external feedback (provided by the PT) and more on ‘automatic, self-generated feedback.’ Research shows that performance of task specific movement repetition leads to increased task dependent neural plasticity changes and improved ambulation performance (gait fluidity and speed) in patients with cerebral lesions.28 For this reason, body weight supported (BWS) treadmill ambulation training may be an effective treatment option to improve gait mechanics and overall performance in the population with cerebral lesions.28,29,30 Use of BWS treadmill training may be more likely to engender automatic reciprocal limb movement and improve ambulation in patients with attention deficits due to the continuous motion of the treadmill belt.28,29,30

1. Identification of the PT Guide to Practice Guideline(s) appropriate to the condition you’ve chosen may help you in considering possible issues a PT would address. Review of this/these practice pattern(s) will help you think about the “functional toolbox” that you’ll recommend to your classmates for assessment of this clinical problem.

PT Guide to Practice Guidelines:

Practice Pattern 5D: Impaired Motor Function and Sensory Integration Associated with Nonprogressive Disorders of the Central Nervous System – Acquired in Adolescence or Adulthood.31

Possible issues to address with impaired cognition/behavioral deficits: 31

* Decreased ability to negotiate terrain
* Difficulty planning movements
* Fall risk
* Impaired communication
* Impaired motor function
* Inability to perform work
* Self-care/ADL deficits

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