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Feature Article

Caring for Student-Athletes Following a Concussion

Sarah K. Piebes, MS, ATC, Meganne Gourley, MS, ATC, EMT-B, and Tamara C. Valovich McLeod, PhD, ATC

The school nurse plays a dynamic role in the care and treatment of a concussed athlete. Concussions in the adolescent populations are of special concern due to their potential impact on mental development and cognitive function, as well as an increased risk of serious complications including second impact syndrome. The complexity of a concussion requires collaboration between a variety of health care and school personnel to create an optimal situation for the student-athlete and their family. As the primary health care provider for students during the school day, school nurses can help ensure all necessary steps are taken to aid the recovery of an injured student-athlete. It is important that school nurses are up-to-date on current concussion information to allow for optimal care following injury and during the recovery process.

Keywords: athlete health; injuries; safety; injury prevention; school nurse

INTRODUCTION

In the school setting, school nurses play a dynamic role in the care and treatment of student-athletes following concussion. As the primary health care provider for students during the school day, school nurses have the ability to ensure all the necessary steps are taken to aid in the recovery of an injured student-athlete. The school nurse should work in conjunction with the athletic trainer, school faculty, counselors, and administrators, as well as the student-athlete's physician and family, to provide the best healing environment possible. In the case of a concussion, school nurses need to be able to recognize signs and symptoms, to be aware of risks associated with recurrent injury, and to make recommendations to student-athletes, parents, and school officials on proper care and recovery.

OVERVIEW OF CONCUSSION

Sport-related concussion, or mild traumatic brain injury (MTBI), is a potentially serious

consequence of participation in interscholastic athletics and an important public health issue because of the large number of athletes sustaining these injuries, the relatively young age of individuals at the time of injury, and the potential for cumulative effects of repeated injuries (Thurman, Branche, & Sniezek, 1998). Recent data suggest that concussions account for 8.9% of all high school sports injuries and that females may be prone to higher rates of concussive injuries compared to male athletes participating in the same

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TABLE 1. Common Signs and Symptoms Following Concussion

Headache	Dizziness
Nausea	Vomiting
Feeling in a fog	Feeling slowed down
Trouble falling asleep	Sleeping more than usual
Fatigue	Drowsiness
Sensitivity to light or noise	Loss of balance
Feeling "dinged," dazed or stunned	"Seeing stars"
Tinnitus	Double vision

Note. Adapted from "National Athletic Trainers' Association Position Statement: Management of sport-related concussion," by Guskiewicz et al., 2004, *Journal of Athletic Training*, 39, 280-297.

sports (Gessel, Fields, Collins, Dick, & Comstock, 2007).

"Sport-related concussion, or mild traumatic brain injury (MTBI), is a potentially serious consequence of participation in interscholastic athletics and an important public health issue because of the large number of athletes sustaining these injuries, the relatively young age of individuals at the time of injury, and the potential for cumulative effects of repeated injuries."

Concussion terminology has been revised as more research about this injury has been published and researchers and clinicians have begun to better understand the pathology, etiology, and prognosis of concussions. Following the 2001 Vienna meeting of the Concussion in Sport Group (Aubry et al., 2002), the following definition of concussion was developed: "Concussion is defined as a complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces. Several common features that incorporate clinical, pathological, and biomechanical injury constructs that may be used in defining the nature of a concussive head injury include

1. Concussion may be caused by a direct blow to the head, face, neck, or elsewhere on the body with an "impulsive" force transmitted to the head.
2. Concussion typically results in the rapid onset of short lived impairment of neurological function that resolves spontaneously.

3. Concussion may result in neuropathological changes, but the acute clinical symptoms largely reflect a functional disturbance rather than structural injury.
4. Concussion results in a graded set of clinical syndromes that may or may not involve loss of consciousness (LOC). Resolution of the clinical and cognitive symptoms typically follows a sequential course; however, in some cases postconcussive symptoms may be prolonged.
5. Concussion is typically associated with grossly normal structural neuroimaging studies" (Aubry et al., 2002).

The use of this definition for concussion was subsequently reaffirmed by the National Athletic Trainers' Association (Guskiewicz et al., 2004) and the Concussion in Sport Group following the Prague (McCrory, Johnston, & Meeuwisse, 2005) and Zurich (McCrory et al., 2009) consensus meetings.

Signs and Symptoms

Common signs and symptoms reported following are listed in Table 1. A common misconception is that LOC must accompany a concussion. However, LOC has been found to occur in only 8.9% of all sport-related concussive injuries (Guskiewicz, Weaver, Padua, & Garrett, 2000). Headache has been found to be the most common symptom reported following concussion, found in 86% of sport-related cases (Guskiewicz et al., 2004). Research has also indicated that 10% of collegiate and high school concussed athletes continue to experience a headache for greater than 5 days following a concussion (Guskiewicz et al., 2000). An investigation regarding the duration of self-reported symptoms of dizziness, headache, and nausea in high school athletes found a total of 4 days were needed for these symptoms to resolve following a concussion (Lovell, Collins, & Iverson, 2003). Therefore, there may be lingering effects from a sport-related concussion that may have an impact on the physical and mental health of the adolescent resulting in academic difficulties that the school nurse should be made aware (McCrory et al., 2009).

Unlike other athletic injuries that result in obvious signs (e.g., bleeding, swelling, bruising), concussion symptoms reflect functional deficits, such as loss of memory, concentration, processing speed, reaction time, and coordination (Guskiewicz et al., 2004). As a result, neuroimaging techniques,

such as magnetic resonance imaging (MRI) or computed tomography (CT) techniques, are not sensitive enough to diagnose a concussive injury. These techniques are valuable in the diagnosis of more serious brain lesions, such as intracranial bleeding, but of little use in the evaluation of sport-related concussion (Guskiewicz et al., 2004). There are currently no neuroimaging techniques that are capable of diagnosing a concussion or determining the severity or full recovery of memory loss, processing speed, reaction time, or concentration and coordination deficits of a concussive injury (Guskiewicz et al., 2004).

“Unlike other athletic injuries that result in obvious signs (e.g., bleeding, swelling, bruising), concussion symptoms reflect functional deficits, such as loss of memory, concentration, processing speed, reaction time, and coordination.”

Complications

The developing brains of children and adolescents are thought to respond differently than the adult brain following a concussive injury; however, the effects of concussion on the developing brain, as well as the neurophysiological differences between adults and adolescents, are not completely understood (Guskiewicz et al., 2004; Lovell & Fazio, 2008). Adolescents are in a period of growth and development, which places them at greater risk of sustaining a head injury. The head of an adolescent is larger in relation to the rest of the body, and the neck muscles and other supporting structures are not as strong when compared to a structurally mature adult (Buzzini & Guskiewicz, 2006; McCrory, Collie, Anderson, & Davis, 2004). The decreased strength from the supportive structures of the head may increase the risk of a concussion as the structures are unable to absorb forces, resulting in increased force transmission to the brain. In addition, the skull of an adolescent is not fully developed, which may affect the way forces are transmitted following a traumatic incident (Buzzini & Guskiewicz, 2006; McCrory et al., 2004). Research has also

suggested that the way the brain adapts and physiologically responds to mechanical stress is age dependent (McCrory et al., 2004). As a result of these factors, it has been reported that an adolescent must sustain a force two to three times greater than an adult to display similar signs and symptoms following a concussion (Browne & Lam, 2006; McCrory et al., 2004). Subsequently, there is the potential for additional complications resulting from the concussion, including second impact syndrome (SIS) and postconcussion syndrome.

Second Impact Syndrome (SIS). The most recognized age-related concern with concussion is known as SIS. SIS is a rare but catastrophic event that typically effects the adolescent population. SIS occurs when an individual sustains a secondary trauma to the brain before the brain has completely healed following the original head injury (Guskiewicz et al., 2004). Those affected by SIS are typically symptomatic at the time of reinjury (Cantu, 1998). Following this event, the athlete may appear dazed but is usually able to walk off the field or court under his or her own power. The second insult to the brain, however, results in a loss of the brain's ability to autoregulate blood flow. Lack of autoregulation of blood flow quickly results in vascular engorgement, diffuses brain swelling, and increases intracranial pressure. Within minutes, the athlete will collapse and present with loss of eye movement, rapidly dilating pupils, and respiratory failure (Cantu, 1998). These events lead to coma and potentially death (Cantu, 1998; Kirkwood, Yeates, & Wilson, 2006).

SIS is a very serious concern when dealing with adolescents. With the proper care, this condition is preventable. An athlete should never be allowed to return to any type of physical activity, including sport, while symptomatic. Symptomatic recovery of the athlete should follow a step-by-step progression with all signs and symptoms being assessed at rest and after exertional exercises during follow-up evaluations. If the athlete experiences no signs or symptoms of concussion following these evaluations, he or she may return to practice but not participate in sport-specific skills that increase his or her risk of a subsequent concussion (Guskiewicz et al., 2004).

The return-to-play issue is an important one and was previously guided by the grade of

TABLE 2. Return to Activity Progression

<i>Rehabilitation Stage</i>	<i>Functional Exercises</i>
No activity	Complete physical and cognitive rest
Light aerobic exercise	Walking, swimming, stationary cycle
Sport-specific exercise	Running, skating (No head impact)
Non-contact training drills	More complex training drills (passing)
Full contact practice	Participate in normal training activities (following medical clearance)
Return to play	Normal game play

Note. Adapted from "Consensus statement on Concussion in Sport-The 3rd International Conference on Concussion in Sport held in Zurich, November 2008," by McCrory et al., 2009, *Journal of Science and Medicine in Sport*, 12, 340-351.

concussion using various return-to-play guidelines such as Cantu, Colorado, American Academy of Neurology (AAN). However, in 2001 the Concussion in Sport Group (Aubry et al., 2002) recommended to abandon concussion grading scales because most were based on LOC and post-traumatic amnesia, two less common features of concussion. Instead of using grading scales and their related return-to-play guidelines, it is now recommended to manage each concussion individually and use objective measures of symptoms, cognition, and balance (discussed below) to determine when an athlete is ready to return to play (Aubry et al., 2002; Guskiewicz et al., 2004). The currently recommended return-to-play protocol is presented in Table 2. In the absence of objective measures to determine whether the athlete has returned to their preseason baseline scores, a 7-day waiting period after the athlete reports to be asymptomatic is advocated before beginning the return-to-play progression (Guskiewicz et al., 2004).

Postconcussion syndrome. In addition to SIS, the increased risk of recurrent concussions following the initial episode is also an important concern. Research has indicated that athletes with a history of concussion may be at greater risk of sustaining subsequent reinjury. Guskiewicz et al (2003) reported that an athlete with a history of one previous concussion is at 1.5 times the risk of sustaining another concussion; two previous concussions

raises the risk to 2.8 times; and three previous concussions raise the risk to 3.8 times that of a first occurrence. While not leading to the same catastrophic outcome as SIS, the effects of injury may be additive or cumulative.

In addition to the risk of previous injury, current literature suggests that postconcussion symptoms may take longer to resolve in adolescents (Field, Collins, Lovell, & Maroon, 2003; Guskiewicz et al., 2004; McCrory et al., 2004). This sequela, known as postconcussion stress syndrome (PCSS), is defined as a continued manifestation of concussion symptoms for greater than 6 weeks following concussion (Emery & Meeuwisse, 2006). As a result of this syndrome, the athlete is often hindered in his or her academic and personal routine, creating concern for the individual's health-related quality of life (HRQOL), following injury and during the recovery process (Moser, Schatz, & Jordan, 2005).

A child's HRQOL revolves primarily around school, extracurricular activities, social interactions, and family life; therefore, it cannot be judged using the same criteria used for adults (Hershey et al., 2001). A decline in HRQOL may result in an increase in school absences and a decrease in performance at school. Participation in normal activities and involvement with friends and family may also suffer with a change in HRQOL.

Post-Traumatic headache (PTHA). Headache is the most frequently reported symptom following concussion (Guskiewicz et al., 2000, 2004; McCrory et al., 2004). Adult studies have shown a tremendous impact of chronic headache on HRQOL. Lake, Branca, Lutz, & Saper (1999) stated that chronic PTHA results in a decreased ability to concentrate and also has an impact on memory and thinking processes. It has also been shown that pain associated with chronic PTHA affects attention and the ability to process new information and consequently learning (Martelli, Grayson, & Zasler, 1999).

The impact of PTHA on adolescents is not completely understood (Callaghan & Abu-Arafeh, 2001). The characteristics, length, and degree of associated impairments in adolescents are unknown, although it has been suggested there is a direct correlation to academic and social involvement. Attention deficits, for example, can

have an impact on the ability to keep up with school demands. It is possible that these problems will last after physical symptoms of a concussion have resolved (McCrorry et al., 2004).

A study examining the long-term consequences of closed head injury in adolescents and children found that while 57% of participants were able to return to school without problems, 23% experienced difficulty in the areas of concentration, memory, and understanding (Ruijs, Keyser, & Gabreels, 1990). In addition, behavioral issues may develop following injury or continue despite the return to baseline scores. Behavioral issues also have the potential to affect educational or social interaction. Yeates et al. (1999) found that at 3 months following concussion, children continued to experience an increase in postconcussive symptoms when compared to their baselines scores. This study reported that deficits appeared to affect neuropsychological and neurobehavioral dimensions (Yeates et al., 1999).

In addition to cognitive deficits, children with chronic headache commonly experience nausea and vomiting, as well as sensitivity to sound and light (Hershey et al., 2001). As a result, children suffering from PTHA tend to show a decrease in school attendance, as well as the ability to participate in extracurricular activities and to spend time with friends (Grazzi, D'Amico, Usai, Solari, & Bussone, 2004). These elements are important factors related to adolescent HRQOL. McCarthy et al. (2006) reported that 64% of individuals suffering from a mild head injury returned to a normal HRQOL at approximately 3 months postinjury.

ASSESSMENT

Objective measures provide a quantifiable means of concussion assessment and allow a more thorough understanding of the impairments the athlete may have, as opposed to using past grading scales that address only LOC and post-traumatic amnesia (Guskiewicz et al., 2004). This is important not only for the initial assessment of concussion but also allows progress to be tracked during recovery. For these measures to be used, baseline data need to be collected prior to injury. Baseline data allow the clinician to know what is "normal" for each individual athlete and provide a means of comparison for subsequent testing

(Guskiewicz et al., 2004). Adolescents pose a challenge when collecting baseline data, as they are in a period of cognitive development. As a result, there is an increase in retest variability when working with adolescents (Patel, Shivdasani, & Baker, 2005); therefore, it has been recommended to perform baseline testing more frequently (Guskiewicz et al., 2004) to account for potential changes in baseline scores resulting from maturation (Guskiewicz et al., 2004; McCrorry et al., 2004; Patel et al., 2005). The current recommendations for concussion assessments suggest that the baseline and postinjury tests be comprised of neurocognitive, mental status, and postural stability (balance) tests, as well as the use of a symptom scale or checklist (Guskiewicz et al., 2004; McCrorry et al., 2009).

Neuropsychological testing measures memory, processing speed, visuomotor and visuospatial ability, execution, planning, and attention (Patel et al., 2005). Initial testing typically occurs within 24 hours of the injury and then again 3, 5, and 7 days postinjury (Field et al., 2003), although some recommendations suggest testing each day following injury until return to baseline (Oliaro, Anderson, & Hooker, 2001). Computer-based testing is being implemented as a means of determining baseline measures, which are used following concussion to track recovery progress (Kirkwood et al., 2006); however, an individual may return to baseline before completely healed (Asplund, McKeag, & Olsen, 2004). Research has shown that memory and information processing speed takes the longest to return to baseline following concussion (Patel et al., 2005). Furthermore, Collins et al. (2003) concluded that the presence of headache symptoms suggest an unresolved concussion.

In addition to neuropsychological testing, assessment tools including sideline cognitive and postural stability testing and symptom scales are common forms of assessment following a suspected concussion. The *Standard Assessment of Concussion* (SAC) was developed as a means of sideline mental status assessment at the game site immediately following injury and has been shown to be sensitive to the effects of concussion for the first 48 hours postinjury (McCrea, 2001). The instrument requires 5–7 minutes to administer and is designed for use by individuals with no prior expertise in neurocognitive test administration. The SAC assesses orientation, immediate

TABLE 3. Postconcussion Symptom Scale^a*Postconcussion Symptom Scale (Circle Appropriate Number Indicating the Severity of Each Symptom)*

Symptom	None	Mild	Moderate	Severe			
1. Headache	0	1	2	3	4	5	6
2. Nausea	0	1	2	3	4	5	6
3. Dizziness	0	1	2	3	4	5	6
4. Trouble sleeping	0	1	2	3	4	5	6
5. Sensitivity to light	0	1	2	3	4	5	6
6. Sensitivity to noise	0	1	2	3	4	5	6
7. Blurred vision	0	1	2	3	4	5	6
8. Feel "in a fog"	0	1	2	3	4	5	6
9. Loss of memory	0	1	2	3	4	5	6
10. Feel "slowed down"	0	1	2	3	4	5	6
11. Trouble concentrating	0	1	2	3	4	5	6
12. Balance problems	0	1	2	3	4	5	6
13. Ringing in ears	0	1	2	3	4	5	6
14. Irritability	0	1	2	3	4	5	6
15. Vomiting	0	1	2	3	4	5	6
Total	—	—	—	—	—	—	—
Symptom score	—	—	—	—	—	—	—

Note. Adapted from "National Athletic Trainers' Association Position Statement: Management of sport-related concussion," by Guskiewicz et al., 2004, *Journal of Athletic Training*, 39, 280-297

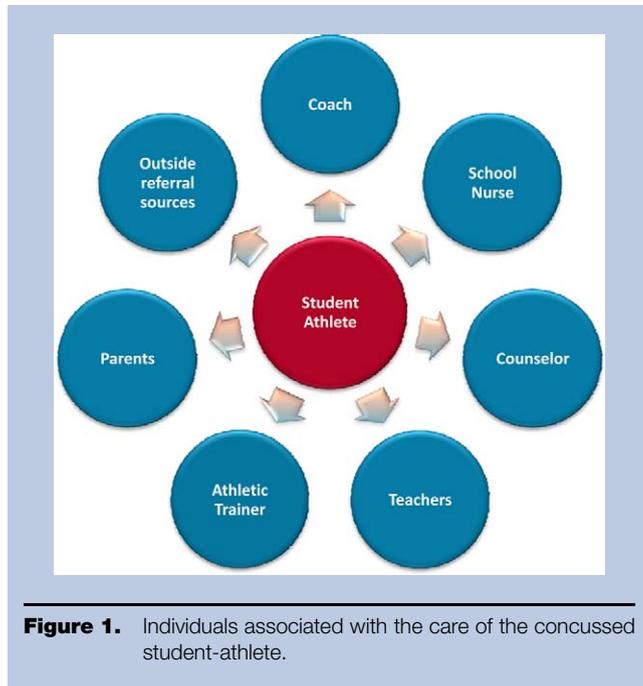
^a The GSS is a self-report scale which the athlete completes. The school nurse can then sum the total scores for each column and add them together to get a total symptom score. The number of symptoms endorsed (any symptom not 0) can also be recorded.

memory, concentration, and delayed recall following injury. The assessment also incorporates a neurological screening focusing on domains of strength, sensation, and coordination (McCrea, 2001; Patel et al., 2005). Orientation is assessed by asking the participant to provide the day of the week, date, month, year, and time. A five-word list of unrelated terms is used to measure immediate memory. The list is read to the participant for immediate recall and is repeated for a total of three trials. Concentration is assessed by having the participant repeat strings of numbers in the reverse order of how they were read by the examiner and by reciting the months of the year in reverse order. Delayed recall of the five-word list is also recorded. A composite score, with a maximum of 30 points, is derived (McCrea, 2001).

The *Balance Error Scoring System* (BESS) is a standardized assessment of postural stability that has been shown to have excellent validity with computerized measures of postural stability (Riemann, Guskiewicz, & Shields, 1999). The BESS consists of six separate 20-s balance tests that the student-athlete performs in different stances and on different surfaces. The test consists of three stance conditions (double-leg, single-leg, and tandem stance) and two different surfaces (firm and foam). For all

conditions, the student-athlete is required to keep their hands on their hips and their eyes closed in each position. The clinician administering the test watches for compensatory movements (errors) that are recorded as the quantitative measurement of postural stability under each testing conditions. These errors included (a) opening the eyes, (b) stepping, stumbling, and falling out of the test position, (c) lifting the hands off the iliac crests, (d) lifting the toes or heels, (e) moving the leg into $>30^\circ$ of flexion or abduction, and (f) remaining out of the test position for >5 s. The total number of errors during the testing comprises the total score of the test (Riemann et al., 1999).

Graded symptom scales (GSS) are a self-administered scale that identifies the number and severity of postconcussive symptoms (Table 3). The GSS includes a list of concussion-related symptoms presented in a Likert scale format. A 7-point Likert scale is used with "0" representing no symptoms; 1-2, mild symptoms; 3-4, moderate symptoms; and 5-6, severe symptoms. The student-athlete is instructed to circle the appropriate number for each symptom, indicating the presence and severity of a given symptom. Each column is totaled, and the total sum indicates the student-athlete's symptom score. A GSS



should be used following initial injury, as well as during the recovery process following both rest and exertional activities (Guskiewicz et al., 2004).

MANAGEMENT

The importance of communication in the care of a concussed student-athlete cannot be overemphasized. The complexity of a concussion requires the assistance of a variety of health care and school personnel to create an environment that encourages physical and cognitive rest to promote recovery. The school nurse plays a vital role, acting as a liaison among all aspects of care (Figure 1).

The school nurse may also need to interact with the certified athletic trainer employed or contracted by the school. The school's athletic trainer is responsible for the prevention, care, assessment, treatment, and rehabilitation of injuries resulting from athletic activity. In the case of student-athletes, the athletic trainer will likely be the first qualified health care provider to come in contact with the student-athlete following injury at school. Athletic trainers can provide valuable information regarding the status of the student-athlete, injury history, and specific concerns regarding the student-athlete's condition, as well as the scores from the objective concussion assessments.

In some instances, the signs of a concussion do not become obvious until several hours or even days after the injury. Please be especially observant for the following signs and symptoms:

1. Headache (especially one that increases in intensity*)
2. Nausea and vomiting*
3. Difference in pupil size from right to left eye, dilated pupils*
4. Mental confusion/behavior changes
5. Dizziness
6. Memory loss
7. Ringing in the ears
8. Changes in gait or balance
9. Blurry or double vision*
10. Noticeable changes in the level of consciousness (difficulty awakening or losing consciousness suddenly)*
11. Decreased or irregular pulse OR respiration*
12. Loss of orientation
13. Nervousness
14. Sensitivity to light
15. Sensitivity to noise
16. Vacant stare/glassy eyed
17. Fatigue
18. Feel "in a fog" or "slowed down"

* Seek medical attention at the nearest emergency department

The best guideline is to *note symptoms that worsen*, and behaviors that seem to represent a change in the student-athlete. If you have any questions or concerns at all about the signs and symptoms you are observing, contact the school nurse immediately.

Source: Guskiewicz et al., 2004.

Figure 2. Sample form the school nurse may share with teachers showing the signs and symptoms of concussion.

Note. Adapted from "National Athletic Trainers' Association Position Statement: Management of sport-related concussion," by Guskiewicz et al., 2004, *Journal of Athletic Training*, 39, 280-297.

The school nurse and the school's athletic trainer can form a valuable partnership that can benefit the care of an injured student-athlete. However, according to the National Athletic Trainers' Association, only 42% of high schools in the United States have access to a certified athletic trainer (National Athletic Trainers' Association, 2009), therefore making the school nurse the primary care provider in the school setting. The school nurse should be in direct contact with physicians and specialists involved in patient care. In the case of an injured student-athlete, the school nurse is likely to communicate with an athlete's family following a concussion and may be the main source of communication with other school officials. Proper management following a concussion includes proper preparation for home care, which involves athlete and parent education. Additionally, parents should be clear on any recommendations and instructions for home care as well as details regarding follow-up evaluation (Guskiewicz et al., 2004).

It is important that school nurses are aware of "red flags" that could indicate a worsening condition or more severe head injury and share that information with parents following a concussion (Figure 2). As the primary health care provider during the school day, questions or concerns may

be directed to the school nurse. This further supports the importance of a close professional relationship between the school nurse and the athletic trainer to allow for clear communication with the family. Additionally, the school nurse may need to work with the student-athlete, school counselor, and teachers to ensure the student-athlete is not experiencing academic difficulties and to monitor for other problems that may occur.

Precautions

As the concussed student-athlete recovers and may deal with postconcussion syndrome or PTHA, it is important that school nurses are educated about important precautions that should be taken with the use of nonsteroidal anti-inflammatory drugs (NSAIDs) and aspirin following a head injury. Ibuprofen is a beneficial anti-inflammatory medication; however, it blocks the activity of cyclooxygenase, thromboxane, and prostaglandins during the inflammatory process, therefore inhibiting the aggregation of blood platelets on blood vessel walls and decreasing the blood's ability to clot (Ciccone, 2002).

Another commonly consumed medication that should be taken with caution following a brain injury is aspirin, which also inhibits the activity of thromboxane and decreases the body's ability to clot blood (Ciccone, 2002). The school nurse also needs to have a strong knowledge base of what medications a student-athlete should be taking or not taking to aid in relief from the short-term, and possibly long-term, effects of concussion such as headache, LOC, blurred vision, dizziness, amnesia, continuous irritability, reaction time impairments, delayed memory, and delayed processing speed (Collins et al., 2002; McClincy, Lovell, Pardini, Collins, & Spore, 2006; Sim, Terryberry-Spohr, & Wilson, 2008).

Special Accommodations

The school nurse also plays a vital role in the utilization of school resources that will aid in the student-athlete's recovery. As previously discussed, concussive injury has the potential to affect a student-athlete's ability to function in the classroom. Like parents, teachers need to be educated on the signs and symptoms of a concussion, as well as what to expect from a student with this injury. The

Centers for Disease Control and Prevention has developed the *Heads Up: Brain Injury in Your Practice—A Tool Kit for Physicians* (http://www.cdc.gov/ncipc/tbi/physicians_tool_kit.htm) that includes the Acute Concussion Evaluation plan for returning to school (Appendix). This form contains a list of concussion-related symptoms, red flags, advice on returning to daily activities, school, and sports and the progression for returning to sports that was discussed earlier.

School nurses and teachers should also be familiar with the educational accommodation plans that may need to be put in place for student-athletes dealing with the short- or long-term effects of sustaining a head injury during their participation in school sports. These plans, required to be provided by the high school, may be put in place to help concussive student-athletes deal with cognitive delays or learning problems that may have occurred following their head injury. Currently, there are two policies provided by high schools to meet the needs of a concussed student-athlete: the 504 plan and an individualized education program (IEP). The 504 plan is derived from Section 504 of the Rehabilitation Act of 1973. The Department of Education (U.S. Department of Education, 2007) describes Section 504 as a section that protects the rights of individuals with disabilities in activities and programs that receive federal funds, such as public school districts. A rule of Section 504 permits that a school district must give free appropriate public education to each person with a disability regardless of the severity of his or her disability (U.S. Department of Education, 2007). The other policy is the IEP, from the Individuals with Disabilities Education Act (IDEA), which is designed for each individual receiving special education (U.S. Department of Education, 2007). An IEP provides the opportunity for teachers, parents, the student-athlete's physician, the school nurse, and the student-athlete to come together to improve the educational goals for the concussed student-athlete (U.S. Department of Education & National Information Center for Children and Youth with Disabilities, 2000). An IEP for a child with concussion may include reducing the number of assignments, providing more time to finish class work and tests, making an outline and listing steps for big tasks, providing written instructions the student-athlete may refer to when confused, and using a notebook to write down tasks that need to be done (Hossler & Savage, 2006). To

address the severity of a person's disability, the Section 504 plan outlines various accommodations that may be provided. Concerns following a brain injury include processing delays, visual deficits, memory deficits, motor difficulties, fatigue, academic progress, and emotional well-being (deBettencourt, 2002). Suggested accommodations for these concerns include breaking down complex material into steps, allowing longer time to complete tests or assignments, written direction for tasks, frequent review of information, distraction free work areas, a note-taker for classes, incorporation of less stressful coursework, weekly progress report between home and school, and a quiet area for refocusing (Hossler & Savage, 2006).

"An IEP provides the opportunity for teachers, parents, the student-athlete's physician, the school nurse, and the student-athlete to come together to improve the educational goals for the concussed student-athlete."

CONCLUSION

The care of a concussed student-athlete requires the cooperation and coordination of several health care providers. The adolescent population presents a challenge when it comes to concussion management. It is important to be familiar to signs and symptoms commonly associated with concussive injury, as well as the complications that can occur as a result of concussion. Several assessment tools, such as the SAC and BESS, are currently used to evaluate a student-athlete following concussion. These tools provide valuable information that is helping in determining a course of action during the recovery process, as well as in return-to-play decisions. The school nurse is an essential source of information for school administration and faculty, as well as an advocate for the wellbeing of the student-athlete. The school nurse plays an integral role during the school day, working to ensure proper action is being taken to create the best possible environment for the student-athlete. It is important that the school nurse is up-to-date

on current concussion information to allow for optimal care following injury and during the recovery process.

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APPENDIX

ACUTE CONCUSSION EVALUATION (ACE)

CARE PLAN

Gerard Gioia, PhD¹ & Micky Collins, PhD²
¹Children's National Medical Center
²University of Pittsburgh Medical Center

Patient Name: _____
DOB: _____ Age: _____
Date: _____ ID/MR# _____
Date of Injury: _____

You have been diagnosed with a concussion (also known as a mild traumatic brain injury). This personal plan is based on your symptoms and is designed to help speed your recovery. Your careful attention to it can also prevent further injury.

Rest is the key. You should not participate in any high risk activities (e.g., sports, physical education (PE), riding a bike, etc.) if you still have any of the symptoms below. It is important to limit activities that require a lot of thinking or concentration (homework, job-related activities), as this can also make your symptoms worse. If you no longer have any symptoms and believe that your concentration and thinking are back to normal, you can slowly and carefully return to your daily activities. Children and teenagers will need help from their parents, teachers, coaches, or athletic trainers to help monitor their recovery and return to activities.

Today the following symptoms are present (circle or check).				No reported symptoms
Physical		Thinking	Emotional	Sleep
Headaches	Sensitivity to light	Feeling mentally foggy	Irritability	Drowsiness
Nausea	Sensitivity to noise	Problems concentrating	Sadness	Sleeping more than usual
Fatigue	Numbness/Tingling	Problems remembering	Feeling more emotional	Sleeping less than usual
Visual problems	Vomiting	Feeling more slowed down	Nervousness	Trouble falling asleep
Balance Problems	Dizziness			

RED FLAGS: Call your doctor or go to your emergency department if you suddenly experience any of the following			
Headaches that <u>worsen</u>	Look <u>very</u> drowsy, can't be awakened	Can't <u>recognize</u> people or places	Unusual behavior change
Seizures	<u>Repeated</u> vomiting	Increasing confusion	Increasing irritability
Neck pain	Slurred speech	Weakness or numbness in arms or legs	Loss of consciousness

Returning to Daily Activities

1. Get lots of rest. Be sure to get enough sleep at night- no late nights. Keep the same bedtime weekdays and weekends.
2. Take daytime naps or rest breaks when you feel tired or fatigued.
3. **Limit physical activity as well as activities that require a lot of thinking or concentration. These activities can make symptoms worse.**
 - Physical activity includes PE, sports practices, weight-training, running, exercising, heavy lifting, etc.
 - Thinking and concentration activities (e.g., homework, classwork load, job-related activity).
4. Drink lots of fluids and eat carbohydrates or protein to main appropriate blood sugar levels.
5. **As symptoms decrease, you may begin to gradually return to your daily activities. If symptoms worsen or return, lessen your activities, then try again to increase your activities gradually.**
6. During recovery, it is normal to feel frustrated and sad when you do not feel right and you can't be as active as usual.
7. Repeated evaluation of your symptoms is recommended to help guide recovery.

Returning to School

1. If you (or your child) are still having symptoms of concussion you may need extra help to perform school-related activities. As your (or your child's) symptoms decrease during recovery, the extra help or supports can be removed gradually.
2. Inform the teacher(s), school nurse, school psychologist or counselor, and administrator(s) about your (or your child's) injury and symptoms. School personnel should be instructed to watch for:
 - Increased problems paying attention or concentrating
 - Increased problems remembering or learning new information
 - Longer time needed to complete tasks or assignments
 - Greater irritability, less able to cope with stress
 - Symptoms worsen (e.g., headache, tiredness) when doing schoolwork

~Continued on back page~

This form is part of the "Heads Up: Brain Injury in Your Practice" tool kit developed by the Centers for Disease Control and Prevention (CDC).

SCHOOL VERSION

Returning to School (Continued)

Until you (or your child) have fully recovered, the following supports are recommended: *(check all that apply)*

- No return to school. Return on (date) _____
- Return to school with following supports. Review on (date) _____
- Shortened day. Recommend ___ hours per day until (date) _____
- Shortened classes (i.e., rest breaks during classes). Maximum class length: _____ minutes.
- Allow extra time to complete coursework/assignments and tests.
- Lessen homework load by ____%. Maximum length of nightly homework: _____ minutes.
- No significant classroom or standardized testing at this time.
- Check for the return of symptoms (use symptom table on front page of this form) when doing activities that require a lot of attention or concentration.
- Take rest breaks during the day as needed.
- Request meeting of 504 or School Management Team to discuss this plan and needed supports.

Returning to Sports

1. **You should NEVER return to play if you still have ANY symptoms** – (Be sure that you do not have any symptoms at rest and while doing any physical activity and/or activities that require a lot of thinking or concentration.)
2. Be sure that the PE teacher, coach, and/or athletic trainer are aware of your injury and symptoms.
3. It is normal to feel frustrated, sad and even angry because you cannot return to sports right away. With any injury, a full recovery will reduce the chances of getting hurt again. It is better to miss one or two games than the whole season.

The following are recommended at the present time:

- Do not return to PE class at this time
- Return to PE class
- Do not return to sports practices/games at this time
- Gradual** return to sports practices under the supervision of an appropriate health care provider (e.g., athletic trainer, coach, or physical education teacher).
 - Return to play should occur in gradual steps beginning with aerobic exercise only to increase your heart rate (e.g., stationary cycle); moving to increasing your heart rate with movement (e.g., running); then adding controlled contact if appropriate; and finally return to sports competition.
 - Pay careful attention to your symptoms and your thinking and concentration skills at each stage of activity. Move to the next level of activity only if you do not experience any symptoms at the each level. If your symptoms return, let your health care provider know, return to the first level, and restart the program gradually.

Gradual Return to Play Plan

1. No physical activity
2. Low levels of physical activity (i.e., *symptoms do not come back during or after the activity*). This includes walking, light jogging, light stationary biking, light weightlifting (lower weight, higher reps, no bench, no squat).
3. Moderate levels of physical activity with body/head movement. This includes moderate jogging, brief running, moderate-intensity stationary biking, moderate-intensity weightlifting (reduced time and/or reduced weight from your typical routine).
4. Heavy non-contact physical activity. This includes sprinting/running, high-intensity stationary biking, regular weightlifting routine, non-contact sport-specific drills (in 3 planes of movement).
5. Full contact in controlled practice.
6. Full contact in game play.

*Neuropsychological testing can provide valuable information to assist physicians with treatment planning, such as return to play decisions.

This referral plan is based on today's evaluation:

- Return to this office. Date/Time _____
- Refer to: Neurosurgery ___ Neurology ___ Sports Medicine ___ Physiatrist ___ Psychiatrist ___ Other ___
- Refer for neuropsychological testing
- Other _____

ACE Care Plan Completed by: _____