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Pediatric Head and Spinal Cord Injuries

Introduction

Head and spinal cord injuries affect millions of Americans each year, many of which are children. The question is, how can health care professionals effectively care for pediatric patients suffering from a head and/or spinal cord injury? This course will answer that very question, while providing insight into recommendations for the assessment, diagnosis, prognosis, and management/treatment of head injuries and spinal cord injuries in pediatric patients.

Section 1: Head Injuries

A 12-year-old male child places two wooden boards on the road around a large pothole. The child's goal is to create a ramp so he can jump over the pothole on his bike. When the child is satisfied with his ramp, he gets on his bike and rides down to the other end of the street. The child is not wearing a helmet. When the child feels like he is ready, he takes a deep breath, and begins to pedal as hard as he can. The child races down the street right towards the wooden ramp. Upon hitting the lip of the ramp, the child is thrown off his bike onto the hard pavement. The child hits his head when he falls. A neighbor happens to see the bike accident, and rushes to the child's side. The child's eyes are open and he is breathing, however, the child is not moving. Immediately the neighbor calls 911, followed by the child's parents. The neighbor tells the child he is going to be okay, however, the neighbor is truly not sure if the child will be okay.

Unfortunately, scenarios like the one presented above, where a child is involved in an incident that can lead to a head and/or spinal cord injury, occur every day in America. The question that remains is, how can health care professionals effectively care for pediatric patients suffering from a head and/or spinal cord injury? The answer to the previous question is, to possess insight into head and/or spinal cord injuries. With that in mind, this section of the course will focus on pediatric head injuries. The information found within this section of the course was derived from materials provided by the Centers for Disease Control and Prevention (CDC) unless, otherwise, specified (Centers for Disease Control and Prevention [CDC], 2021).

What is a head injury?

A head injury may refer to any trauma to the scalp, skull, or brain.

Health care professionals should note that a head injury may lead to a scalp injury, skull fracture, and/or a traumatic brain injury (TBI).

What types of scalp injuries can result from a head injury?

Head injuries can lead to abrasions, scrapes, and lacerations.

Health care professionals should note the following: many blood vessels can be found in the scalp, therefore even minor cuts may lead to excessive bleeding; scalp injuries can be more severe if the skull is exposed; wound care, stitches, and/or surgery may be required.

What types of fractures can result from a head injury?

- Head injuries may lead to the following types of skull fractures: linear fractures, depressed fractures, comminuted fractures, and ping-pong fractures.
- A linear skull fracture may refer to a break in a cranial bone resembling a thin line, without separating into two pieces.
- A depressed skull fracture may refer to a break in a cranial bone with depression of the bone toward the brain.
- A comminuted skull fracture may refer to a fracture in which the bone shatters into multiple pieces.
- A ping-pong skull fracture may refer to an indentation in the skull that resembles a ping-pong ball.
- Health care professionals should note that ping-pong skull fractures typically occur in newborn and young infants because their skull is relatively soft and resilient and able to indent upon impact.

What is a traumatic brain injury (TBI)?

Traumatic brain injury (TBI) may refer to damage to the brain that is typically caused by sudden trauma.

Health care professionals should note that pediatric head injuries often lead to mild traumatic brain injuries (mTBIs).

What is a mild traumatic brain injury (mTBI)?

A mild traumatic brain injury (mTBI), also referred to as a concussion, may refer to a type of brain injury that is typically caused by a bump, blow, or jolt to the head or by a hit to the body that causes the head and brain to move rapidly back and forth.

What are the signs/symptoms of a mTBI?

The signs/symptoms of a mTBI include the following:

- Dizziness
- Balance problems
- Headaches
- Nausea
- Vomiting
- Vision problems
- Sensitivity to light
- Sensitivity to noise
- Fatigue
- Drowsiness
- Problems with attention and/or concentration
- Feeling foggy and/or groggy
- Problems with short- or long-term memory
- Trouble thinking clearly
- Anxiety
- Nervousness
- Irritability
- Easily angered

- Heightened emotional reactions
- Feelings of depression
- Trouble falling asleep
- Sleeping less than usual
- Sleeping more than usual

Health care professionals should note the following: mTBI signs/symptoms may appear immediately, while others may not appear for hours or days after the head injury; signs/symptoms of mTBI are different for each individual; signs/symptoms generally improve over time, and most individuals with mTBI improve within a couple of weeks; signs/symptoms may change during recovery (e.g., headaches followed by nausea followed by sleep problems).

What are the "danger signs" of a mTBI/TBI?

The term danger signs, in the context of mTBI/TBI, may refer to specific signs related to the potential for a blood clot that can push or crowd the brain against the skull. The danger signs of a mTBI/TBI include the following:

- A headache that gets worse and does not go away
- Weakness
- Numbness
- Decreased coordination
- Convulsions
- Seizures
- Vomit repeatedly
- Slurred speech or unusual behavior
- One pupil is larger than the other
- Cannot recognize people or places
- Confusion

- Restlessness
- Agitation
- Drowsiness
- Loss of consciousness; cannot wake up

Health care professionals should note the following: children should seek health care if they experience any of the aforementioned danger signs following a head injury, or if they will not stop crying post injury and/or refuse to nurse or eat.

How should health care professionals assess pediatric patients for a mTBI?

To effectively assess pediatric patients for a mTBI, health care professionals should obtain relevant information essential to the diagnosis, prognosis, and management/ treatment of mTBI. Examples of relevant information essential to the diagnosis, prognosis, and management/treatment of mTBI may be found below.

- **Injury description** - health care professionals should obtain information regarding the events resulting in the head injury (e.g., how the head injury occurred; type of force that caused the head injury; location of the injury on the head).
- **Cause** - health care professionals should obtain information regarding the cause of the head injury.
- **Amnesia** - health care professionals should determine if the patient is suffering from amnesia; health care professionals should determine if the patient is suffering from retrograde or anterograde amnesia, when applicable (note: amnesia may refer to the loss of memories, such as facts, information and experiences; retrograde amnesia may refer to a type of amnesia that is characterized by the inability to recall memories that were formed before the event that caused the amnesia; anterograde amnesia may refer to a type of amnesia characterized by the inability to form new memories). Health care professionals can assess patients for retrograde and/or anterograde amnesia by asking the patient specific questions, such as the following: do you know what caused your head injury; what is the last thing you remember before your head injury; what is the first thing you remember after your head injury.

- **Loss of consciousness (LOC)** - health care professionals should determine the length of LOC, when applicable.
- **Early signs observed by others** - health care professionals should ask individuals who know the patient (e.g., parent) if they observed any signs/symptoms of mTBI (e.g., balance problems; vomiting).
- **Seizure** - health care professionals should determine if the patient suffered from a seizure before or after the head injury.
- **Signs/symptoms** - health care professionals should determine mTBI-related signs/symptoms (note: health care professionals may ask the patient's parents about related signs/symptoms, when applicable).
- **mTBI/concussion history** - health care professionals should determine the number and date(s) of prior mTBIs/concussions (note: history of prior concussions, especially recent [within the past several weeks or months] suggests the need for more conservative decision-making regarding general post-injury management).
- **Headache history** - health care professionals should determine the patient's personal history of headaches (note: research indicates that headaches [migraines in particular] can result in protracted recovery from mTBI).
- **Developmental history** - health care professionals should determine the patient's personal history of learning disabilities (e.g., Attention-Deficit/Hyperactivity Disorder).
- **Psychiatric history** - health care professionals should determine the patient's personal history of depression/mood disorder, anxiety, and/or sleep disorder.

What are the recommendations for the diagnosis, prognosis, and management/treatment of mTBI in pediatric patients?

- Health care professionals should not routinely obtain head computed tomography (CT) for diagnostic purposes in children with mTBI.
- Health care professionals should use validated clinical decision rules to identify children with mTBI at low risk for intracranial injury (ICI) in whom head CT is not indicated, as well as children who may be at higher risk for clinically important ICI

and thus may warrant head CT. Existing decision rules, such as the Pediatric Emergency Care Applied Research Network (PECARN) decision rules, combine a variety of factors that, when assessed together, may increase the risk for more serious injury. Such risk factors include the following: age younger than two years; vomiting; loss of consciousness; severe mechanism of injury; severe or worsening headache; amnesia; nonfrontal scalp hematoma; Glasgow Coma Scale score less than 15; clinical suspicion for skull fracture.

- For children diagnosed as having mTBI, health care professionals should discuss the risks of pediatric head CT in the context of risk factors for ICI with the patient and his/her family (note: children seen in the emergency department [ED] with mTBI may suffer from ICI; identification of risk factors for ICI in children initially seen with possible mTBI in the acute setting is important to the diagnosis of more severe forms of TBI).
- Health care professionals should not routinely use magnetic resonance imaging (MRI) in the acute evaluation of suspected or diagnosed mTBI.
- Skull radiographs should not be used in the diagnosis of pediatric mTBI.
- Health care professionals may use validated, age-appropriate computerized cognitive testing in the acute period of injury as a component of the diagnosis of mTBI.
- The Standardized Assessment of Concussion should not be exclusively used to diagnose mTBI in children aged six to 18 years (note: undiagnosed mTBI may contribute to the prolongation of symptoms and an increased risk of reinjury; the systematic review concluded that the Graded Symptom Checklist is useful in distinguishing children six years and older with mTBI from those without TBI within the first two days after injury; the review concluded that the Post Concussion Symptom Scale used in a computerized neurocognitive testing battery distinguishes high school athletes with mTBI from those without TBI within the first four days after injury; there are several other validated symptom scales that are reliable in the diagnosis of mTBI and have demonstrated validity at ages younger than high school [e.g., the Health and Behavior Inventory and the Post-Concussion Symptom Inventory]).
- Health care professionals should not use biomarkers outside of a research setting for the diagnosis of children with mTBI.

- Health care professionals should counsel patients and families that most (70% - 80%) children with mTBI do not show significant difficulties that last more than one to three months after injury.
- Health care professionals should counsel patients and families that, although some factors predict an increased or decreased risk for prolonged symptoms, each child's recovery from mTBI is unique and will follow its own trajectory.
- Health care professionals should assess the premorbid history of children either before injury as a part of pre-participation athletic examinations or as soon as possible after injury in children with mTBI to assist in determining prognosis.
- Health care professionals should counsel children and families completing preparticipation athletic examinations and children with mTBI, as well as their families, that recovery from mTBI might be delayed in those with the following: premorbid histories of mTBI; lower cognitive ability (for children with an intracranial lesion); neurological or psychiatric disorder; learning difficulties; increased preinjury symptoms; family and social stressors.
- Health care professionals should screen for known risk factors for persistent symptoms in children with mTBI (e.g., age; gender) (note: headaches may persist longer in girls suffering from mTBI).
- Health care professionals should use a combination of tools to assess recovery in children with mTBI.
- Health care professionals should use validated symptom scales to assess recovery in children with mTBI.
- Health care professionals may use validated cognitive testing (including measures of reaction time) to assess recovery in children with mTBI.
- Health care professionals may use balance testing to assess recovery in athletes with mTBI (note: multiple tools have shown effectiveness in the assessment of individual patients and their recovery from mTBI; symptom scales and cognitive testing [including measures of reaction time] have the strongest evidence in terms of their contribution to predicting outcomes and assessing recovery).
- Health care professionals should closely monitor children with mTBI who are determined to be at high risk for persistent symptoms based on their premorbid history, demographics, and/or injury characteristics (note: the symptoms

experienced by most children with mTBI resolve within one to three months after injury).

- For children with mTBI whose symptoms do not resolve as expected with standard care (i.e., within four to six weeks), health care professionals should provide or refer for appropriate assessments and/or interventions.
- Health care professional should include the following information when providing education and reassurance to the family of a pediatric patient suffering from mTBI: warning signs of more serious injury; description of injury and expected course of symptoms and recovery; instructions on how to monitor postconcussive symptoms; prevention of further injury; management of cognitive and physical activity/rest; instructions regarding return to play/recreation and school; clear clinician follow-up instructions.
- Health care professionals should counsel patients to observe more restrictive physical and cognitive activity during the first several days after mTBI in children.
- Following the first several days, health care professionals should counsel patients and families to resume a gradual schedule of activity that does not exacerbate symptoms, with close monitoring of symptom expression (number and severity).
- After the successful resumption of a gradual schedule of activity, health care professionals should offer an active rehabilitation program of progressive reintroduction of noncontact aerobic activity that does not exacerbate symptoms, with close monitoring of symptom expression (number and severity).
- Health care professionals should counsel patients to return to full activity when they return to premorbid performance if they have remained symptom free at rest and with increasing levels of physical exertion (note: rest is the foundation in the treatment of acute mTBI; related evidence suggests that rest or reduction in cognitive/physical activity is beneficial immediately after mTBI and, for those who are slow to recover, rest may help accelerate recovery).
- Health care professionals may assess the extent and types of social support (e.g., emotional, informational, instrumental, and appraisal) available to children with mTBI and emphasize social support as a key element in the education of caregivers and educators.
- To assist children returning to school after mTBI, medical and school-based teams should counsel the student and family regarding the process of gradually

increasing the duration and intensity of academic activities as tolerated, with the goal of increasing participation without significantly exacerbating symptoms.

- Return-to-school protocols should be customized based on the severity of postconcussion symptoms in children with mTBI as determined jointly by medical and school-based teams.
- For any student with prolonged symptoms that interfere with academic performance, school-based teams should assess the educational needs of the student and determine the student's need for additional educational supports, including those described under pertinent federal statutes (e.g., Individuals With Disabilities Education Act).
- Postconcussion symptoms and academic progress in school should be monitored collaboratively by the student, family, health care professional(s), and school teams, who jointly determine what modifications or accommodations are needed to maintain an academic workload without significantly exacerbating symptoms.
- The provision of educational supports should be monitored and adjusted on an ongoing basis by the school-based team until the student's academic performance has returned to preinjury levels.
- For students who demonstrate prolonged symptoms and academic difficulties despite an active treatment approach, health care professionals should refer the child for a formal evaluation by a specialist in pediatric mTBI (note: the return to school after a mTBI must be carefully planned given the injury symptoms [e.g., headaches and fatigue interfering with learning, greater problems concentrating on schoolwork, and difficulty taking notes] that can affect learning and performance; recommendations for returning to school after mTBI should attempt to minimize cognitive and physical overexertion, while encouraging a prompt return to school to avoid the negative effects of prolonged school absence; return-to-school protocols should affirm the need for continued collaboration among medical, school, and family systems to gradually adjust interventions and return the child to full participation without significant worsening of symptoms; protocols should target the student's symptoms as the focus of intervention, linking specific accommodations in efforts to limit symptom expression; because postconcussive symptoms resolve at different rates in different children after mTBI, individualization of return-to-school programming is necessary).

- Health care professionals in the ED should clinically observe and consider obtaining a head CT in children seen with severe headache, especially when associated with other risk factors and worsening headache after mTBI, to evaluate for ICI requiring further management in accord with validated clinical decision-making rules.
- Children undergoing observation periods for headache with acutely worsening symptoms should undergo emergent neuroimaging.
- Health care professionals and caregivers should offer nonopioid analgesia (e.g., ibuprofen or acetaminophen) to children with painful headaches after acute mTBI but also provide counseling to the family regarding the risks of analgesic overuse, including rebound headache (note: painful headaches in children require intervention; nonopioid analgesics, such as ibuprofen and acetaminophen, are often effective in treating headaches in children, and opioids are not generally recommended as therapy for headaches; nonopioid analgesic overuse carries important risks of toxic effects and rebound headache).
- Health care professionals should not administer 3% hypertonic saline to children with mTBI for treatment of acute headache outside of a research setting.
- Chronic headache after mTBI is likely to be multifactorial; therefore, health care professionals should refer children with chronic headache after mTBI for multidisciplinary evaluation and treatment, with consideration of analgesic overuse as a contributory factor (note: children with a headache, including worsening or severe headache, after mTBI with GCS scores of 13 to 15 may be at moderate risk for ICI).
- Health care professionals may refer children with subjective or objective evidence of persistent vestibule-oculomotor dysfunction after mTBI to a program of vestibular rehabilitation (note: evidence suggests that vestibular and oculomotor dysfunction may contribute to the diagnosis of mTBI and longer symptom duration; evidence suggests that early vestibulo-ocular and cervicovestibular physical therapy may be of benefit for patients seen with subjective reports (symptoms of dizziness) or objective physical examination findings).
- Health care professionals should provide guidance on proper sleep hygiene methods to facilitate recovery from pediatric mTBI.

- If sleep problems emerge or continue despite appropriate sleep hygiene measures, health care professionals may refer children with mTBI to a sleep disorder specialist for further assessment.
- Health care professionals should attempt to determine the etiology of cognitive dysfunction within the context of other mTBI symptoms.
- Health care professionals should recommend treatment for cognitive dysfunction that reflects its presumed etiology.
- Health care professionals may refer children with persisting problems related to cognitive function for a formal neuropsychological evaluation to assist in determining the etiology and recommending targeted treatment (note: cognitive impairment occurs after mTBI and includes the areas of attention, memory and learning, response speed, and aspects of executive functions; cognitive impairment may be directly related to the pathology of the brain injury [i.e., impaired neurotransmission] but may also reflect secondary effects of other symptoms [e.g., ongoing headache pain, fatigue/low energy, and low frustration tolerance] that may produce a disruption in cognitive processing; neuropsychological evaluations can assist in determining the etiology of cognitive impairment and directing treatment).

What are the complications typically associated with mTBI?

- **Decreased school/work productively and physical activity** - a mTBI can lead to dizziness, balance problems, headaches, fatigue, drowsiness, problems with attention and/or concentration, feeling foggy and/or groggy, problems with short- or long-term memory, and trouble thinking clearly, all of which can lead to decreased school/work productively and decreased physical activity (note: physical activity may refer to any bodily movement produced by the contraction of skeletal muscle that increases energy expenditure above a basal level).
- **Falls** - due to the symptoms of mTBI such as dizziness, balance problems, and headaches, individuals suffering from mTBI may experience falls. The term fall may refer to an event which results in an individual coming to rest on the ground or a lower level. Health care professionals should note that fall precautions constitute the basics of patient safety and should be applied in all health care facilities to all patients. Specific fall precautions may be found below.

Fall Precautions

- Familiarize the patients with their environment
- Have patients demonstrate call light use, when applicable
- Maintain call light within reach
- Keep patients' personal possessions within safe reach of the individual patient
- Have sturdy handrails in patients' rooms, bathrooms, and hallways
- Place the patient's bed in a low position when a patient is resting in bed; raise the patient's bed to a comfortable height when the patient is transferring out of bed, when applicable
- Keep patients' bed brakes locked
- Keep wheelchair wheel locks in the locked position when stationary, when applicable
- Keep nonslip, comfortable, well-fitting footwear on the patient
- Use night lights or supplemental lighting
- Keep floor surfaces clean and dry
- Clean up all spills promptly
- Keep patient care areas uncluttered
- Follow safe patient handling practices

- **Depression** - a mTBI may lead to depression. Specific information regarding depression may be found below.
    - A depressive disorder may refer to a mental health disorder characterized by a persistent depressed mood and/or anhedonia, which ultimately causes significant interference in daily life (note: anhedonia may refer to a loss of interest in previously enjoyable activities).

    - There are many different types of depressive disorders such as: major depressive disorder, persistent depressive disorder, psychotic depression, and atypical depression.
    - One of the most common forms or types of depressive disorders is major depressive disorder.
    - Major depressive disorder may refer to a form of depression that occurs most days of the week for a period of two weeks or longer leading to clinically significant distress or impairment in social, occupational, or other important areas of functioning.
    - The signs and symptoms of major depressive disorder may include the following: depressed mood, anhedonia (a loss of interest in previously enjoyable activities), appetite changes, weight changes, sleep difficulties, psychomotor agitation or retardation, fatigue or loss of energy, diminished ability to think or concentrate, feelings of worthlessness or excessive guilt, and suicidality.
- **Post-Concussion Syndrome (PCS)** - a mTBI may lead to post-concussion syndrome (PCS). Specific information regarding PCS may be found below.
    - PCS may refer to the presence of mTBI symptoms beyond the normal course of recovery; a cluster of physical, cognitive, behavioral, and emotional symptoms occurring after mTBI/TBI.
    - Research indicates that most cases of PCS occur in patients with mTBI, however PCS can occur with TBI of any severity.
    - Symptoms of PCS include: headache, vision changes, dizziness, disturbances in balance, confusion, fatigue, insomnia, and difficulty concentrating.
    - Repetitive head trauma and greater severity of symptoms at initial presentation are associated with symptoms persisting for more than one month, although the vast majority of patients recover by three months.
    - When evaluating patients potentially suffering from PCS, health care professionals should conduct a thorough patient history and physical exam; health care professionals should document the following information when obtaining a patient's history: headache history, history

of depression, anxiety or mood disorders, dizziness, fatigue, irritability, insomnia, loss of concentration and memory, noise sensitivity, and chronic pain; health care professionals should obtain the following information during patient exam: mechanism of injury, date of injury, loss of consciousness at the time of injury, and symptoms; additionally, the patient physical exam should include a full neurological exam including evaluation of cranial nerves, visual acuity, reflexes, strength, proprioception, and sensation.

- Treatment of PCS should be individualized to each patient and the patient's particular symptoms. Rest is often an important part of treatment.
- Complications associated with PCS include: inability to perform activities of daily living, cognitive impairment, depression, anxiety, sleep disturbances, and suicidal ideation (note: suicidal ideation may refer to thoughts of suicide and/or thoughts of planning suicide).

Are there specific strategies that can be used to help with mTBI recovery?

Yes, pediatric patients and their parents/caregivers may use specific strategies to help with mTBI recovery. Examples of the specific strategies that may be used to help with mTBI recovery may be found below.

- Set up school rest breaks in a quiet place.
- Shorten the school day if symptoms do not get better.
- Avoid cognitive activities that can cause symptoms to worsen (e.g., complex school assignments/exams).
- Set aside a quiet place in the home for school work or other learning activities.
- Decrease screen time (e.g., tablet and computer screens).
- Take ibuprofen or acetaminophen to help with pain.
- Wear sunglasses or a hat when outside, or when exposed to bright lights or sunlight.
- Avoid noisy/crowded places.

- Work to prevent falls (e.g., wear adequate footwear that fits appropriately; avoid walking without wearing adequate footwear; avoid clutter in the house).
- Provide written notes with specific instructions to help with memory problems.
- Reduce stress.
- Engage in deep breathing exercises.
- Stay connected to family and friends.
- Keep to a set bedtime routine with fixed sleep and wake up times.

How can individuals prevent head injuries and resulting mTBIs?

Individuals can prevent head injuries and resulting mTBIs by following the recommendations found below.

- Use a rear-facing car seat - children from birth to ages two - four should be buckled into a rear-facing car seat until they reach the maximum weight and/or height for the car seat.
- Use a forward-facing car seat - when children outgrow their rear-facing car seat, they should be buckled into a forward-facing car seat until they reach the maximum weight and/or height for the car seat.
- Use a booster seat - when children outgrow their forward-facing car seat, they should be buckled into a booster seat until a seat belt adequately fits the child.
- Use a seat belt - children should use a seat belt every time they ride in a vehicle.
- Wear a helmet, or appropriate headgear - children should wear a helmet, or appropriate headgear, when applicable (e.g., when riding a bike, motorcycle, snowmobile, scooter, or using an all-terrain vehicle; playing a contact sport; bating while playing baseball; using in-line skates; riding a skateboard; riding a horse; skiing; snowboarding).
- Wear adequate footwear - as previously mentioned, wearing adequate footwear (e.g., footwear that fits appropriately) can help prevent falls, which may lead to a head injury/mTBI.

- Install window guards - window guards can help prevent small children from falling out of a window.
- Use safety gates - safety gates, installed at the top and bottom of stairs, can help prevent stair-related falls.
- Routine eye checks - routine eye checks can help identify individuals with vision problems and/or individuals that require glasses, which in turn, can help prevent falls related to poor vision.

Section 1 Summary

A head injury may refer to any trauma to the scalp, skull, or brain. A pediatric head injury may lead to a mTBI, which, subsequently, may lead to decreased school/work productively and physical activity, falls, depression, and PCS. Health care professionals should work to effectively identify and assess patients suffering from a head injury.

Section 1 Key Concepts

- A head injury may lead to a scalp injury, skull fracture, and/or a TBI.
- mTBI signs/symptoms may appear immediately, while others may not appear for hours or days after the head injury; signs/symptoms of mTBI are different for each individual; signs/symptoms generally improve over time, and most individuals with mTBI improve within a couple of weeks; signs/symptoms may change during recovery.
- Children should seek health care if they experience any danger signs following a head injury, or if they will not stop crying post injury and/or refuse to nurse or eat.
- Health care professionals should follow recommendations for the effective diagnosis, prognosis, and management/treatment of mTBI in pediatric patients.

Section 1 Key Terms

Head injury - any trauma to the scalp, skull, or brain

Linear skull fracture - a break in a cranial bone resembling a thin line, without separating into two pieces

Depressed skull fracture - a break in a cranial bone with depression of the bone in toward the brain

Comminuted skull fracture - a fracture in which the bone shatters into multiple pieces

Ping-pong skull fracture - an indentation in the skull that resembles a ping-pong ball

Traumatic brain injury (TBI) - damage to the brain that is typically caused by sudden trauma

Mild traumatic brain injury (mTBI) (also referred to as a concussion) - a type of brain injury that is typically caused by a bump, blow, or jolt to the head or by a hit to the body that causes the head and brain to move rapidly back and forth

Danger signs (within the context of mTBI/TBI) - specific signs related to the potential for a blood clot that can push or crowd the brain against the skull

Amnesia - the loss of memories, such as: facts, information, and experiences

Retrograde amnesia - a type of amnesia that is characterized by the inability to recall memories that were formed before the event that caused the amnesia

Anterograde amnesia - a type of amnesia characterized by the inability to form new memories

Physical activity - any bodily movement produced by the contraction of skeletal muscle that increases energy expenditure above a basal level

Fall - an event which results in an individual coming to rest on the ground or a lower level

Depressive disorder - a mental health disorder characterized by a persistent depressed mood and/or anhedonia, which ultimately causes significant interference in daily life

Anhedonia - a loss of interest in previously enjoyable activities

Major depressive disorder - a form of depression that occurs most days of the week for a period of two weeks or longer leading to clinically significant distress or impairment in social, occupational, or other important areas of functioning

Post-concussion syndrome (PCS) - the presence of mTBI symptoms beyond the normal course of recovery; a cluster of physical, cognitive, behavioral, and emotional symptoms occurring after mTBI/TBI

Suicidal ideation - thoughts of suicide and/or thoughts of planning suicide

Section 1 Personal Reflection Question

How can health care professionals use the above recommendations to safely and effectively assess, diagnose, determine a prognosis, and manage/treat mTBIs in pediatric patients?

Section 2: Pediatric Spinal Cord Injuries

This section of the course will focus on pediatric spinal cord injuries. The information found within this section of the course was derived from materials provided by the National Institute of Neurological Disorders and Stroke unless, otherwise, specified (National Institute of Neurological Disorders and Stroke, 2022).

What is a spinal cord injury?

- A spinal cord injury (SCI) may refer to damage to the tight bundle of cells and nerves that sends and receives signals from the brain to and from the rest of the body.
- Health care professionals should note the following: a SCI can be caused by direct injury to the spinal cord itself or from damage to the tissue and vertebrae that surround the spinal cord; the aforementioned type of damage can result in temporary or permanent changes in sensation, movement, strength, and body functions below the site of injury; motor vehicle accidents and catastrophic falls are the most common causes of SCIs in the United States.
- Health care professionals should also note the following: individuals may suffer from an incomplete spinal cord injury or a complete spinal cord injury; an incomplete spinal cord injury may refer to a spinal cord injury that allows the spinal cord to transmit some messages to and from the brain and to the rest of the body; a complete spinal cord injury may refer to a spinal cord injury that does

not allow the spinal cord to transmit messages to and from the brain and to the rest of the body.

What are the signs/symptoms of a SCI?

The signs/symptoms of a SCI include the following:

- Numbness, tingling, or a loss of or changes in sensation in the hands and feet
- Paralysis that may happen immediately or develop over time as swelling and bleeding affects the spinal cord
- Pain or pressure in the head, neck, or back
- Loss of mobility
- Weakness or inability to move any part of the body
- Unnatural positions of the spine or head
- Loss of bladder and bowel control
- Problems walking
- Difficulty breathing

Retention of movement depends on the type of injury and where it occurs along the spine. An injury higher on the spinal cord may cause tetraplegia or quadriplegia (note: tetraplegia may refer to paralysis affecting the upper and lower parts of the body; quadriplegia may refer to paralysis affecting the body from the neck down, including the trunk, legs, and arms). A lower injury to the spinal cord may cause paraplegia (note: paraplegia may refer to paralysis affecting the legs and lower body).

How should health care professionals assess pediatric patients for a SCI?

To effectively assess pediatric patients for a SCI, health care professionals should obtain relevant information essential to the diagnosis, prognosis, and management/treatment of SCIs. Examples of relevant information essential to the diagnosis, prognosis, and management/treatment of SCIs may be found below.

- Emergency care - due to the nature of SCIs, some pediatric patients may require emergency care, especially if the patient presents to the ED. When determining

the need for emergency care, health care professionals should evaluate the patient's needs for maintaining his or her ability to breathe, as well as immobilizing the neck to prevent further spinal cord damage.

- Injury description - health care professionals should obtain information regarding the events resulting in the SCI (e.g., how the SCI occurred; the type of force that caused the SCI).
- Cause - health care professionals should obtain information regarding the cause of the SCI.
- Loss of consciousness (LOC) - health care professionals should determine the length of LOC, when applicable.
- Early signs observed by others - health care professionals should ask individuals who know the patient (e.g., parent) if they observed any signs/symptoms of a SCI (e.g., problems with movement).
- Seizure - health care professionals should determine if the patient suffered from a seizure before or after the SCI.
- Signs/symptoms - health care professionals should determine SCI-related signs/symptoms (note: health care professionals may ask the patient's parents about related signs/symptoms, when applicable).
- TBI - health care professionals should determine the presence of a TBI.

What are the recommendations for the diagnosis, prognosis, and management/treatment of SCIs in pediatric patients?

- When arriving at the scene of a SCI, health care professionals should immobilize the spine as gently and quickly as possible using a rigid neck collar and a rigid carrying board.
- When arriving at the scene of a SCI, health care professionals should use a carrying board to transport the patient to the ED.
- Once the patient is in the ED, health care professionals should focus on maintaining the patient's ability to breathe.

- Once the patient is in the ED, health care professionals should immobilize the neck to prevent further spinal cord damage.
- Health care professionals should determine the need for breathing assistance. Approximately one-third of those with a SCI will need temporary or permanent help with breathing and may require an inserted artificial breathing tube. Any injury to the spinal cord between the C1 - C4 segments can stop breathing; training regarding breathing and swallowing may be required.
- Health care professionals should determine the need for surgery. Surgery may be used to remove fluid or tissue pressing on the spinal cord (decompression laminectomy); remove bone fragments, disk fragments, or foreign objects; fuse broken spinal bones; or place spinal braces.
- Health care professionals should determine the need for traction. Traction may refer to a technique that stabilizes the spine and brings it into proper alignment.
- Health care professionals should determine the need for methylprednisolone (Medrol). If administered within eight hours of the injury, some patients may experience improvement. Methylprednisolone appears to work by reducing damage to nerve cells and decreasing inflammation near the site of injury.
- Health care professionals should determine the need for physical therapy geared toward muscle strengthening, communication, and mobility.
- Health care professionals should determine the need for assistive devices such as wheelchairs, walkers, and leg braces.
- Health care professionals should determine the need for adaptive devices for communication.
- Health care professionals should determine the need for occupational therapy focused on fine motor skills.
- Health care professionals should determine the need for techniques for self-grooming and bladder and bowel management.
- Health care professionals should determine the need for coping strategies for dealing with spasticity and pain.

- Health care professionals should determine the need for functional electrical stimulation for assistance with restoration of neuromuscular function, sensory function, or autonomic function (e.g., bladder, bowel, or respiratory function).
- Health care professionals should use a combination of tools to assess recovery in children with SCI.
- Health care professionals should use validated symptom scales to assess recovery in children with a mTBI and a SCI.
- Health care professionals should use validated cognitive testing (including measures of reaction time) to assess recovery in children with a mTBI and a SCI.
- Health care professionals should use balance testing to assess recovery in children with a mTBI and a SCI.
- Health care professionals should monitor children with a mTBI and a SCI who are determined to be at high risk for persistent symptoms based on premorbid history, demographics, or injury characteristics.
- To assist children returning to school following a SCI, medical and school-based teams should counsel the student and family regarding the process of gradually increasing the duration and intensity of academic activities as tolerated, with the goal of increasing participation without significantly exacerbating symptoms.
- Return to school protocols should be customized based on the severity of SCI.
- For any child with prolonged symptoms that interfere with academic performance, school-based teams should assess the educational needs of that student and determine the student's need for additional educational support, including those described under pertinent federal statutes.
- SCI symptoms and academic progress in school should be monitored collaboratively by the student, family, health care professional, and school teams, who jointly determine which modifications or accommodations are needed to maintain an academic workload without significantly exacerbating symptoms.
- The provision of educational support should be monitored and adjusted on an ongoing basis by the school-based team until the student's academic performance has returned to pre-injury levels.

- For children who demonstrate prolonged symptoms and academic difficulties despite an active treatment approach, health care professional should refer the child for a formal evaluation by a specialist in pediatric SCIs.

What are the complications typically associated with a SCI?

- **Pain** - one of the first complications that may initially come to mind when considering SCIs is pain. Individuals suffering from a SCI are likely to experience pain. Pain may refer to an unpleasant sensory and emotional experience arising from actual or potential tissue damage. Health care professionals should work to evaluate/assess and treat any physical pain related to a SCI. Health care professionals should note the following: health care professionals may evaluate/ assess a patient's pain and related discomfort by using pain assessment tools, such as a numerical pain intensity scale and the Wong/Baker faces rating scale.

  A simple numerical pain intensity scale, when applied to pain assessment, may refer to a numerically based method, which may be used by health care professionals to help patients rate their pain from 0 - 10, with 0 meaning no pain and 10 meaning severe pain or worst possible pain. A simple numerical pain intensity scale may be relatively uncomplicated and/or straightforward - however, it may be the most efficient way for health care professionals to obtain pain-related information from a patient. Health care professionals should note that simple numerical pain intensity scales may be incorporated into other pain assessment guides, scales, and tools.

  The Wong/Baker faces rating scale may refer to a pain assessment tool consisting of faces associated with numerical values. The Wong/Baker faces rating scale includes faces with different simplified facial expressions, which are associated with a numerical pain intensity scale ranging from 0 - 10 (i.e., each face of the Wong/Baker faces rating scale is associated with a numerical value and an expression of pain). To use the scale effectively, health care professionals should show the scale to patients and ask them to select a face that best represents how their experience of pain is making them feel. By simply pointing to an easy to understand picture of a face in pain, patients can provide health care professionals with a pain rating from 0 - 10, as well as valuable insight into their individual experience of pain. Health care professionals should note that the Wong/Baker faces rating scale may be ideal for pediatric patients, patients with

language barriers, and patients that simply have trouble associating a numerical value with their experience of pain.

- **Pneumonia** - respiratory complications are the leading cause of death in individuals with a SCI, commonly as a result of pneumonia. Patients who have an inserted breathing tube and are placed on a ventilator to assist with breathing are at increased risk of developing pneumonia. The aforementioned patients must be carefully monitored and treated with antibiotics if symptoms of pneumonia appear. Health care professionals should note the following: clearing secretions from the throat and preventing food and liquids from being sucked into the lungs can help prevent pneumonia.

- **Circulatory problems** - changes in circulation, including blood pressure instability, abnormal heart rhythms, and blood clots may appear days after the SCI. Blood pressure needs to be closely monitored to keep blood and oxygen flowing through the spinal cord tissue. Because the brain's control of the cardiac nerves can be cut off, the heart can beat at a dangerously slow pace, or it can pound rapidly and irregularly. Patients with spinal cord injuries are at increased risk for blood clots due to stagnation of blood flow in the large veins in the legs. Health care professionals should note the following: SCI patients may require anticoagulant drugs and/or compression stockings to increase blood flow in the lower legs and feet.

- **Autonomic dysreflexia** - autonomic dysreflexia may refer to a life-threatening reflex action that primarily affects individuals with injuries to the neck or upper back. Symptoms of autonomic dysreflexia may include the following: flushing, sweating, a pounding headache, anxiety, a sudden increase in blood pressure, vision changes, and goose bumps on the arms and legs. Health care professionals should note the following: patients experiencing autonomic dysreflexia should be kept in a sitting position, rather than lying flat, to keep blood flowing to the legs and feet and help reduce blood pressure.

- **Decreased mobility** - SCIs may lead to decreased mobility. Decreased mobility may refer to a state in which an individual has a limitation in independent, purposeful physical movement. Health care professionals should note the following signs/symptoms of decreased mobility: inability to intentionally move; inability to perform activity as instructed; limited range of motion (ROM); hesitance to attempt movement due to pain or fear of pain.

- **Pressure injuries** - due to decreased mobility patients suffering from a SCI may experience a pressure injury. A pressure injury, also referred to as a pressure ulcer or bedsore, may refer to localized damage to the skin and/or underlying soft tissue, usually over a bony prominence. Pressure injuries typically result from intense and/or prolonged pressure. A pressure injury can present as intact skin or an open ulcer. Pressure injuries can be painful to patients, and typically affect high-risk patient populations such as patients with a SCI. When evaluating the presence of pressure injuries, health care professionals should attempt to identify the stage or type of pressure injury. Specific information regarding the different stages/types of pressure injuries may be found below. The information found below was derived from materials provided by the Joint Commission (Joint Commission, 2022).

    - Stage 1 pressure injury - Stage 1 pressure injuries are characterized by intact skin with a localized area of non-blanchable erythema (i.e., Stage 1 pressure injuries are characterized by a superficial reddening of the skin that, when pressed, does not turn white).

    - Stage 2 pressure injury - Stage 2 pressure injuries are characterized by partial-thickness skin loss with exposed dermis; a Stage 2 pressure injury wound bed is typically viable, pink or red, moist, and may present as an intact or ruptured serum-filled blister; adipose (fat) is not visible and deeper tissues are not visible; granulation tissue, slough and eschar are not present. Slough may refer to a layer or mass of necrotic or dead tissue. Eschar may refer to dead tissue that sheds or falls from the skin.

    - Stage 3 pressure injury - Stage 3 pressure injuries are characterized by full-thickness loss of skin, in which adipose (fat) is visible in the ulcer and granulation tissue and epibole (note: epibole may refer to rolled wound edges) are often present; slough and/or eschar may be visible; the depth of tissue damage varies by anatomical locations; undermining and tunneling may occur; fascia, muscle, tendon, ligament, cartilage and/or bone are not exposed.

    - Stage 4 pressure injury - Stage 4 pressure injuries are characterized by full-thickness skin and tissue loss with exposed or directly palpable fascia, muscle, tendon, ligament, cartilage, or bone in the ulcer; slough and/or eschar may be visible; epibole, undermining and/or tunneling often occur; depth varies by anatomical location.

- Unstageable pressure injury - unstageable pressure injuries are characterized by full-thickness skin and tissue loss in which the extent of the tissue damage within the ulcer cannot be confirmed because it is obscured by slough or eschar; if slough or eschar is removed, a Stage 3 or Stage 4 pressure injury may be revealed. Health care professionals should note the following regarding an unstageable pressure injury: stable eschar on an ischemic limb or the heel(s) should not be removed; stable eschar may refer to eschar/dead tissue that is dry, adherent, and intact without erythema or fluctuance.

- Deep tissue pressure injury - deep tissue pressure injuries are characterized by intact or non-intact skin with localized area or persistent non-blanchable deep red, maroon, purple discoloration, or epidermal separation revealing a dark wound bed or blood-filled blister; pain and temperature changes often preceded skin color changes; discoloration may appear differently in darkly pigmented skin. Health care professionals should note the following regarding a deep tissue pressure injury: deep tissue pressure injuries typically result from intense and/or prolonged pressure and shear forces at the bone-muscle interface; the wound may evolve rapidly to reveal the actual extent of tissue injury, or may resolve without tissue loss; if necrotic tissue, subcutaneous tissue, granulation tissue, fascia, muscle, or other underlying structures are visible, this indicates a full-thickness pressure injury (unstageable, Stage 3 or Stage 4).

- Medical device-related pressure injury - medical device-related pressure injuries result from the use of devices designed and applied for diagnostic or therapeutic purposes. Health care professionals should note the following: a medical device-related pressure injury generally conforms to the pattern or shape of the device; the injury should be staged according to the aforementioned stages.

- Mucosal membrane pressure injury - a mucosal membrane pressure injury may be found on mucous membranes with a history of a medical device used at the location of the injury. Health care professionals should note the following: due to the anatomy of the tissue, typically, mucosal membrane pressure injuries cannot be staged.

- **Weight gain/obesity** - due to decreased mobility and other SCI symptoms, a SCI may lead to weight gain/obesity. Specific information regarding obesity may be

found below. The information found below was derived from materials provided by the CDC (CDC, 2021).

- Obesity may refer to a condition characterized by abnormal or excessive fat accumulation, which may impair health.
- The fundamental cause of obesity is an energy imbalance between the calories consumed and the calories expended.
- A health care professional can determine if an individual is obese by calculating his or her body mass index (BMI). Body mass index (BMI) may refer to a value derived from an individual's height and weight.
- Health care professionals may use the following formula to calculate an individual's BMI: BMI = weight (kg) / height $(m)^2$; health care professionals may also use the following formula to calculate an individual's BMI: BMI = weight (lb) / $[height (in)]^2$ x 703.
- BMI does not measure body fat directly; BMI can be used to help determine if an individual is underweight, at a normal weight, overweight, or obese.
- Underweight - an individual may be considered to be underweight if his or her BMI is less than 18.5 kg/m^2.
- Normal weight - an individual may be considered to be at a normal weight, or healthy weight, if his or her BMI is between 18.5 - 24.9 kg/m^2.
- Overweight - an individual may be considered to be overweight if his or her BMI is between 25.0 - 29.9 kg/m^2.
- Obese - an individual may be considered to be obese if his or her BMI is greater than or equal to 30.0 kg/m^2.
- Childhood obesity may refer to a condition in which a child or adolescent is significantly overweight for his or her age and height; a child/adolescent is well above the normal or healthy weight for his or her age and height.
- A health care professional can determine if a child/adolescent is obese by calculating his or her age-related BMI, otherwise referred to as BMI-for-age.

- For children and adolescents, BMI is age- and sex-specific and is often referred to as BMI-for-age; a child's weight status is determined using an age- and sex-specific percentile for BMI rather than the previously highlighted BMI categories used for adults; the reason a child's weight status is determined using an age- and sex-specific percentile for BMI is because children's body composition varies as they age and varies between boys and girls. Health care professionals should note the following: a child/adolescent is considered to be overweight if his or her BMI is equal to or above the 85th percentile and below the 95th percentile for children and teens of the same age and sex; a child/adolescent is considered to be obese if his or her BMI is equal to or above the 95th percentile for children and teens of the same age and sex.

- Underweight - a child/adolescent may be considered to be underweight if his or her BMI is less than the 5th percentile.

- Normal weight - a child/adolescent may be considered to be at a normal weight, or healthy weight, if his or her BMI is in the 5th percentile to less than the 85th percentile.

- Overweight - a child/adolescent may be considered to be overweight if his or her BMI is in the 85th to less than the 95th percentile.

- Obese - a child/adolescent may be considered to be obese if his or her BMI is in the 95th percentile or greater.

- **Post-traumatic stress disorder (PTSD)** - a SCI, especially if it is related to a traumatic event, may lead to post-traumatic stress disorder (PTSD). Specific information regarding PTSD may be found below. The information found below was derived from materials provided by the National Institute of Mental Health (National Institute of Mental Health, 2019).

    - PTSD may refer to a psychiatric disorder characterized by intense physical and emotional responses to thoughts and reminders of a traumatic event(s) (e.g., the death of a loved one) (note: the term traumatic event may refer to an event, or series of events, that cause a moderate to severe stress reaction).

    - The risk factors associated with PTSD include the following: experienced a traumatic event; witnessed a traumatic event; a close family member or

friend experiences a traumatic event; social isolation after a traumatic event; the sudden, unexpected death of a loved one; history of mental illness; history of substance abuse; stress; prolonged periods of unrelenting stress; consistent feelings of horror or extreme fear; consistent feelings of helplessness.

- PTSD may lead to re-experiencing symptoms, avoidance symptoms, arousal and reactivity symptoms, and cognition and mood symptoms.
- Re-experiencing symptoms - re-experiencing symptoms may refer to symptoms that force or trigger a person to re-experience a traumatic event. Re-experiencing symptoms include the following: nightmares; fearful thoughts; guilty thoughts; flashbacks (note: the term flashback may refer to the re-emergence of memories associated with a traumatic event that manifest a collection of overwhelming sensations, such as emotionally disturbing images and sounds).
- Avoidance symptoms - avoidance symptoms may refer to symptoms that force an individual to alter his or her daily routines. Avoidance symptoms include the following: avoids thoughts related to a traumatic event; avoids feelings related to a traumatic event; avoids individuals related to a traumatic event; avoids places, events, or objects related to a traumatic event.
- Arousal and reactivity symptoms - arousal and reactivity symptoms may refer to symptoms that cause long-term feelings of rage, anger, and stress. Arousal and reactivity symptoms include the following: rage; anger; anger outbursts; feeling stressed; feeling tense; feeling on edge; easily startled; problems sleeping.
- Cognition and mood symptoms - cognition and mood symptoms may refer to symptoms that impact an individual's ability to think, reason, apply logic, and perceive reality that are not related to injury or substance use. Cognition and mood symptoms include the following: forgetfulness; inability to remember important aspects of a traumatic event; negative and distorted thoughts about oneself and others; negative and distorted thoughts about feelings and emotions; negative and distorted thoughts about reality; anhedonia (note: anhedonia may refer to a loss of interest in previously enjoyable activities).

    - PTSD is typically diagnosed by a health care professional using criteria outlined in the American Psychiatric Association's Diagnostic and Statistical Manual, Fifth edition (DSM-5).

- **Bladder or bowel dysfunction** - a SCI may lead to bladder or bowel dysfunction. Specific information regarding bladder and bowel dysfunction may be found below.

    - A SCI may interrupt communication between the nerves in the spinal cord that control bladder and bowel function and the brain, which may lead to bladder or bowel dysfunction.

    - Bladder dysfunction may refer to the inability to control the release of urine. The term bladder dysfunction may be used as an umbrella term to describe a range of urine-related problems.

    - The signs/symptoms of bladder dysfunction include the following: urinary incontinence, inability to empty the bladder, increased urinary frequency, and urinary tract infections (note: urinary incontinence may refer to a loss of bladder control that may vary from a slight loss of urine control to complete inability to control urination).

    - Bladder dysfunction may lead to daytime wetting. The term daytime wetting may refer to the loss of bladder control during awake hours (e.g., while the child is in school).

    - Bladder dysfunction may lead to laughter incontinence. The term laughter incontinence may refer to a leakage of urine while an individual is laughing.

    - Bowel dysfunction may refer to the inability to control bowel movements.

    - The signs/symptoms of bowel dysfunction include the following: bowel incontinence, constipation, and increased bowel frequency (note: bowel incontinence may refer to an inability to control bowel movements, resulting in involuntary bowel movements).

- **Low self-esteem** - the aforementioned complications associated with a SCI may lead to low self-esteem. Self-esteem may refer to an individual's subjective evaluation of his or her own value or worth. Health care professionals should note the following signs of low self-esteem: poor confidence; self-doubt; negative

view of oneself; talking about oneself in a negative manner; negative outlook towards life; an inability to accept acknowledgement or positive feedback; outward feelings of shame; anxious mood; and depressed mood.

- **Relationship problems** - due to low self-esteem and or related contributing factors, individuals suffering from a SCI may have problems maintaining relationships with other individuals (e.g., individuals suffering from a SCI may not be able to sustain long-term romantic or platonic relationships with other individuals). Health care professionals should note that low self-esteem may contribute to or result from relationship problems.
- **Social isolation** - SCI-associated low self-esteem and relationship problems may lead to social isolation (note: the term social isolation may refer to a lack of social connections that may impact an individual's health and quality of life). Health care professionals should note that SCI-associated low self-esteem and relationship problems may contribute to or result from social isolation.
- **Suicidal ideation** - SCI-associated PTSD, low self-esteem, relationship problems, and social isolation may, collectively or independently, lead to suicidal ideation. Suicidal ideation may refer to thoughts of suicide and/or thoughts of planning suicide. Suicidal ideation may lead to a suicide attempt and/or suicide. A suicide attempt may refer to a non-fatal self-directed and potentially injurious behavior with any intent to die as a result of the behavior (note: a suicide attempt may or may not result in an injury). Suicide may refer to a death caused by injuring oneself with the intent to die. Health care professionals should note the following: suicide can be prevented; suicide prevention is best achieved by a focus across the individual, relationship, family, community, and societal-levels.

Are there specific strategies that can be used to help with SCI recovery?

- Yes, pediatric patients and their parents/caregivers may use specific strategies to help with SCI recovery. Examples of specific strategies that may be used to help with SCI recovery may be found below.
- Set up school rest breaks in a quiet place.
- Shorten the school day if symptoms do not get better.
- Avoid cognitive activities that can cause symptoms to worsen (e.g., complex school assignments/exams).

- Set aside a quiet place in the home for school work or other learning activities.
- Ensure adequate nutrition.
- Ensure an adequate night sleep (note: individuals 4 - 12 months old should sleep 12 - 16 hours per 24 hours (including naps); individuals 1 - 2 years old should sleep 11 - 14 hours (including naps) per 24 hours; individuals 3 - 5 years old should sleep 10 - 13 hours (including naps) per 24 hours; individuals 6 - 12 years old should sleep 9 - 12 hours per 24 hours; individuals 13 - 18 years old should sleep 8 - 10 hours per 24 hours).
- Work to reduce/prevent stress. Methods that may be used to reduce/prevent stress may be found below.
    - Engage in physical activity (note: engaging in physical activity can help individuals create the following healthy cycle - reducing/preventing stress can help individuals remain active and engage in physical activity; remaining active and engaging in physical activity can help individuals reduce/prevent stress).
    - Engage in yoga (note: yoga can help individuals remain active, engage in physical activity, and reduce/prevent stress).
    - Engage in art projects (e.g., drawing; painting).
    - Listen to relaxing music.
    - Turn off smartphones and other electronic devices for extended periods of time.
    - Limit daily social media exposure.
    - Promote positive thinking (e.g., help children/adolescents focus on positive or productive feelings, emotions, and ideas).
    - Help build and maintain a child's/adolescent's self-esteem.
- Engage in physical activity, when appropriate and able. Specific age-related physical activity recommendations may be found below. The information found below was derived from materials provided by the U.S. Department of Health and Human Services (U.S. Department of Health and Human Services, 2018).

    <u>Physical Activity Recommendations for Preschool-Aged Children</u>

Preschool-aged children (note: the term preschool-aged children may refer to individuals ages three through five years) should be physically active throughout the day to enhance growth and development.

Adult caregivers of preschool-aged children should encourage active play that includes a variety of activity types.

Physical Activity Recommendations for Children and Adolescents

It is important to provide young people opportunities and encouragement to participate in physical activities that are appropriate for their age, that are enjoyable, and that offer variety.

Children and adolescents ages 6 through 17 years should do 60 minutes (1 hour) or more of moderate-to-vigorous physical activity daily.

Most of the 60 minutes or more per day should be either moderate- or vigorous-intensity aerobic physical activity and should include vigorous-intensity physical activity at least 3 days a week.

As part of their 60 minutes or more of daily physical activity, children and adolescents should include muscle-strengthening physical activity at least 3 days a week.

As part of their 60 minutes or more of daily physical activity, children and adolescents should include bone-strengthening physical activity at least 3 days a week.

Physical Activity Recommendations for Safe Physical Activity

Individuals should understand the risks, yet be confident that physical activity can be safe for almost everyone.

Individuals should choose types of physical activity that are appropriate for their current fitness level and health goals, because some activities are safer than others.

Individuals should increase physical activity gradually over time to meet key guidelines or health goals. Inactive people should “start low and go slow” by starting with lower intensity activities and gradually increasing how often and how long activities are done.

Individuals should protect themselves by using appropriate gear and sports equipment, choosing safe environments, following rules and policies, and making sensible choices about when, where, and how to be active.

Individuals should be under the care of a health care professional if they have chronic conditions or symptoms. Individuals with chronic conditions and symptoms can consult a health care professional or physical activity specialist about the types and amounts of activity appropriate for them.

- Monitor height and weight - health care professionals should encourage parents and caregivers to monitor a child's height and weight (note: monitoring a child' height after a SCI can help identify developing spinal abnormalities they may be related to the SCI; a child's height and weight can be used to determine his or her BMI-for-age). Specific recommendations/steps to accurately measure a child's height and weight may be found below. The information found below was derived from materials provided by the CDC (CDC, 2021).

  Steps to Accurately Measure a Child's Height

  1. Obtain a tape measure and an object with a flat surface, which will serve as a headpiece (e.g., a small piece of cardboard) (note: the tape measure will be used to measure the child's height).

  2. Engage in hand hygiene (note: hand hygiene may refer to the process of cleaning hands in order to prevent contamination and/or infections). To effectively engage in hand hygiene, individuals should use an alcohol-based hand sanitizer or wash their hands with soap and water. If using an alcohol-based hand sanitizer, individuals should note the following: place the alcohol-based hand sanitizer on the hands and rub the hands together until the hands feel dry; the hand hygiene process with an alcohol-based hand sanitizer should take approximately 20 seconds. If using soap and water, individuals should note the following: wet the hands with warm water; apply a nickel- or quarter-sized amount of soap to the hands; rub the hands together until the soap forms a lather; counting rubbing for approximately 15 seconds; rinse the hands well under running water; use a paper towel or towel to dry the hands; use a paper towel/towel to turn off the faucet.

3. Identify a location to measure the child's height (e.g., a location with flat flooring and without a carpet that is against a flat wall without molding) (note: the same location should be used when measuring a child's height).
4. Ensure that the child's shoes are removed/instruct the child to remove his or her shoes.
5. Instruct the child to remove any head wear or hair ornaments.
6. Ensure that the child's hair is laying flat on his or her head (i.e., ensure that the child's hair is not sticking or bunched up in a manner that may interfere with accurately measuring the child's height).
7. Instruct the child to stand with his or her feet flat, together, and against the desired wall. Ensure the child's legs are straight, arms are at the sides, and shoulders are level.
8. Instruct the child to look straight ahead. Ensure the child's line of sight is parallel with the floor.
9. Gently place the headpiece on the crown of the child's head while the child stands with head, shoulders, buttocks, and heels touching the flat surface of the desired wall (note: the headpiece should rest on top of the child's head; depending on the overall body shape of the child or teen, all points may not touch the wall).
10. Ensure that the headpiece rests firmly on the child's head (note: the measurer's eyes should be at the same level as the headpiece).
11. Lightly mark where the bottom of the headpiece meets the wall.
12. Use a tape measure to measure from the base on the floor to the marked measurement on the wall to get an accurate height measurement.
13. Accurately record the child's height, to the nearest 1/8th inch or 0.1 centimeter, in a height and weight diary (note: a height and weight diary may refer to a document or book that may be used to chronicle/record a child's height and weight).
14. Engage in hand hygiene.

<u>Steps to Accurately Measure a Child's Weight</u>

1. Obtain a digital scale (note: a digital scale is the desired scale for accurately measuring a child's weight; classic bathroom scales that are spring-loaded should be avoided).
2. Engage in hand hygiene.
3. Identify a location to measure the child's weight (e.g., a location with flat flooring and without a carpet).
4. Instruct the child to remove his or her shoes and heavy clothing (e.g., sweaters; jeans).
5. Instruct the child to gently step onto the scale.
6. Instruct the child to stand with both feet in the center of the scale.
7. Observe the digital numbers on the scale. Note when the digital numbers on the scale stop moving, if applicable.
8. Record the weight to the nearest decimal fraction (e.g., 55.5 pounds or 25.1 kilograms) in a height and weight diary.
9. Instruct the child to gently step off of the scale. Repeat steps 1 - 9 if desired or deemed necessary to get the most accurate child weight.
10. Engage in hand hygiene.

How can individuals prevent SCIs?

Individuals can prevent SCIs by following the recommendations found below.

- Drive safely - driving safely can help prevent accidents, which may lead to SCIs.
- Use a seat belt - children should use a seat belt every time they drive in a vehicle.
- Wear a helmet, or appropriate headgear - children should wear a helmet, or appropriate headgear, when applicable (e.g., when riding a bike, motorcycle, snowmobile, scooter, or using an all-terrain vehicle; playing a contact sport; bating while playing baseball; using in-line skates; riding a skateboard; riding a horse; skiing; snowboarding).
- Avoid extreme sports - extreme sports (e.g., bungee jumping, sky-diving, and base-jumping) may lead to SCIs.

- Work to prevent falls - falls may lead to a SCI. Therefore, individuals should work to prevent falls to help prevent a SCI. Individuals can prevent falls by wearing adequate footwear, removing clutter from the home, and avoiding climbing on furniture and playground equipment.
- Conduct medication reconciliations - health care professionals should conduct patient medication reconciliations to identify medications that may contribute to or lead to falls (e.g., cause an adverse effect such as sedation, which may contribute to or lead to a fall). A medication reconciliation may refer to a process of comparing the medications an individual is taking (or should be taking) with newly ordered medications (Joint Commission, 2022). Health care professionals should note the following information regarding medication reconciliations: medication reconciliations are intended to identify and resolve medication discrepancies; medication reconciliations should address medication duplications, omissions, and interactions, and the need to continue current medications; the type of information health care professionals should use to reconcile medications should include (among others) medication name, dose, frequency, route, and purpose; health care professionals should identify the information that needs to be collected in order to reconcile current and newly ordered medications and to safely prescribe medications in the future (Joint Commission, 2022).
- Inspect playground equipment - parents and/or caregivers should inspect playground equipment before a child plays on any playground equipment to ensure it is safe.
- Do not dive head first into shallow water - before diving into a pool, ocean, or other body of water, individuals should make sure there is enough water so that they do not hit the bottom; individuals should not dive into water less than 10 - 12 feet deep.
- Ensure pool safety - to prevent a SCI, individuals should work to ensure pool safety; individuals should keep the area around a pool free from clutter; individuals should avoid pushing other individuals into a pool.

Section 2 Summary

A SCI can dramatically impact the health, overall well-being, and quality of life of those who suffer from such an injury. SCIs may lead to pain, decreased mobility, weight gain/ obesity, PTSD, bladder or bowel dysfunction, low self-esteem, relationship problems,

social isolation, and suicidal ideation. Health care professionals should work to effectively identify and assess patients suffering from a SCI.

Section 2 Key Concepts

- A SCI can be caused by direct injury to the spinal cord itself or from damage to the tissue and vertebrae that surround the spinal cord; the aforementioned type of damage can result in temporary or permanent changes in sensation, movement, strength, and body functions below the site of injury; motor vehicle accidents and catastrophic falls are the most common causes of SCIs in the United States.
- Health care professionals should follow recommendations for the effective diagnosis, prognosis, and management/treatment of SCIs in pediatric patients.

Section 2 Key Terms

Spinal cord injury (SCI) - damage to the tight bundle of cells and nerves that sends and receives signals from the brain to and from the rest of the body

Incomplete spinal cord injury - a spinal cord injury that allows the spinal cord to transmit some messages to and from the brain and to the rest of the body

Complete spinal cord injury - a spinal cord injury that does not allow the spinal cord to transmit messages to and from the brain and to the rest of the body

Tetraplegia - paralysis affecting the upper and lower parts of the body

Quadriplegia - paralysis affecting the body from the neck down, including the trunk, legs, and arms

Paraplegia - paralysis affecting the legs and lower body

Traction - a technique that stabilizes the spine and brings it into proper alignment

Pain - an unpleasant sensory and emotional experience arising from actual or potential tissue damage

Simple numerical pain intensity scale - a numerically based method, which may be used by health care professionals to help patients rate their pain from 0 - 10, with 0 meaning no pain and 10 meaning severe pain or worst possible pain

Wong/Baker faces rating scale - a pain assessment tool consisting of faces associated with numerical values

Autonomic dysreflexia - a life-threatening reflex action that primarily affects individuals with injuries to the neck or upper back

Decreased mobility - a state in which an individual has a limitation in independent, purposeful physical movement

Pressure injury (also referred to as a pressure ulcer or bedsore) - localized damage to the skin and/or underlying soft tissue, usually over a bony prominence

Slough - a layer or mass of necrotic or dead tissue

Eschar - dead tissue that sheds or falls from the skin

Epibole - rolled wound edges

Stable eschar - eschar/dead tissue that is dry, adherent, and intact without erythema or fluctuance

Obesity - a condition characterized by abnormal or excessive fat accumulation, which may impair health

Body mass index (BMI) - a value derived from an individual's height and weight

Childhood obesity - a condition in which a child or adolescent is significantly overweight for his or her age and height; a child/adolescent is well above the normal or healthy weight for his or her age and height

Post-traumatic stress disorder (PTSD) - a psychiatric disorder characterized by intense physical and emotional responses to thoughts and reminders of a traumatic event(s)

Traumatic event - an event, or series of events, that causes a moderate to severe stress reaction

Re-experiencing symptoms - symptoms that force or trigger a person to re-experience a traumatic event

Flashback - the re-emergence of memories associated with a traumatic event that manifest a collection of overwhelming sensations, such as emotionally disturbing images and sounds

Avoidance symptoms - symptoms that force an individual to alter his or her daily routines

Arousal and reactivity symptoms - symptoms that cause long-term feelings of rage, anger, and stress

Cognition and mood symptoms - symptoms that impact an individual's ability to think, reason, apply logic, and perceive reality that are not related to injury or substance use

Bladder dysfunction - the inability to control the release of urine

Urinary incontinence - a loss of bladder control that may vary from a slight loss of urine control to complete inability to control urination

Daytime wetting - the loss of bladder control during awake hours

Laughter incontinence - a leakage of urine while an individual is laughing

Bowel dysfunction - the inability to control bowel movements

Self-esteem - an individual's subjective evaluation of his or her own value or worth

Social isolation - a lack of social connections they may impact an individual's health and quality of life

Suicide attempt - a non-fatal self-directed and potentially injurious behavior with any intent to die as a result of the behavior

Suicide - a death caused by injuring oneself with the intent to die

Preschool-aged children - individuals aged three through five years

Hand hygiene - the process of cleaning hands in order to prevent contamination and/or infections

Height and weight diary - a document or book that may be used to chronicle/record a child's height and weight

Medication reconciliation - a process of comparing the medications an individual is taking (or should be taking) with newly ordered medications (Joint Commission, 2022)

Section 2 Personal Reflection Question

How can health care professionals use the above recommendations to safely and effectively assess, diagnose, determine a prognosis, and manage/treat SCIs in pediatric patients?

Conclusion

Health care professionals can effectively care for pediatric patients suffering from a head and/or spinal cord injury by possessing insight into head and spinal cord injuries. With that in mind, health care professionals should work to identify patients suffering from a head and/or spinal cord injury. Finally, health care professionals should follow recommendations for the assessment, diagnosis, prognosis, and management/ treatment of head injuries and spinal cord injuries in pediatric patients in order to optimize patient care.

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