

# Concussion Management

*The Team Plan*

Joseph F. Waeckerle M.D., FACEP



# Concussion Management

## *The Team Plan*

**Joseph F. Waeckerle M.D., FACEP**

Clinical Professor of Emergency Medicine, University of Missouri at Kansas City School of Medicine

Editor Emeritus, Annals of Emergency Medicine

In Partnership with:

Missouri School Boards' Association

Brain Injury Association of Missouri

Missouri Department of Health and Senior Services



Support is provided in part by the Maternal and Child Health Bureau Title V,  
Social Security Act, Health Resources and Services Administration,  
Department of Health and Human Services.

Copyright 2013

Joseph F. Waeckerle

# Contents

|                                      |           |
|--------------------------------------|-----------|
| <b>I. EDUCATION</b>                  | <b>4</b>  |
| Definition of Concussion             |           |
| Mechanism of Injury                  |           |
| Predisposing Factors                 |           |
| Epidemiology                         |           |
| <b>II. A SENSIBLE STRATEGY</b>       | <b>7</b>  |
| Concussion Management: The Team Plan |           |
| Goals                                |           |
| Members                              |           |
| The Family Unit                      |           |
| The Athletic Unit                    |           |
| The Medical Unit                     |           |
| The School Unit                      |           |
| The Community Unit                   |           |
| Legislation                          |           |
| Responsibilities                     |           |
| <b>III. PREVENTION</b>               | <b>10</b> |
| Unit Responsibilities                |           |
| The Athletic Unit Role               |           |
| Buddy System                         |           |
| The School Unit Role                 |           |
| School Plan                          |           |
| Concussion Care Advocate             |           |
| <b>IV. RECOGNITION</b>               | <b>12</b> |
| Diagnosis                            |           |
| Risk Factors for Concussions         |           |
| Concussion Indicators                |           |
| Risk Factors for Prolonged Recovery  |           |
| Unit Responsibilities                |           |
| <b>V. EVALUATION</b>                 | <b>14</b> |
| Concussion Exam                      |           |
| Concussion Assessment Tool           |           |
| “Field of Play” Evaluation           |           |
| Sideline/Locker Room Evaluation      |           |

|  |           |
|--|-----------|
| Indicators of Potentially Severe Injury  |           |
| Home Care Instructions                   |           |
| Follow-up Medical Care                   |           |
| Unit Responsibilities                    |           |
| <b>VI. MANAGEMENT</b>                    | <b>19</b> |
| Principle of Rest                        |           |
| Symptoms                                 |           |
| Cognitive (Mental) Capability Testing    |           |
| Balance Testing                          |           |
| Medications                              |           |
| Unit Responsibilities                    |           |
| <b>VII. RECOVERY</b>                     | <b>23</b> |
| Objectives                               |           |
| Cognitive (Mental) Recovery              |           |
| Physical Recovery                        |           |
| Complete Recovery                        |           |
| <b>VIII. PROGNOSIS</b>                   | <b>26</b> |
| Post-Concussion Syndrome                 |           |
| Second Impact Syndrome                   |           |
| Long-Term Health Problems                |           |
| Chronic Traumatic Encephalopathy (CTE)   |           |
| Neurocognitive Impairment (NCI)          |           |
| <b>IX. CONCLUSIONS</b>                   | <b>27</b> |
| Selected References/Additional Resources | <b>29</b> |
| Selected General References              |           |
| Selected Specific References             |           |
| Additional Resources                     |           |
| <b>ACKNOWLEDGEMENTS</b>                  | <b>31</b> |

*There are many health benefits to participating in sports, but there are also risks. Concussions are one injury in sports that has come to the attention of most people.*

## ***Education: Know the problem!***

A concussion is a type of traumatic brain injury (TBI). Although it is a mild brain injury, it can cause problems if not cared for properly.

The Centers for Disease Control (CDC) defines concussion as “a type of traumatic brain injury, or TBI, caused by a bump, blow, or jolt to the head that can change the way your brain normally works. Concussions can also occur from a fall or a blow to the body that causes the head and brain to move quickly back and forth.”

Medical experts define a concussion as “a complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces.” (Consensus Statement on Concussion in Sport: The 3rd International Conference on Concussion in Sport [Zurich 2008]).

Recently, a group of concussion specialists considered all the available medical evidence on concussions and provided a more detailed definition. “Concussion is defined as a traumatically induced transient disturbance of brain function and involves a complex pathophysiological process. Concussion is a subset of mild traumatic brain injury (MTBI) which is generally self-limited and at the less-severe end of the brain injury spectrum.” (American Medical Society for Sports Medicine position statement: concussion in sport. *Br J Sports Med.* 2013;47:15-26.)

The last sentence puts the injury in proper perspective, as a vast majority of concussions resolve within a month. However, mild traumatic brain injuries including concussions rarely may progress to a more severe brain injury, even with proper medical care. This further emphasizes the need for quality medical care administered by a licensed healthcare provider trained in the evaluation and management of concussions as set forth by the Missouri State Interscholastic Youth Sports Brain Injury Prevention Act (2011).

*Football is a tough sport. I tell parents and kids all the time, “Football is not for everyone.” Football is not a comfort sport and in order to excel you are going to be dealing with soreness and discomfort all season long. The one injury a player should never “deal with” is a concussion. The long-term ramifications of concussions that aren’t treated properly can be life-changing and players, coaches, and parents need to understand that. Playing through it or toughing it out are not options.*

— **Trent Green**  
**All-Pro NFL Quarterback**

## **Mechanisms of Injury**

External forces, such as collisions between players or with the ground acting on the head or anywhere on the body, transfer damaging energy to the brain cells, resulting in immediate injury to those cells. This causes a breakdown of the cell structure and metabolism, and also impedes blood flow to the brain cells. The damage results in the cells no longer functioning correctly to maintain their baseline activities and/or to recover.

A concussion results in symptoms and signs that negatively affect the concussed student/athlete’s health and well-being for a period ranging from days to several weeks. Furthermore, during this recovery period, the brain is more vulnerable to subsequent injury—even from lesser force.

The vast majority of student/athletes will fully recover from a concussion. However, if a potential concussion is not recognized or managed properly, the student/athlete may be at risk of poor mental and physical performance, further brain injury, longer recovery time, and, potentially, death or long-term disabilities.

Additional information about concussions is available from a number of resources including Brain Injury Association of Missouri, Department of Health and Senior Services, Missouri State High School Activities Association and local healthcare providers.

## Predisposing Factors

There are factors that may predispose student/athletes to concussions or alter the severity and recovery process.

- Younger age groups are more vulnerable to concussion and prone to longer recovery time
- Student/athletes with learning disabilities, attention deficit/hyperactivity disorder, emotional disorders, and migraines may also experience more difficult recoveries
- Female student/athletes have higher concussion rates and longer recovery times compared with their male counterparts for the same sport
- Participation in certain sports increases the risk of a concussion
- Prior concussions increase the risk of subsequent concussions. This is especially true for younger student/athletes

### Trends in Concussion Incidence in High School Sports, A Prospective 11-Year Study

#### CONCUSSION DATA FOR SCHOOL YEARS 1997–1998 TO 2007–2008

| SPORT               | CONCUSSIONS<br>n (%) | ATHLETIC EXPOSURES<br>n/ (%) | INCREASE<br>(%) |
|---------------------|----------------------|------------------------------|-----------------|
| <b>BOYS</b>         |                      |                              |                 |
| Football            | 1407 (53.1)          | 2 335 666 (21.4)             | 8               |
| Lacrosse            | 244 (9.2)            | 800 085 (7.3)                | 17              |
| Soccer              | 103 (3.9)            | 606 100 (5.5)                | 13              |
| Wrestling           | 123 (4.6)            | 724 430 (6.6)                | 27              |
| Basketball          | 77 (2.9)             | 788 022 (7.2)                | 17              |
| Baseball            | 32 (1.2)             | 579 420 (5.3)                | 14d             |
| <b>GIRLS</b>        |                      |                              |                 |
| Soccer              | 195 (7.4)            | 554 400 (5.1)                | 14              |
| Lacrosse            | 114 (4.3)            | 559 295 (5.1)                | 14              |
| Basketball          | 120 (4.5)            | 730 876 (6.7)                | 24              |
| Softball            | 47 (1.8)             | 439 175 (4.0)                | 23              |
| Field hockey        | 58 (2.2)             | 588 456 (5.4)                | 20              |
| Cheerleading        | 131 (4.9)            | 2 220 967 (20.3)             | 26              |
| All boys            | 1986 (74.9)          | 5 833 723 (53.4)             | 14              |
| All girls           | 665 (25.1)           | 5 093 169 (46.6)             | 21              |
| <b>ALL ATHLETES</b> | 2651                 | 10 926 892 0.24              | 16              |

Lincoln AE, Caswell SV, Almquist JL, Dunn RE, Norris JB, Hinton RY. Am J Sports Med. 2011;39(5):958-963. Because no concussions were reported for baseball in school year 1997-1998, the mean annual increase for baseball uses school year 1998-1999 as a baseline.



# A Sensible Strategy

## Concussion Management: The Team Plan

*The Team Plan* is a “best practices” approach to give the best care to the concussed student/athlete, from injury to well-being. It begins with the topics of education and prevention to gain understanding and reduce the risks of long-term complications. Then, *The Team Plan* discusses evaluation and treatment plans, and finishes with recovery protocols and the potential problems of concussions. *The Team Plan* relies on open communication and partnership among all individuals involved in the health of the concussed student/athlete.

The goal of *The Team Plan* is the full recovery of the concussed student/athlete. Full recovery means that the concussed student/athlete is/has:

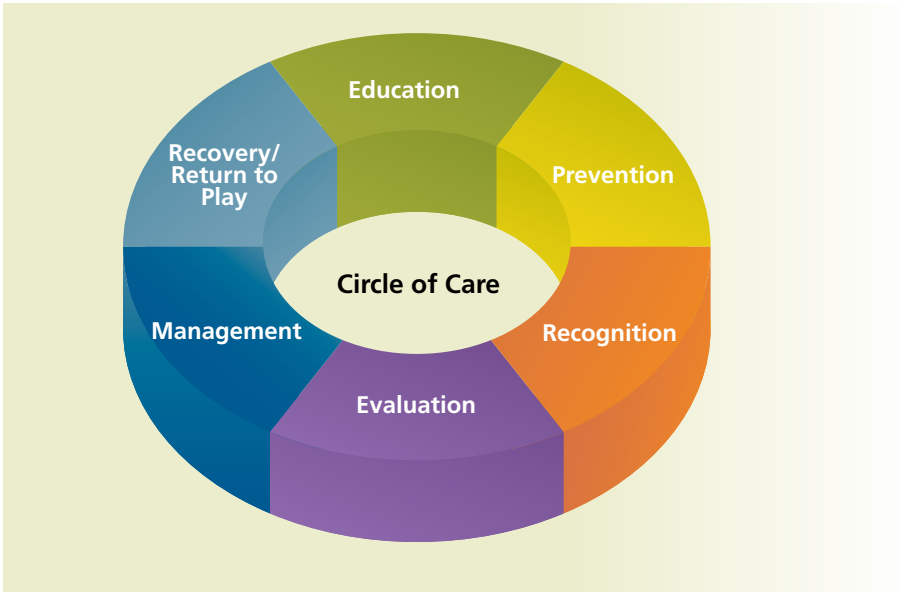
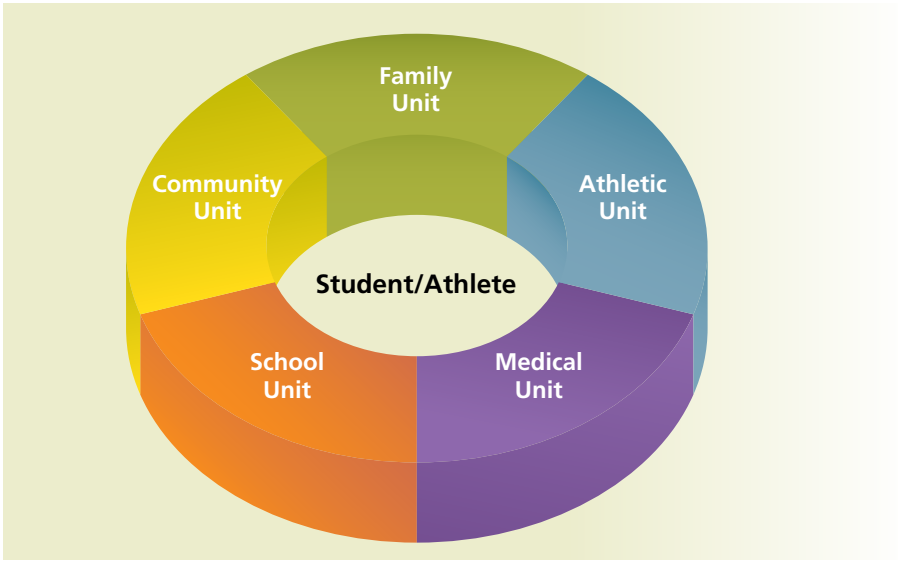
- Symptom-free
- Normal neurological examination
- Normal cognitive (mental capabilities) testing
- Normal balance testing
- Able to participate at same competitive level of physical activity in his or her sport as prior to the injury without any symptoms

Members of *The Team Plan* include: Family Unit, Athletic Unit, Medical Unit, School Unit, and Community Unit.

### **Missouri State Interscholastic Youth Sports Brain Injury Prevention Act (2011) key components:**

- Annual education for coaches, parents, and athletes regarding concussions
- Student/athletes suspected of sustaining a concussion immediately removed from play or practice for a minimum of 24 hours
- Written return-to-play clearance for the student/athlete by a licensed healthcare provider trained in the evaluation and management of concussions
- Annual data collection and report compiled to better understand the magnitude of concussions in interscholastic sports

*Using The Team Plan approach will allow all members of the Units to help minimize risk and maximize recovery for the concussed student/athlete.*



## ***The Team Plan***

**The Family Unit:** student/athlete, their family members, and close friends.

**The Athletic Unit:** coaches, state-licensed athletic trainers, equipment managers, game officials, and athletic regulatory organizations.

**The Medical Unit:** team-licensed healthcare provider/doctor, family healthcare provider/doctor, licensed healthcare provider trained in the evaluation and management of concussions as defined by the guidelines of the Missouri Interscholastic Youth Sports Brain Injury Prevention Act, and parents or others in the community who provide initial care to a potentially concussed student/athlete at the time of injury.

**The School Unit:** public school districts, private and parochial schools, governing boards and oversight organizations, administrators, teachers, school nurses, and staff members.

**The Community Unit:** Emergency Medical Services, fire department, hospital emergency department personnel, and the general public.

Each Unit of *The Team Plan* has responsibilities in each stage of the “Circle of Care,” from education, prevention, recognition, and evaluation, to management and recovery/return to play.

## **Circle of Care**

All Units of *The Team Plan* are responsible for:

- Learning about concussions and their consequences
- Monitoring advancements in concussion care
- Becoming familiar with the Interscholastic Youth Sports Brain Injury Prevention Act
- Understanding The Team Plan approach
- Understanding the financial and legal implications of concussions

*No equipment can prevent concussions but the proper equipment, properly fitted, properly worn, and properly maintained may reduce the risks to some extent.*

## ***Prevention: Minimize the risk!***

The student/athlete's risk of a concussion cannot be eliminated, but the risk can be reduced.

Most Units of *The Team Plan* are responsible for:

- Reducing the risks through education and proper action or care plans
- Understanding the signs and symptoms of a potential concussion
- Encouraging the student/athlete to report any signs and symptoms
- Reporting any concerns for the concussed student/athlete
- Communicating any concerns about a possible concussion to appropriate Units

The Athletic Unit should also:

- Educate Family Unit members yearly about risks, symptoms and signs, and consequences of concussions as required by Missouri Law
- Teach the student/athlete proper fitness, sporting techniques, and sportsmanship
- Maintain equipment and ensure that it is properly worn
- Implement the "buddy system"

**Buddy System:** Young people often do not report an injury. Developing a "buddy system" by assigning student/athletes to monitor a buddy may provide early and reliable information regarding a potential concussion. Teammates playing the same position often know each other's performance and are aware of changes in teammates.

The School Unit should:

- Develop a school concussion plan and management policy
- Identify personnel to act as a concussion care advocate to help the concussed student/athlete and make sure there is good communication among all Units

### **Some Considerations for Your School Plan**

- Expand the pre-participation school exam to include a more complete history, neurological exam, mental testing, and balance testing
- Offer baseline cognitive testing, if it meets the needs of your school
- Offer computerized cognitive testing to monitor the concussed student/athlete's current level of mental functioning, if it meets the needs of your school
- Establish a communication plan among all Team Plan Units for all stages of care
- Appoint a concussion care advocate to communicate with all other Units
- Define the process and people responsible for the on-field, sideline/locker room, and follow-up medical assessment
- Comply with government privacy standards and HIPAA (Health Insurance Portability and Accountability Act) that protect personal medical information
- Define the process of return to academic participation and available accommodations
- Define the process of return-to-play

*It is always best to be cautious if there is any doubt!*

## **Recognition**

*A concussion must be recognized before it can be treated!*

Recognizing a possible concussion is very important. Currently, there are no tests or X-rays that can reliably diagnose a concussion. X-rays and computerized tomography (CT) scans do not show damage to the brain from concussion. CT is used to determine the presence of more serious injuries, such as bleeding or bruising on the brain.

A concussion is diagnosed by obtaining a history suggestive of the injury, performing a physical exam including a neurological exam, testing mental capabilities, and testing balance. In other words, the diagnosis is criteria-based because there is no specific test to diagnose a concussion.

The brain injury that results from a concussion is typically manifested by symptoms. (Table 1) The symptoms are not specific to concussions but are commonly associated with a brain injury and are considered indicators of a possible concussion. Symptoms do not necessarily indicate the severity of the brain injury and potential problems since symptoms of concussions can vary from mild to severe.

### **Risk Factors for Sustaining a Concussion**

- Younger age of student/athlete
- Female student/athletes
- Prior concussions increase the risk of subsequent concussions. This is especially true for younger student/athletes
- Weak neck muscles. The neck muscles support the head and are the link to stabilizing the head with the body. If the neck muscles are weak through lack of training or fatigued by overexertion, they cannot absorb the energy from direct and indirect forces. This may result in more damaging energy being transmitted to the brain
- Dehydration. Inadequate fluid intake may increase the brain's susceptibility to injury

## **Concussion Indicators**

- Injured student/athlete is impaired for a variable period of time but the impairment usually resolves on its own
- There does not have to be a loss of consciousness for a concussion to occur. A loss of consciousness due to a concussion may occur in about 10% of cases
- A concussion often occurs without any symptoms of amnesia, although amnesia may occur in approximately 20% of student/athletes injured
- A student/athlete may have a seizure immediately or shortly after the injury. But a concussion usually occurs without a seizure

## **Risk Factors for Potential Prolonged or Difficult Recovery for the Student/Athlete:**

- Younger age of student/athlete
- Female student/athlete
- Prior concussions, especially if they were severe
- More severe or prolonged symptoms
- Loss of consciousness or amnesia
- History of migraines
- Learning disabilities, depression, anxiety disorders, or sleep disturbances
- Medications and side effects. Medications to treat the symptoms of headache, emotional imbalances, sleep disturbances, attention deficit disorders, and other behavioral or neurological functions can mask or minimize the symptoms of a possible concussion, making evaluation more complicated
- Blood-thinning medication can increase the risk of complications from brain trauma

## **All Units of *The Team Plan* Are Responsible for:**

- Monitoring the student/athlete for changes or symptoms of a concussion
- Knowing the symptoms and signs of a potential concussion
- Knowing the risk factors for a concussion

*Remove student/athlete from play or practice when a concussion is suspected for a minimum of 24 hours. Seek medical advice.*

## ***Evaluation: Once suspected, act immediately!***

Each student/athlete is unique, and each concussion is different—so always be cautious. The overriding principle is “when in doubt, take them out”!

The proper evaluation of the potentially concussed student/athlete is important to determine whether a concussion has occurred and whether the student/athlete is progressing with care. Currently, there is no testing that is the “gold standard” for determining the presence or absence of a concussion or the recovery from a concussion.

The diagnosis of a concussion is made by performing a complete exam.

The complete concussion exam includes four parts:

- Symptom/sign history
- Physical exam with a detailed neurological exam
- Mental (cognitive) functions
- Balance capabilities

The results of the complete exam allow the licensed healthcare professional to determine if the student/athlete has suffered a concussion and how she or he is progressing during care management.

Various concussion assessment tools are available to “standardize” the concussion exam. By using a standard approach, the exams and results are complete and consistent. This early documentation of all important findings helps in assessing improvement or worsening of concussion symptoms for the student/athlete.

This examination should occur many times after the injury.

### **“Field of Play” Assessment**

The assessment of an injured student/athlete on the “field of play” provides an immediate status after the injury and especially indicates the possibilities of a more severe or life-threatening injury. An emergency action plan,



appropriate for the local community resources, should be developed and implemented by the Team members to respond to more serious injuries.

### **Sideline/Locker Room Assessment**

In cases where the “field of play” assessment does not indicate more severe brain or spinal injuries or other life-threatening injuries, and the injured student/athlete can safely walk, he or she can be escorted to the sidelines or bench. In most cases, the student/athlete will come to the sideline or bench on his or her own. The student/athlete should then undergo a more thorough exam on the sideline or in the locker room.

When there is no indication of a severe or life-threatening injury, the student/athlete should undergo sideline/locker room assessments 15 to 30 minutes apart for a period of about two hours after injury or as indicated. In rare instances, concussion symptoms will not be present immediately following the injury. As a result, the sideline/locker room assessments will allow for discovery of delayed or new symptoms—or any worsening of previously noted symptoms.

### **Indicators of a Potentially Severe Injury**

Emergency care is recommended for the following symptoms and signs:

- Life-threatening signs or symptoms
- Seizure activity on the field or later
- Loss of consciousness
- Persistent amnesia
- Constant or worsening headache, nausea/vomiting, confusion, lethargy, or balance disturbances
- New or worsening neck pain, chest/abdominal pain, or any other symptoms that cause concern to any Unit member

Student/athletes requiring emergency care need further evaluation by a licensed healthcare provider experienced in assessing traumatic injuries, especially those of the brain and spine, in accordance with the predetermined emergency action plan.

### **Home Care Instructions**

When it is deemed safe for a student/athlete to go home, take-home information regarding concussion symptoms and care should be given to the family by a member of the Athletic or Medical Unit.

**If the following problems are noticed, then further evaluation of the concussed student/athlete is needed:**

- The student/athlete is “not right” or “not normal for him or her” as noticed by the Family, Athletic or Team Unit.
- The student/athlete does not improve or a symptom worsens upon repeat sideline/locker room exams.

Concussed student/athletes should be monitored at home for symptoms and signs of concussions. Any concerns should trigger immediate evaluation by the licensed healthcare provider or in an emergency department.

The concussed student/athlete must understand the importance of mental and physical rest. Initially, the concussed student/athlete may require rest at home in a controlled environment with no reading, no homework, no cell phone use, no loud music or sounds, no bright lights, no TV, no computers, and certainly no physical activity. Mental activities are gradually reintroduced and continued if they do not provoke symptoms before any physical activities are attempted.

*The concussed student/athlete does not need to be awakened from sleep every few hours as uninterrupted sleep is beneficial for recovery.*

**What Can Help With Recovery From a Concussion:**

- Brain and body rest
- Avoiding alcohol and substance use
- Use of acetaminophen rather than aspirin or other anti-inflammatory drugs, such as ibuprofen and naproxen sodium
- Following Medical Unit instructions for treatment and further evaluation

## **Follow-up Medical Care**

Follow-up care by a licensed healthcare provider is important. The follow-up concussion exams add information for comparison to the prior exams completed on the field of play and sideline/locker room. These exams determine the current status of and appropriate concussion management care for the student/athlete.

### **All Units of The Team Plan are responsible for:**

- Obtaining help from the Medical and Athletic Units if the student/athlete has a possible concussion

### **The Athletic, Emergency Personnel of the Community, and Medical Units are responsible for:**

- Implementing medical care protocol for athletes down on the “field of play”
- Making sure that no emergent medical condition is present
- Implementing emergency action plan if an emergent medical condition is suspected
- Ensuring proper stabilization and removal of equipment as indicated by the emergent medical condition until higher level of care is available
- If no emergent medical condition is identified, conducting concussion assessment, including history, neurological exam, balance testing, and cognitive testing
- Utilizing assessment tools to evaluate and document
- Continuing sideline/locker room exam in 15- to 30-minute intervals until the concussed student/athlete is stable or sending the student/athlete to the emergency room or medical clinic for further exam
- Monitoring concussed student/athlete with regular concussion exams

*A useful take-home monitoring tool is the  
CDC Concussion Signs and Symptoms Checklist  
[http://www.cdc.gov/concussion/pdf/TBI\\_schools\\_checklist\\_508-a.pdf](http://www.cdc.gov/concussion/pdf/TBI_schools_checklist_508-a.pdf)*



*Studies suggest that **complete recovery** of a concussion may not occur until approximately 21 days, especially in the younger population.*

## **Management: Rest the brain, rest the body!**

Each student/athlete is unique and requires an individualized plan of management. The management of the concussed student/athlete is summarized by the principle of brain and body rest. All concussions require rest because the brain needs time to recover and is more vulnerable to additional injury during recuperation. Mental (cognitive) or physical activities that require brain energy may make the concussion symptoms worse or delay recovery. If the brain does not have time to recover, there is increased risk of additional concussions, prolonged symptoms, and short- and long-term complications.

The individualized management plan is guided by symptoms, results of “field of play” and sideline/locker room assessments, and follow-up concussion exams. The management of the concussed student/athlete is ongoing with the cooperation of the Medical, Family, Athletic, and School Units. Each Unit monitors the concussed student/athlete for improvement or worsening of symptoms. The Units should always communicate their findings to each other according to the “School Concussion Plan” while following HIPAA standards for maintaining privacy of the personal medical information and records.

Concussed student/athletes experience symptoms for a period of time after the injury. Symptoms are an important indicator of how the concussed student/athlete is recovering, but they are only one component of the complete assessment. Studies have shown that the recovery time for student/athletes is usually:

- 7–10 days for 80% of student/athletes
- 2–4 weeks for 10%–15% of student/athletes
- 4 weeks to several months for 1%–5% of student/athletes

Younger or female student/athletes, and those with a prior history of concussions, may experience prolonged symptoms—usually 2-4 weeks or more. Also, a more prolonged recovery is predicted when the concussed student/athlete:

- Experiences 4 or more symptoms
- Reports fogginess, fatigue, or sleep disturbances

- Has a headache lasting longer than 3 days, especially with migraine symptoms
- Has symptoms lasting longer than 10 days

The concussion exam includes not only the history with symptoms, but also a physical exam with a detailed neurological exam, cognitive (mental) capabilities testing, and balance testing. All four components of the concussion exam must return to normal before the concussed student/athlete can be considered recovered!

### **Cognitive (Mental) Capability Testing**

Neuropsychological testing may not be available to all concussed student/athletes. There is some disagreement as to whether neuropsychological testing is needed in all concussed student/athletes. Most current consensus documents consider cognitive testing to be one of the four elements of evaluation and management. However, cognitive testing is not considered the definitive test for concussions. As noted earlier, the diagnosis of concussions is criteria-based, relying on the results of the four elements of the concussion exam. If indicated and available, the concussed student/athlete's status and progress can be followed by computerized cognitive testing or formal neuropsychological testing.

Some school districts administer the computerized testing to students upon entering high school so that baseline results are available for comparison in concussion management care. This may be helpful, but is not a generally accepted practice by most school systems. The computerized cognitive testing in age groups over 11 years old is reported to be sensitive to concussion changes, more so than the history and physical exam, so if abnormalities are discovered, the injured student/athlete needs to be carefully followed until testing returns to baseline. The various domains measured by the computerized neuropsychological testing are designed to be specific and sensitive to concussions, especially the reaction time and memory measurements. Cognitive testing is not as conclusive in the population below 11 years old.

More extensive formal testing administered by neuropsychologists or other qualified specialists is more accurate than the computer versions. Neuropsychologists offer sophisticated evaluation measures and intervention

strategies, but the formal testing is time-consuming, costly, and requires qualified personnel to administer and interpret the test results. Formal neuropsychological testing may be especially helpful when the student/athlete experiences prolonged postconcussion symptoms, has learning disabilities or medical conditions that may complicate recovery, or requires medications that complicate the evaluation.

## **Balance Testing**

About 30% of concussed student/athletes have balance problems for about 3–7 days after their concussion. Balance is a marker of recovery and, along with reaction time, is crucial to athletic performance, so the concussed student/athlete must regain stability prior to returning to play. Clinical balance testing is valid, reliable, and easily done by a licensed healthcare provider.

## **Medications**

There are no medications currently available that benefit the recovery of a concussed student/athlete. Medications may mask symptoms of the injury, give a false sense of improvement, and affect the four components of the concussion exam, notably the cognitive testing. However, the Medical Unit may provide medications to treat prolonged or severe concussion symptoms or preexisting medical conditions.

Most Units of *The Team Plan* are responsible for:

- Following Medical Unit directions
- Encouraging concussed student/athlete to follow Medical Unit directions
- Supporting student/athlete throughout the process, especially if symptoms resume during return to activities protocols
- Communicating potential need for academic accommodation
- Involving the school's concussion care advocate early
- Implementing education accommodations for concussed student/athlete as needed
- Implementing graduated mental activity protocol at home and in cooperation with the School Unit and concussion care advocate
- Being knowledgeable about the graduated academic and physical return-to-play protocols
- Seeking expert consultation for prolonged or complicated cases





## *Recovery: Back to normal safely!*

The objective of recovery is for the injured student/athlete to be able to participate in pre-injury activities at the same level as prior to his or her concussion.

### **Cognitive (Mental) Recovery**

Prior to engaging in physical activities, the concussed student/athlete must be capable of performing normal and routine mental activities without the return of symptoms and signs that indicate he or she has not improved.

If, however, cognitive activities cause or worsen symptoms/signs of a concussion, these activities should be gradually introduced in a progressive manner that does not result in a worsening state.

There currently are no validated benchmarks to gauge mental improvement with graduated cognitive activities.

Activities to reintroduce progressively in the following order would be:

- Reading
- Playing a board game like checkers or chess
- Playing a memory game
- Playing video games for half an hour

These activities should not cause any symptoms, notably headache, nausea, or decreased frustration tolerance. If the concussed student/athlete can progress to the point where they can perform these mental activities for about 30 minutes without symptoms, this usually means that they can return to their academic duties.

When the concussed student/athlete is allowed to return to school, educational accommodations may still be needed. The school's concussion care advocate is responsible for monitoring the student/athlete's progress. The concussion care advocate communicates regularly with the concussed student/athlete, teachers, Family Unit, Athletic Unit, and Medical Unit.

They establish any accommodations needed, including:

- Rest breaks
- Lessened workload and homework

- Reduced computer time, at school and at home
- Postponement of national or merit testing, because the results may not reflect the concussed student/athlete's actual capabilities

## **Physical Recovery**

In most cases, concussed student/athletes should not participate in the physical return-to-play protocol until they have no symptoms at rest or with normal activities for a minimum of 24 hours. Once they can do this, they can begin physical activities. The graduated return-to-play protocol combines physical activities with the presence or absence of symptoms (Table 2). This protocol is recommended as a "best practice."

The student/athlete progresses through the physical protocols as long as he or she is symptom-free after each stage. If symptoms reemerge at any stage during the physical protocol activities, the student/athlete should be placed at rest until symptoms are gone for 24 hours. The student/athlete may then attempt that level of return-to-play exercises again.

The Athletic Unit monitors the progression of the return-to-play protocol in cooperation with the Medical, Family, and School Units.

Complete recovery of the concussion is required prior to any student/athlete returning to play. Recovery is defined as:

- Symptom-free
- Normal neurological exam
- Normal cognitive testing
- Normal balance testing
- The ability to participate at same competitive level of physical activity in his or her sport as prior to the injury without any symptoms

Most Units of *The Team Plan* are responsible for:

- Working with all other Units to ensure complete mental/physical recovery, starting with brain and body rest
- Gradually increasing mental (cognitive) activities to reach normal level of mental status
- Implementing the return-to-play protocol as directed by the Medical Unit
- Seeing a concussion specialist or other Medical Unit specialist for problems or difficult cases
- Making sure that the concussed student/athlete is cleared to play by a licensed healthcare provider trained in the evaluation and management of concussions as defined by the guidelines of the Missouri Interscholastic Youth Sports Brain Injury Prevention Act
- Following up with the Family Unit one to two weeks after student/athlete's return to normal activity

*Research about CTE and NCI continues to determine what causes these conditions and who is most at risk.*

## **Prognosis**

The potential short- and long-term negative outcomes of concussions are always a concern, and include:

### **Post-Concussion Syndrome**

Concussion symptoms that last longer than four weeks, with most resolving within several months. Post-Concussion Syndrome appears to be more common in individuals with multiple concussions, and among older age groups and female student/athletes. Management and recovery for this condition may require a concussion specialist.

### **Second Impact Syndrome**

The injured student/athlete has a first concussion, which may or may not be diagnosed, and then receives a second concussion before the first injury has completely healed. Second Impact Syndrome occurs in young children, teenagers, and young adults. It can cause death. The concussed student/athlete must be completely healed before returning to physical activities such as PE class or sports.

### **Long-Term Health Problems**

Chronic traumatic encephalopathy (CTE) and neurocognitive impairment (NCI) are two of the potential long-term problems of concussions. These result in difficulties in mental functioning, physical abilities, emotional well-being, personality, balance, vision, and more.

CTE and NCI cases are most often seen in professional athletes who have a long history of playing, but not enough is known about the conditions. It is best to carefully manage the care of the concussed student/athlete to reduce any possible risks of these long-term problems.

## *Conclusions*

A well-thought-out and implemented concussion plan will greatly benefit the concussed student/athlete. The Team Plan presented here can provide a “best practices” approach from prevention to recovery. By using open communication and partnership, all involved parties come together for one purpose—the health and well-being of the concussed student/athlete.



## **General References:**

### **Heads Up Program, CDC**

<http://www.cdc.gov/concussion/headsup/index.html>

Consensus statement on concussion in sport: the 4th International Conference on Concussion in Sport held in Zurich, November 2012

McCroly P, Meeuwisse WH, Aubry M, et al. Br J Sports Med 2013;47:250-258.

<http://bjsm.bmj.com/content/47/5/250.full>

### **Summary of Evidence-based Guideline Update:**

#### **Evaluation and Management of Concussion in Sports**

Report of the Guideline Development Subcommittee of the American Academy of Neurology

Giza CC, et al. Neurology; Published online before print March 18, 2013;

DOI10.1212/WNL.0b013e31828d57dd

<http://www.neurology.org/content/early/2013/03/15/WNL.0b013e31828d57dd.full.pdf+html>

### **American Medical Society for Sports Medicine Position Statement:**

#### **Concussions in Sports**

Harmon KG, et al. Br J Sports Med 2013; 47:15–26.

[http://www.amssm.org/Content/pdf%20files/2012\\_ConcussionPositionStmnt.pdf](http://www.amssm.org/Content/pdf%20files/2012_ConcussionPositionStmnt.pdf)

### **Mild Traumatic Brain Injury in Children and Adolescents**

#### **From Basic Science to Clinical Management**

Kirkwood MW, Yeates KO. New York: Guilford Press. 2012

### **Concussions in Sports, Clinic in Sports Medicine**

Meehan III WP, Micheli LJ. Clin Sports Med 2011;30 (1):1-208

[http://www.sportsmed.theclinics.com/issues?issue\\_key=S0278-5919%2810%29X0005-9](http://www.sportsmed.theclinics.com/issues?issue_key=S0278-5919%2810%29X0005-9)

### **Concussion (mild traumatic brain injury) and the Team Physician:**

#### **A Consensus Statement—2011 update.**

Herring SA et al. Med Sci Sports Exerc 2011;43:2412–22.

[http://crlnsw.com.au/fileadmin/user\\_upload/National\\_Sports\\_Trainers\\_Scheme/2011\\_Expert\\_Consensus\\_Statement.pdf](http://crlnsw.com.au/fileadmin/user_upload/National_Sports_Trainers_Scheme/2011_Expert_Consensus_Statement.pdf)

### **Clinical Report-Sports-Related Concussions in Children and Adolescents**

#### **Halstead ME, Walter KD, The Council on Sports Medicine and Fitness.**

Pediatrics 2010;126 (3):597-611.

<http://pediatrics.aappublications.org/content/126/3/597.full.html>

**National Athletic Trainers' Association Position Statement:  
Management of Sport-related Concussion.**

Guskiewicz KM, et al. J Athletic Training 2004;39:280–97.  
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC522153/>

**National Athletic Trainers' Association Position Statement:  
Acute Management of the Cervical Spine–Injured Athlete**

Swartz EE, et al. J Athl Train 2009 May-Jun; 44(3): 306–331.  
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2681208/>

## *Selected Resources*

**Brain Injury Association of America**

<http://www.biausa.org/>

**Brain Injury Association of Missouri**

<http://www.biamo.org/>

**The Brain Injury Guide & Resources: A Collaboration of the Missouri Department  
of Hand and Senior Services and the MU Department of Health Psychology**

<http://Braininjuryeducation.org/>

**Missouri Department of Health and Senior Services TBI Resources**

<http://health.mo.gov/living/healthcondiseases/tbi/relatedlinks.php>

**NFL Sideline Assessment Tool and Post Injury Tool**

<http://www.nflevolution.com/article/Sideline-Assessment-Tool?ref=283>

<http://www.nflevolution.com/article/Concussion-Test-Post-Injury-?ref=293>

## **SCAT2**

**Sports Concussion Assessment Tool**

Consensus Statement on Concussion in Sports, 3rd International Conference on Concussion in Sport held in Zurich, November 2008. Clinical Journal of Sports Medicine 2009;19 ( 3): pp.185-200.

[http://bjism.bmj.com/content/43/Suppl\\_1/i85.full.pdf](http://bjism.bmj.com/content/43/Suppl_1/i85.full.pdf)



## **SCAT3**

### **Sports Concussion Assessment Tool-3rd Edition**

Br J Sports Med 2013 47: 259

### **REAP Concussion Management Program**

<http://www.rockymountainhospitalforchildren.com/sports-medicine/concussion-management/reap-guidelines.htm>

### **Brainlinekids.org**

[http://www.brainline.org/landing\\_pages/features/blkids.html](http://www.brainline.org/landing_pages/features/blkids.html)

### **Project Brain**

<http://brain101.orcasinc.com/>

### **Center for Brain Injury Research and Training (CBIRT)**

<http://www.cbirt.org/>

### **Traumatic Brain Injury Networking Team Resource Network**

<http://cokidswithbraininjury.com/>

## ***Acknowledgements***

### **Brain Injury Association of Missouri**

Maureen Cunningham, CFRE, Executive Director, Brain Injury Association of Missouri

### **Missouri School Boards' Association**

Melissa Randol, Deputy Executive Director/General Counsel

Paul Fennewald, MSBA Special Advisor, Missouri Center for Education Safety

### **Missouri Department of Health and Senior Services**

Steve Cramer, MA, Administrator, Section for Special Health Services,  
Missouri Department of Health and Senior Services

Melody A. Boling, CBIS, LCSW, TBI Project Coordinator, UMKC-Institute for Human  
Development/Missouri Department of Health and Senior Services

(continued)

## **Missouri Department of Health and Senior Services (continued)**

Lori A. Brenneke, Special Projects Coordinator, Division of Community and Public Health, Missouri Department of Health and Senior Services

Gena Terlizzi, Communications Director, Missouri Department of Health and Senior Services

Dean Watson, Public Information Coordinator, Office of Public Information, Missouri Department of Health and Senior Services.

## ***Special acknowledgement to the peer reviewers who shared their expertise through peer review of The Team Plan***

### **Peer Reviewers**

Greg S. Canty MD, Medical Director, Assistant Professor of Pediatrics & Orthopaedics, Center for Sports Medicine, Emergency Medicine, Children's Mercy Hospitals & Clinics

David D. Dyck Jr., DO, FAOASM - Midwest Sports Medicine Physicians

Mark E. Halstead, MD, FAAP, Assistant Professor, Washington University Sports Medicine (St Louis); Team Physician, St Louis Rams

Brian L. Mahaffey MD, MSPH, Director, Mercy Sports Medicine, Team Physician, Saint Louis Cardinals, Head Team Physician, Missouri State University

Raman K. Malhotra MD, Director, Sports Neurology and Concussion Program, Saint Louis University

Thomas A. Martin Psy.D, University Of Missouri-Columbia, School of Health Professions

Anne W. Stevens, Ph.D., Clinical Neuropsychologist. MindWorks: Comprehensive Neuropsychology Services., University of Arkansas Concussion Management Team.

Josh Thompson, MED, LAT, ATC, Head Athletic Trainer, Westminster College, Missouri Athletic Trainers Association

Shannon L. Woods MD, Medical Director CoxHealth Sports Medicine, Team Physician Drury University, Team Physician Evangel University



