

Facts for Physicians



Heads Up

Facts for Physicians About
Mild Traumatic Brain Injury
(MTBI)

Physicians can play a key role in helping to prevent mild traumatic brain injury (MTBI or concussion) and in appropriately identifying, diagnosing, and managing it when it does occur. Physicians can also improve patient outcomes when MTBI is suspected or diagnosed by implementing early management and appropriate referral. MTBI symptoms may appear mild, but can lead to significant, life-long impairment affecting an individual's ability to function physically, cognitively, and psychologically. Appropriate diagnosis, referral, and patient and family/caregiver education are critical for helping patients with MTBI achieve optimal recovery and to reduce or avoid significant sequelae.

This tool kit was developed to provide physicians with a more individualized assessment of MTBI and to help guide the management and recovery of patients with MTBI.

Definition of Mild Traumatic Brain Injury (MTBI)

The term mild traumatic brain injury (MTBI) is used interchangeably with the term concussion. An MTBI or concussion is defined as a complex patho-physiologic process affecting the brain, induced by traumatic biomechanical forces secondary to direct or indirect forces to the head. MTBI is caused by a blow or jolt to the head that disrupts the function of the brain. This disturbance of brain function is typically associated with normal structural neuroimaging findings (i.e., CT scan, MRI). MTBI results in a constellation of physical, cognitive, emotional and/or sleep-related symptoms and may or may not involve a loss of consciousness (LOC). Duration of symptoms is highly variable and may last from several minutes to days, weeks, months, or even longer in some cases.^{1,2}

Magnitude of MTBI

- An estimated 75%-90% of the 1.4 million traumatic brain injury (TBI)-related deaths, hospitalizations, and emergency department visits that occur each year are concussions or other forms of MTBI.³⁻⁶
- Approximately 1.6 - 3.8 million sports- and recreation-related TBIs occur in the United States each year.⁷ Most of these are MTBIs that are not treated in a hospital or emergency department.

This tool kit includes:

- A patient assessment tool, titled "Acute Concussion Evaluation;"
- An information sheet for patients who recently sustained a concussion, titled "Acute Concussion Evaluation Care Plan;"
- A palm card with information about the on-field management of concussion, titled "Concussion in Sports;"
- A general fact sheet for patients, titled, "Heads Up: Preventing Concussion;" and
- A CD-ROM with downloadable tool kit materials and additional resources.

- Blasts are an important cause of MTBI among military personnel in war zones.⁸
- Direct medical costs and indirect costs such as lost productivity from MTBI totaled an estimated \$12 billion in the United States in 2000.⁹
- Individuals with a history of concussion are at an increased risk of sustaining a subsequent concussion.¹⁰
- Duration of symptoms is highly variable and may last from several minutes to days, weeks, months, or even longer in some cases. Research shows that recovery time may be longer for children and adolescents.^{11,12}
- Symptoms or deficits that continue beyond three months may be a sign of post-concussion syndrome.¹³ (See page 4 for a list of common signs and symptoms of MTBI.)
- With proper diagnosis and management, most patients with MTBI recover fully.^{14,15}

Leading causes of MTBI (seen in emergency departments)¹⁶

- Falls;
- Motor vehicle trauma;
- Unintentionally struck by/against events;
- Assaults; and
- Sports.

Groups at highest risk for MTBI¹⁶

- Infants and children (ages 0 to 4);
- Children and young adults (ages 5 to 24); and
- Older adults (ages 75 or older).

Neuropathophysiology of MTBI

Unlike more severe TBIs, the disturbance of brain function from MTBI is related more to dysfunction of brain metabolism rather than to structural injury or damage. The current understanding of the underlying pathology of MTBI involves a paradigm shift away from a focus on anatomic damage to an emphasis on neuronal dysfunction involving a complex cascade of ionic, metabolic and physiologic events. Clinical signs and symptoms of MTBI such as poor memory, speed of processing, fatigue, and dizziness result from this underlying neurometabolic cascade.¹⁷

The CD-ROM included in this tool kit contains more information about the neuropathophysiology of MTBI, downloadable kit materials, and additional MTBI-related research articles and resources.

Signs and Symptoms

Signs and symptoms of MTBI generally fall into four categories: physical, cognitive, emotional, and sleep, and may include:

Physical	Cognitive	Emotional	Sleep
<ul style="list-style-type: none"> • Headache • Nausea • Vomiting • Balance problems • Dizziness • Visual problems • Fatigue • Sensitivity to light • Sensitivity to noise • Numbness/ Tingling • Dazed or stunned 	<ul style="list-style-type: none"> • Feeling mentally “foggy” • Feeling slowed down • Difficulty concentrating • Difficulty remembering • Forgetful of recent information or conversations • Confused about recent events • Answers questions slowly • Repeats questions 	<ul style="list-style-type: none"> • Irritability • Sadness • More emotional • Nervousness 	<ul style="list-style-type: none"> • Drowsiness • Sleeping less than usual • Sleeping more than usual • Trouble falling asleep

Diagnosis

Diagnosing MTBIs can be challenging as symptoms of MTBI are common to those of other medical conditions (such as post-traumatic stress disorder [PTSD], depression, and headache syndromes), and the onset and/or recognition of symptoms may occur days or weeks after the initial injury.^{14,18}

A systematic assessment of the injury and its manifestations is essential to proper management and reduced morbidity. The Acute Concussion Evaluation (ACE) form included in this tool kit was developed to provide physicians with an evidence-based protocol to conduct an initial evaluation and diagnosis of patients (both children and

MTBI is an important concern among military personnel returning from war zones. Symptoms of MTBI may be missed or may not be noticed until after they have returned home. The identification and management of MTBI in these patients may also be complicated by the presence of PTSD.

For more information about TBI in returning military personnel, please see the paper titled, “Mild Traumatic Brain Injury: Military Considerations,” included on the CD-ROM and/or visit the Defense and Veterans Brain Injury Center’s Website at: www.dvbic.org.

adults) with known or suspected MTBI. The research evidence documenting the importance of these components in the evaluation of an MTBI is provided in the reference list (see page 23). The ACE can also be used serially to track symptom recovery over time. It provides a systematic protocol for assessing the key components for diagnosing an MTBI and serves as the basis for management and referral recommendations provided by the ACE Care Plan (two versions). These tools were developed to provide physicians with a more individualized assessment of MTBI and to help guide the management and recovery, as well as the referral of patients with such injuries.

The ACE contains three major components that require evaluation:

- Characteristics of the injury;
- Types and severity of the symptoms; and
- Risk factors that can lead to a protracted period of recovery.

The ACE should be administered to patients for whom concussion is clearly indicated (e.g., loss of consciousness or change in mental status, confusion or amnesia) and to those for whom concussion should be suspected (e.g., other traumatic injuries are observed or reported; forcible blow to the head with functional changes).



For example, concussions are

often not recognized among children with orthopedic injuries. Physicians should consider screening for possible concussion among patients with various other types of injuries such as:

- High-speed activities (motor vehicle crashes, bicycle riding, skateboarding)
- Sports and recreation activities
- Falls (including those among older adults), especially from a significant distance (e.g., off a ladder, from a tree)
- Suspected child maltreatment (e.g., shaking, hitting, throwing)
- Exposure to blasts (includes military personnel returning from war zones)
- Injuries to the external parts of the head and/or scalp (e.g., lacerations)


The following summarizes the information contained on the ACE and outlines steps for diagnosing a patient with a known or suspected MTBI. Detailed instructions about how to use the ACE are provided on the back page of the form.

A. Injury Characteristics

1. **Injury Description.** Ask the patient (and/or parent, if child) about how the injury occurred, type of force, and location on the head or body where the force (blow) was received. Different biomechanics of injury may result in varied symptom patterns. For example, an injury that occurs to the posterior aspect of the head may result in visual changes, balance problems, and fatigue. The force to the head may be indirect, such as with an individual being struck in the body resulting in the head accelerating forward and then backward quickly (e.g., whiplash).
2. **Cause.** The cause of the injury may also help to estimate the force of the hit or blow the patient sustained. The greater the force associated with the injury, the more likely the patient will present with more severe symptoms. Conversely, significant symptoms associated with a relatively light force might indicate an increased vulnerability to MTBI (especially among patients with a history of multiple MTBIs or pre-existing history of migraine) or the presence of other physical or psychological factors contributing to symptom exacerbation.
3. **Amnesia (Retrograde).** Determine whether amnesia (memory loss) has occurred for events *before* the injury and attempt to determine the length of time of memory dysfunction. Research indicates that even seconds of amnesia may predict more serious injury.¹⁹
4. **Amnesia (Anterograde).** Determine whether amnesia has occurred for events *after* the injury and attempt to determine the length of time of memory dysfunction. Anterograde amnesia is also referred to as post-traumatic amnesia (PTA).
5. **Loss of Consciousness (LOC).** Inquire whether LOC occurred or was observed and the length of time the patient lost consciousness. (Note: Research indicates that up to 90% of concussions do not involve LOC.)^{19,20}
6. **Early Signs Observed by Others.** Ask those who know the patient (parent, spouse, friend, etc) about specific signs of the MTBI that they may have observed. These signs are typically observed early after the injury. Record their presence or absence with a checkmark.
7. **Seizures.** Inquire whether seizures were observed (although this is uncommon).

B. Symptom Check List

Record the presence and severity of physical, cognitive, emotional, and sleep symptoms and the early signs since the injury.

- 1. Signs and Symptoms.** Use the ACE to record symptoms reported by the patient (and/or parent, if child) in each of the four symptom areas (physical, cognitive, emotional, and sleep). Determine if each symptom is present. If not present, circle “0” for No. If symptom is present (within the past 24 hours), circle “1” for Yes. Since symptoms can be present prior to the injury (e.g., inattention, headaches), it is important to assess *any changes* from usual symptom presentation.^{19,21} Sum the total number of symptoms for each of the four symptom areas and for the Total Symptom Score. Any Total Symptom Score greater than “0” indicates a positive symptom profile. (Note: any presentation of lingering and/or persistent symptoms associated with MTBI indicates incomplete recovery and prudent management is indicated, especially pertaining to activities such as work, school, and sports.)

- 2. Exertion.** Inquire whether any symptoms worsen with exertion, that is, with physical activity (e.g., running, climbing stairs, bike riding) and/or cognitive activity (e.g., academic studies, multi-tasking at work, reading or other tasks requiring focused concentration). Physicians should be aware that symptoms will typically worsen or re-emerge with exertion, indicating incomplete recovery, which may also be protracted with over-exertion.
- 3. Overall “Difference” Rating.** Obtain an overall rating from the patient (and/or parent, if child) regarding their overall perceived change from their pre-injury self. This rating is helpful in summarizing the overall impact of the symptoms. Use the 7 point scale with “0” reflecting no change from normal, to “6” reflecting a major change.

C. Signs of Deteriorating Neurological Function

It is important to assess whether the patient with an MTBI exhibits any signs or reports any symptoms that would indicate deteriorating neurological functioning. Patients should be carefully observed over the first 24-48 hours for the serious signs listed below.²² If any of these signs are reported, they should be referred to an emergency department for an immediate medical evaluation.

- Headaches that worsen
- Seizures
- Focal neurologic signs
- Looks very drowsy or can't be awakened
- Repeated vomiting
- Slurred speech
- Can't recognize people or places
- Increasing confusion or irritability
- Weakness or numbness in arms or legs
- Neck pain
- Unusual behavior change
- Significant irritability
- Any loss of consciousness greater than 30 seconds or longer.
(*Brief loss of consciousness (under 30 seconds) should be taken seriously and the patient should be carefully monitored.*)

D. Identify Risk Factors that may Complicate the Recovery Process

Each of the factors below have been identified through empirical research to be associated with a longer period of recovery from an MTBI. Identifying any of these factors is helpful for understanding the nature and extent of the patient's injury and for monitoring their recovery.

1. Concussion (or MTBI) History.

Assess the number and date(s) of prior concussions and the duration of symptoms for each injury. The effects of multiple MTBIs may be cumulative, especially if there is minimal duration of time between injuries and less biomechanical

force results in subsequent MTBI (which may indicate incomplete recovery from the initial trauma).^{10,21-26}

2. Headache History.

Assess prior personal and/or family history of diagnosis and treatment for headaches. Headaches (migraines in particular) can result in protracted recovery from MTBI.²⁷⁻²⁹



3. **Developmental History.** Assess for a history of learning disabilities, Attention-Deficit/Hyperactivity Disorder or other developmental disorders. Recovery may take longer in patients with these conditions.³⁰
4. **Psychiatric History.** Assess for history of depression/mood disorder, anxiety, and/or sleep disorder.³¹⁻³³

E. Establishing the Diagnosis

Following the above assessment, the diagnosis of concussion or MTBI using the following ICD-9-CM codes may be applicable:

- **850.0 (Concussion, with no loss of consciousness)** - Positive injury description with evidence of a direct or indirect forcible blow to the head, plus evidence of active symptoms and/or signs of any type and number related to the trauma; no evidence of LOC, skull fracture, internal bleed (i.e., intracranial injury).
- **850.1 (Concussion, with brief loss of consciousness < 1 hour)** - Positive injury description with evidence of a direct or indirect forcible blow to the head, plus evidence of active symptoms and/or signs of any type and number related to the trauma; positive evidence of LOC; no skull fracture, internal bleed.
- **850.9 (Concussion, unspecified)** - Positive injury description with evidence of a direct or indirect forcible blow to the head, plus evidence of active symptoms and/or signs of any type and number related to the trauma; unclear or unknown injury details and unclear evidence of LOC; no skull fracture, internal bleed.



If there is evidence of prolonged LOC (>1 hour), skull fracture, and/or intracranial injury, the diagnosis of 854 should be considered (consult the ICD-9-CM manual for detailed codes). Use of ICD-9-CM **959.01 Head injury, unspecified** is not recommended for concussion/MTBI, as it excludes the above concussion diagnoses and is non-specific.

Infants, Toddlers and Preschool Children

Very young children (i.e. infants, toddlers, and preschoolers) frequently sustain bumps and bruises to their heads from a host of mechanisms including falls (down stairs or from heights such as counter tops or beds), direct impacts (e.g. getting hit in the head with a ball), motor vehicle crashes, tricycle/bike accidents or child abuse.

Sometimes these events can be significant enough to result in a concussion.

Deciding whether a child who has hit his or her head needs an immediate assessment to determine whether he or she has had a concussion can be difficult, as young children may have the same symptoms of a concussion as older children, but do not express them in the same way. For example, young children cannot explain a feeling of nausea or amnesia or even describe where they hurt. Physicians should therefore keep this in mind when they ask parents about the presence of the symptoms listed below and have a low threshold for referring a child for immediate evaluation. Primary care physicians (PCPs) should ask caregivers about all “bumps on the head” and should consider referring a child with a “bump on the head” to the emergency department if they suspect a concussion but are unsure about the symptoms.

Acute signs and symptoms of a concussion:

- Vomiting
- Headache
- Crying and inability to be consoled
- Restlessness or irritability
- Seizures
- Dizziness or confusion
- Change in personality

Follow-up in Young Children who have Sustained Concussions

All children with concussion or suspected concussion should be followed closely by their PCP. A follow-up visit with the PCP after the event can offer the opportunity for families to ask questions and for the PCP to assess the child for ongoing symptoms.

Although diagnosing post-concussion syndrome in young children is difficult, it is important to assess for these symptoms in order to determine whether children need further evaluation. The follow-up visit can also provide an important opportunity for discussion of age-appropriate injury prevention which is important to minimize the possibility of subsequent concussions. Infants and young children less than 3 years of age who have had a concussion can have their development tracked by their county’s developmental program for young children; this is particularly important for children who have sustained a complicated concussion (i.e., with contusions or hemorrhage apparent on imaging), those who have had multiple concussions and/or those with underlying neurologic disease.

Persistent signs and symptoms to assess for during follow-up:

- Excessive crying
- Persistent headache
- Poor attention
- Change in sleep patterns
- Change in nursing or eating habits
- Becoming upset easily or increased temper tantrums
- Sad or lethargic mood
- Lack of interest in favorite toys

Children who display these symptoms for more than several weeks after a concussion may require further assessment and/or evaluation by a neuropsychologist, neurologist, or other specialist.

Abusive TBI

Young children may also sustain mild to severe TBIs from abuse.

- Approximately 1,400 cases of abusive TBI (including concussions) occur in the U.S. each year.³⁵
- Injuries resulting from abusive TBI and other types of child maltreatment are often unrecognized or underreported.³⁵
- Recognition of abusive TBI in young children is critical. If children are returned to a violent home, they are at very high risk of being hurt again or killed.
- In any young child with injury to the head, it is imperative to assess whether the history provided for the injury is developmentally appropriate for a child that age. If not, it is important to consider child abuse in the differential diagnosis.
- In some cases of abuse, caretakers do not report a history of any trauma either because (a) they do not know that there has been trauma because it is being inflicted by someone else without their knowledge or (b) because they don’t want to tell. *As a result, if an infant or young child presents with the signs and symptoms listed above, it is important to consider the possibility of abusive TBI even in the absence of a history of trauma.*

Clinical Management

The first step to improving outcomes for patients with MTBI is to determine a plan of action for follow-up. Based on the findings of an evaluation, such as that provided by the ACE, the physician may decide to:

1. Monitor the Patient in the Office.

Office monitoring is particularly appropriate if the number and severity of symptoms are steadily decreasing over time and/or fully resolve within 3 to 5 days. However, if symptoms have not fully abated in this time period, or remain steady or worsen, referral to an MTBI specialist may be warranted.

2. Make a Referral to an MTBI Specialist.

Referral to a specialist who cares for patients with MTBI is appropriate if symptom reduction is not evident within 3 to 5 days post injury, or sooner, and if the type or severity of symptoms is of concern. Referral to a specialist can be particularly valuable to further evaluate the patient's complex presentation and to help manage certain aspects of their condition (e.g., return to sports, school, and work). (Information about specific TBI specialists in a particular area is often available through state or national brain injury associations.)

3. Refer the Patient for Diagnostic Testing.

During the acute phase, diagnostic tests may include neuroimaging (such as a CT or MRI scan) or neuropsychological testing.³⁴ Neuropsychological tests, which involve performance of specific cognitive tasks, can be helpful for confirming self-reported symptoms and tracking recovery. They assess a range of abilities such as memory, concentration, information processing, executive function, and reaction time.³⁴ Brief (approx. 25 minutes) and recently validated computerized test batteries and/or abbreviated traditional (paper and pencil) test batteries may be most practical and informative during this early phase.



Neuropsychological tests may also be helpful for determining the appropriate timing for return to safe sports participation, school, or work. Any indication or suspicion of neurologic deterioration should prompt strong consideration for referral to emergency medical evaluation and/or neuroimaging to rule out intracranial bleed or other structural pathology.

For patients with persisting symptoms, more extensive neuropsychological and neurobehavioral test batteries can be useful for identifying specific deficits and needed supports for return to daily activities, school, or work.

Management Approaches

Physicians should complete the appropriate ACE Care Plan included in this tool kit and a copy of the plan should be provided to the patient.

It is critical for the physician to guide the patient in their recovery with an active management plan based on their current symptom presentation. Careful management can facilitate recovery and prevent further injury. The two ACE Care Plans included in this tool kit are based on current research and clinical experience and were developed to help physicians actively manage patients with known or suspected MTBI.

Rest and Careful Management of Physical and Cognitive Exertion are the Keys to Recovery

Patients must not return to high risk activities (e.g., sports, physical education (PE), high speed activity (riding a bicycle or carnival rides), if **any** post-concussion symptoms are present or if results from cognitive testing show persistent deficits. When symptoms are no longer reported or experienced, a patient may slowly, gradually, and carefully return to their daily activities (both physical and cognitive). Children and adolescents will need the help of their parents, teachers, coaches, athletic trainers, etc. to monitor and assist with their recovery. Management planning should involve all aspects of the patient's life including home life, school, work, and social-recreational activities.

Returning to Daily Home/Community Activities

Increased rest and limited exertion are important to facilitate the patient's recovery. Physicians should be cautious about allowing patients to return to driving, especially if the patient has problems with attention, processing speed, or reaction time. Patients should also be advised to get adequate sleep at night and to take daytime naps or rest breaks when significant fatigue is experienced. Symptoms typically worsen or re-emerge with exertion. Let any return of a patient's symptoms be the guide to the level of exertion or activity that is safe.

Patients should limit both physical and cognitive exertion accordingly.

- Physical activity includes PE, sports practices, weight-training, running, exercising, heavy lifting, etc.
- Cognitive activity includes heavy concentration or focus, memory, reasoning, reading or writing (e.g., homework, classwork, job-related mental activity)

As symptoms decrease, or as cognitive test results show improvement, patients may return to their regular activities gradually. However, the patient's overall status should continue to be monitored closely.

Returning to School

Symptomatic students may require active supports and accommodations in school, which may be gradually decreased as their functioning improves. Inform the student's teacher(s), the school nurse, psychologist/counselor, and administrator of the student's injury, symptoms, and cognitive deficits. Students with temporary yet prolonged symptoms (i.e. longer than several weeks) or permanent disability may benefit from referral for special accommodations and services, such as those provided under a Section 504 Plan.

Section 504 Plans:

Section 504 Plans are implemented when students have a disability (temporary or permanent) that affects their performance in any manner. Services and accommodations for students may include environmental, curriculum, methodology, organizational, behavioral, and presentation strategies.

School personnel should be advised to monitor the student for the following signs:

- Increased problems paying attention/concentrating
- Increased problems remembering/learning new information
- Longer time required to complete tasks
- Increased symptoms (e.g., headache, fatigue) during schoolwork
- Greater irritability, less tolerance for stressors

Until a full recovery is achieved, students may need the following supports:

- Time off from school
- Shortened day
- Shortened classes (i.e., rest breaks during classes)
- Rest breaks during the day
- Allowances for extended time to complete coursework/assignments and tests
- Reduced homework/classwork load (it is best to specify for teachers the percent of workload that the student can reasonably handle, e.g., 50% homework load)
- No significant classroom or standardized testing at this time

Physicians and school personnel should monitor the student's symptoms with cognitive exertion (mental effort such as concentration, studying) to evaluate the need and length of time supports should be provided.

Returning to Play (Sports and Recreation)

Guiding the recovery of individuals of any age with MTBI who participate in competitive or recreational activities requires careful management to avoid re-injury or prolonged recovery. Athletes engaged in collision sports require special management and evaluation to ensure full recovery prior to their return to play.

An individual should never return to competitive sporting or recreational activities while experiencing any lingering or persisting MTBI symptoms. This includes PE class, sports practices and games, and other high-risk/high-exertion activities such as running, bike riding, skateboarding, climbing trees, jumping from heights, playful wrestling, etc. The individual should be completely symptom free at rest and with physical exertion (e.g., sprints, non-contact aerobic activity) and cognitive exertion (e.g., studying, schoolwork) prior to return to sports or recreational activities.

Along with parent and teacher observation for continuing signs or symptoms of concussion,

objective data in the form of formal neuropsychological testing may provide valuable information to assist with return to play decisions in younger athletes, as their symptom reporting may be more limited and less reliable. Formal neuropsychological testing of competitive athletes may also help physicians with return to play decisions, as athletes may minimize their symptoms to facilitate return to play.¹

It is important to inform the athlete's coach, PE teacher, and/or athletic trainer that the athlete should not return to play until they are symptom-free and their cognitive function has returned to normal, both at rest and with exertion.

Return to play should occur gradually. Individuals should be monitored for symptoms and cognitive function carefully during each stage of increased exertion. Patients should only progress to the next level of exertion if they



are asymptomatic at the current level. In competitive sports, a specific return to play protocol outlining gradual increase in activity has been established by the Concussion in Sport Group:¹

- Rest
- Aerobic exercise (e.g., stationary bicycle)
- Sport-specific training (e.g., running, skating)
- Non-contact drills (includes cutting and other lateral movements)
- Full contact *controlled* training
- Full contact game play

Returning to Work

Return-to-work planning should be based upon careful evaluation of symptoms and neurocognitive status. To help expedite recovery from MTBI, patients may initially need to reduce both physical and cognitive exertion. Rest is key. Restricting work during initial stages of recovery may be indicated to help facilitate recovery. Repeated evaluation of both symptoms and cognitive status is recommended to help guide management considerations.



Until a full recovery is achieved, patients may need the following supports:

Schedule Considerations

- Shortened work day (e.g. 8am-12pm)
- Allow for breaks when symptoms increase
- Reduced task assignments and responsibilities

Safety Considerations

- No driving
- No heavy lifting/No working with machinery
- No heights due to risk of dizziness, balance problems

Primary Prevention

As part of preventive care, physicians can provide information to patients, families, and caregivers about behaviors and activities that increase the risk of MTBI/concussion. Recommendations for preventing MTBI include those listed below. These tips are also available on the patient information sheet, “Heads Up: Preventing Concussion,” contained in this tool kit. This information sheet can be placed in a waiting room or in other locations for patients.

To reduce the risk of sustaining a concussion or a more serious TBI, patients should be advised to:

- Wear a seat belt every time they drive or ride in a motor vehicle.
- Buckle their child in the car using a child safety seat, booster seat, or seat belt (according to the child’s height, weight, and age).
 - Children should start using a booster seat when they outgrow their child safety seats (usually when they weigh about 40 pounds). They should continue to ride in a booster seat until the lap/shoulder belts in the car fit properly, typically when they are approximately 4’9” tall.³⁶
- Never drive while under the influence of alcohol or drugs.
- Wear a helmet and make sure their children wear helmets that are fitted and maintained properly when:
 - Riding a bike, motorcycle, snowmobile, scooter, or all-terrain vehicle;
 - Playing a contact sport, such as football, ice hockey, lacrosse, or boxing;
 - Using in-line skates or riding a skateboard;
 - Batting and running bases in baseball or softball;
 - Riding a horse; or
 - Skiing, sledding, or snowboarding.
- Ensure that during athletic games and practices that they and/or their children:
 - Use the right protective equipment (should be fitted and maintained properly in order to provide the expected protection);



For more information, refer to the “Concussion in Sports” palm card included in this tool kit.

- Follow the safety rules and those for the sport;
- Practice good sportsmanship; and
- Do not return to play with a known or suspected concussion until evaluated and given permission by an appropriate health care professional.

■ Make living areas safer for seniors by:

- Removing tripping hazards such as throw rugs and clutter in walkways;
- Using nonslip mats in the bathtub and on shower floors;
- Installing grab bars next to the toilet and in the tub or shower;
- Installing handrails on both sides of stairways;
- Improving lighting throughout the home; and
- Maintaining a regular physical activity program, if their health care provider agrees, to improve lower body strength and balance.³⁷⁻⁴⁰



Researchers have identified that improving lower body strength helps to decrease the risk of falls among seniors.

■ Make living areas safer for children by:

- Installing window guards to keep young children from falling out of open windows;
- Using safety gates at the top and bottom of stairs when young children are around;
- Keeping stairs clear of clutter;
- Securing rugs and using rubber mats in bathtubs; and
- Not allowing children to play on fire escapes or on other unsafe platforms.

■ Make sure playground surfaces are made of shock-absorbing material, such as hardwood mulch or sand, and are maintained to an appropriate depth.^{41,42}

Improving Communication with Patients with MTBI

Patients with MTBI, particularly during the early post-injury phase, may have difficulties communicating with a physician. Obtaining an accurate report from the patient about the injury and its symptoms with tools such as the ACE is critical to proper management. The following provides a summary of types of communication problems related to expression and comprehension that individuals with MTBI may experience, and what physicians can do to improve communication with their patients.

Problem Area	Problem Description	What Physicians Can Do
Expression	<ul style="list-style-type: none"> • May have trouble thinking of specific words (word-finding problems) or expressing the specifics of their symptoms or functional difficulties 	<ul style="list-style-type: none"> • Allow patients time to express themselves • Ask questions about specific symptoms and problems (i.e., are you having headaches?)
Comprehension	<p>Spoken:</p> <ul style="list-style-type: none"> • May become confused if too much information is presented at once or too quickly • May need extra time to understand what others are saying • May have trouble following complex multi-step directions • May take longer than expected to respond to a question <p>Written:</p> <ul style="list-style-type: none"> • May read slowly • May have trouble reading material in complex formats or with small print • May have trouble filling out forms 	<ul style="list-style-type: none"> • Speak slowly and clearly • Use short sentences • Repeat complex sentences when necessary • Allow time for patients to comprehend • Provide both spoken and written instructions and directions <ul style="list-style-type: none"> • Allow patients extra time to read and complete forms • Provide written material in simple formats and large print when possible • Have someone read the items and fill out the forms for patients who are having trouble

In addition to the communications problems listed above, it is also important to note that patients may be sensitive to environmental stimuli. In particular, they may become disoriented or confused when exposed to:

- Bright lights;
- Complex visual stimuli such as busy carpet patterns; and/or
- Noise, including from radio or TV.

To address this, physicians should consider offering patients access to a quiet, low-stimulation waiting area if needed.



References


1. Aubry M, et al. Summary and agreement statement of the first International Conference on Concussion in Sport, Vienna 2001. *Clinical Journal of Sports Medicine* 2002 Jan;12(1):6-11.
2. McCrory P, et al. Summary and agreement statement of the second International Conference on Concussion in Sport, Prague 2004. *British Journal of Sports Medicine* 2005;39:196-204.
3. Centers for Disease Control and Prevention (CDC), National Center for Injury Prevention and Control. Report to Congress on mild traumatic brain injury in the United States: steps to prevent a serious public health problem. Atlanta (GA): Centers for Disease Control and Prevention; 2003.
4. Kraus JF, Nourjah P. The epidemiology of mild, uncomplicated brain injury. *Journal of Trauma* 1988;28(12):1637-43.
5. Luerssen TG, Klauber MR, Marshall LF. Outcome from head injury related to patient's age: A longitudinal prospective study of adult and pediatric head injury. *Journal of Neurosurgery* 1988;68(3):409-16.
6. Lescohier I, DiScala C. Blunt trauma in children: causes and outcomes of head versus intracranial injury. *Pediatrics* 1993;91(4):721-5.
7. Langlois JA, Rutland-Brown W, Wald M. The epidemiology and impact of traumatic brain injury: a brief overview. *Journal of Head Trauma Rehabilitation* 2006;21(5):375-8.
8. Warden D. Military TBI During the Iraq and Afghanistan Wars. *Journal of Head Trauma and Rehabilitation* 2006;21(5):398-402.
9. Finkelstein E, Corso P, Miller T and associates. The Incidence and Economic Burden of Injuries in the United States. New York (NY): Oxford University Press; 2006.
10. Guskiewicz K, et al. Cumulative effects associated with recurrent concussion in collegiate football players: the NCAA Concussion Study. *JAMA* 2003;290(19):2549-55.
11. Field M, Collins M, Lovell M, Maroon J. Does age play a role in recovery from sports-related concussion? A comparison of high school and collegiate athletes. *The Journal of Pediatrics* 2003;142(5):546-53.
12. Pellman EJ, Lovell MR, Viano DC, Casson IR. Concussion in professional football: recovery of NFL and high school athletes assessed by computerized neuropsychological testing—Part 12. *Neurosurgery* 2006;58(2):263-74;discussion 263-74.
13. Kashluba S, Casey JE, Paniak C. Evaluating the utility of ICD-10 diagnostic criteria for postconcussion syndrome following mild traumatic brain injury. *Journal of the International Neuropsychological Society* 2006;12(1):111-8.
14. Kushner DS. Mild traumatic brain injury: toward understanding manifestations and treatment. *Archives of Internal Medicine* 1998;158(15):1617-24.
15. Alexander MP. Mild traumatic brain injury: pathophysiology, natural history, and clinical management. *Neurology* 1995;45:1253-60.
16. Bazarian J, et al. Mild traumatic brain injury in the United States, 1998-2000. *Brain Injury* 2005;19(2):85-91.
17. Giza C, Hovda D. The neurometabolic cascade of concussion. *Journal of Athletic Training* 2001;36(3):228-235.

18. Centers for Disease Control and Prevention, Advisory Group, Mild Traumatic Brain Injury Tool Kit. Meeting summary [unpublished]. Atlanta, GA: CDC. 2001.
19. Collins MW, Iverson G, Lovell MR, McKeag DB, Norwig J, Maroon J. On-field predictors of neuropsychological and symptom deficit following sports-related concussion. *Clinical Journal of Sport Medicine* 2003;13(4):222-9.
20. Schultz MR, et al. Incidence and risk factors for concussion in high school athletes, North Carolina, 1996-1999. *American Journal of Epidemiology* 2004;160(10):937-944.
21. Collins MW, Lovell MR, Iverson G, Cantu R, Maroon J, Field M. Cumulative effects of concussion in high school athletes. *Neurosurgery* 2002;51:1175-181.
22. Fung M, Willer B, Moreland D, Leddy J. A proposal for an evidence-based emergency department discharge form for mild traumatic brain injury. *Brain Injury* 2006;20(9):889-94.
23. Lovell MR, Collins MW, Bradley J. Return to play following sports related concussion. *Clinics in Sports Medicine* 2004;23(3):421-443.
24. Iverson G, Gaetz M, Lovell MR, Collins MW. Cumulative effects of concussion in amateur athletes. *Brain Injury* 2004;18(5):433-43.
25. Collins MW, Field M, Lovell MR, Iverson GL, Johnston K, Maroon J, Fu F. Relationship between post-concussion headache and neuropsychological test performance in high school athletes. *American Journal of Sports Medicine* 2003;31:168-173.
26. Bellanger HG, Vanderploeg RD. The neuropsychological impact of sports-related concussion: a meta-analysis. *Journal of the International Neuropsychological Society* 2005;11(4):345-57.
27. Mihalik J, Stump J, Collins MW, Lovell MR, Field M, Maroon J. Posttraumatic migraine characteristics in athletes following sports-related concussion. *Journal of Neurosurgery* 2005;102(5):850-5.
28. Collins MW, Field M, Lovell MR, Iverson G, Johnston KM, Maroon J, Fu FH. Headache following sports-related concussion: To play or not to play. *American Journal of Sports Medicine* 2003;31(2):168-173.
29. deKruijk J, Leffers P, Menheere P, Meerhoff S, Rutten J, Twijnstra A. Prediction of post-traumatic complaints after mild traumatic brain injury: Early symptoms and biochemical markers. *Journal of Neurology, Neurosurgery, and Psychiatry* 2002;73(6):727-32.
30. Collins MW, et al. Relationship between concussion and neuropsychological performance in college football players. *JAMA* 1999;282(10):964-970.
31. Moore EL, Terryberry-Spohr L, Hope DA. Mild traumatic brain injury and anxiety sequelae: a review of the literature. *Brain Injury* 2006;20(2):117-32.
32. Mooney G, Speed J, Sheppard S. Factors related to recovery after mild traumatic brain injury. *Brain Injury* 2005;19(12):975-87.
33. Mather FJ, Tate RL, Hannan TJ. Post-traumatic stress disorder in children following road traffic accidents: A comparison of those with and without mild traumatic brain injury. *Brain Injury*;17(12):1077-87.
34. Bazarjian J, Blyth B, Cimpello L. Bench to bedside: evidence for brain injury after concussion—looking beyond the computed tomography scan. *Academic Emergency Medicine* 2006;13(2):199-214.

35. Newton AW, Vandeven AM. Unexplained infant and child death: a review of Sudden Infant Death Syndrome, Sudden Unexplained Infant Death, and child maltreatment fatalities including shaken baby syndrome. *Current Opinion in Pediatrics* 2006;18:196-200.
36. Centers for Disease Control and Prevention. Warning on interaction between air bags and rear-facing child restraints. *MMWR* 1993;42(No.14):20-2.
37. Judge JO, Lindsey C, Underwood M, Winsemius D. Balance improvements in older women: effects of exercise training. *Physical Therapy* 1993;73(4):254-65.
38. Lord SR, Caplan GA, Ward JA. Balance, reaction time, and muscle strength in exercising older women: a pilot study. *Archives of Physical Medicine and Rehabilitation* 1993;74(8):837-9.
39. Campbell AJ, Robertson MC, Gardner MM, Norton RN, Buchner DM. Falls prevention over 2 years: a randomized controlled trial in women 80 years and older. *Age and Aging* 1999;28:513-18.
40. Graafmans WC, Ooms ME, Hofstee HMA, Bezemer PD, Bouter LM, Lips P. Falls in the elderly: a prospective study of risk factors and risk profiles. *American Journal of Epidemiology* 1996;143:1129-36.
41. Mack MG, Sacks JJ, Thompson D. Testing the impact attenuation of loose fill playground surfaces. *Injury Prevention* 2000;6:141-4.
42. Consumer Product Safety Commission (US). Handbook on Public Playground Safety. Washington, DC; 1997.

References for the Acute Concussion Evaluation (ACE)

1. Collins MW, Iverson G, Lovell MR, McKeag DB, Norwig J, Maroon J. On-field predictors of neuropsychological and symptom deficit following sports-related concussion. *Clinical Journal of Sport Medicine* 2003;13(4):222-9.
2. Lovell MR, Collins MW. Neuropsychological assessment of the college football player. *Journal of Head Trauma Rehabilitation* 1998;13(2):9-26.
3. Schultz MR, et al. Incidence and risk factors for concussion in high school athletes, North Carolina, 1996-1999. *American Journal of Epidemiology* 2004;160(10):937-944.
4. Guskiewicz K, et al. Cumulative effects associated with recurrent concussion in collegiate football players: the NCAA Concussion Study. *JAMA* 2003;290(19):2549-55.
5. Collins MW, Lovell MR, Iverson G, Cantu R, Maroon J, Field M. Cumulative effects of concussion in high school athletes. *Neurosurgery* 2002;51:1175-181.
6. Lovell MR, Collins MW, Bradley J. Return to play following sports related concussion. *Clinics in Sports Medicine* 2004;23(3):421-443.
7. Iverson G, Gaetz M, Lovell MR, Collins MW. Cumulative effects of concussion in amateur athletes. *Brain Injury* 2004;18(5):433-43.
8. Collins MW, Field M, Lovell MR, Iverson GL, Johnston K, Maroon J, Fu F. Relationship between post-concussion headache and neuropsychological test performance in high school athletes. *American Journal of Sports Medicine* 2003;31:168-173.
9. Bellanger HG, Vanderploeg RD. The neuropsychological impact of sports-related concussion: A meta-analysis. *Journal of the International Neuropsychological Society* 2005;11(4):345-57.
10. Mihalik J, Stump J, Collins MW, Lovell MR, Field M, Maroon J. Posttraumatic migraine characteristics in athletes following sports-related concussion. *Journal of Neurosurgery* 2005;102(5):850-5.
11. Collins MW, Field M, Lovell MR, Iverson G, Johnston KM, Maroon J, Fu FH. Headache following sports-related concussion: To play or not to play. *American Journal of Sports Medicine* 2003;31(2):168-173.
12. deKruijk J, Leffers P, Menheere P, Meerhoff S, Rutten J, Twijnstra A. Prediction of post-traumatic complaints after mild traumatic brain injury: Early symptoms and biochemical markers. *Journal of Neurology, Neurosurgery, and Psychiatry* 2002;73(6):727-32.
13. Collins MW, et al. Relationship between concussion and neuropsychological performance in college football players. *JAMA* 1999;282(10):964-970.
14. Moore E, Terryberry-Spohr L, Hope D. Mild traumatic brain injury and anxiety sequelae: A review of the literature. *Brain Injury* 2006;20(2):117-32.
15. Mooney G, Speed J, Sheppard S. Factors related to recovery after mild traumatic brain injury. *Brain Injury* 2005;19(12):975-87.
16. Mather FJ, Tate RL, Hannan TJ. Post-traumatic stress disorder in children following road traffic accidents: a comparison of those with and without mild traumatic brain injury. *Brain Injury* 2003;17(12):1077-87.
17. Fung M, Willer B, Moreland D, Leddy J. A proposal for an evidence-based emergency department discharge form for mild traumatic brain injury. *Brain Injury* 2006;20(9):889-94.



The Centers for Disease Control and Prevention gratefully acknowledges the following organizations for their participation in this project:

- American Academy of Family Physicians
- American College of Emergency Physicians
- American College of Physicians
- American College of Sports Medicine
- American Medical Society for Sports Medicine
- American Osteopathic Association
- Brain Injury Association of America
- Children's National Medical Center
- Defense and Veterans Brain Injury Center
- Indian Health Service
- National Association of State Head Injury Administrators
- National Brain Injury Research Treatment and Training Foundation
- North American Brain Injury Society
- University of Pittsburgh Medical Center, Sports Concussion Program
- U.S. Health Resources and Services Administration, TBI Program