Maximizing Recovery From Concussions for Youth Participating in Sports and Recreational Activities

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Abstract: Concussions have become a public health issue. This public health concern has drawn the attention of many states in which laws were created to address concussions safety, recognition of signs and symptoms, immediate removal, medical clearance, and return-to-play protocols. Most state legislation focused on student athletes participating in organized sports. However, the rise in concussion can be directly attributed to children, youth, and adolescents participating in nonsports-related events. Maximizing recovery from a concussion involves implementing education programs that focus on recognition of symptoms, treatment, and return-to-learn options. Treatment strategies used to address concussed youth include physical and cognitive rest and minimizing external stimuli that can increase symptoms. Because learning is a direct outcome for all youth, a return-to-learn protocol based on a collaborative school-based team approach is suggested.

Key Words: Youth, Concussions, Return to Play, Return to Learn

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The new recommended mantra in youth sports is *"When in doubt, sit them out!"* This mantra comes at a time when concussion or mild traumatic brain injury (*m*TBI)-related injuries are a growing concern for many pediatricians, athletic administrators, coaches, athletic trainers, parents, and educators. There are various definitions for concussion and *m*TBI. A concussion is a pathophysiological process affecting the brain, caused by direct or indirect traumatic biomechanical forces.[1] A *m*TBI connotes an alteration in brain function or other evidence of brain pathology, caused by an external force.[2] Consequently, the terms concussion and *m*TBI can be used interchangeably. For the purpose of this review, the authors choose the definition by McCrory et al. (2009)[3] as most suitable for the youth population and for this review.

Although the athletic and financial stakes of concussions are high at the college and professional ranks, involving recruiting and scholarship potential, concussions are a growing concern for youth participating in interscholastic athletics and youth sports programs.[4] The importance of concussions should not only be relegated to specific groups of individuals (i.e., male vs. female, learning disabilities) or the sports these individuals participate (i.e., football, soccer, basketball, volleyball, judo); the concern needs to be addressed for *all* youth (those 18 yrs and younger) including preadolescent (younger than 12 yrs) and adolescent (aged 12–18 yrs) whether they participate in organized sports.[5]

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Because of the rise in concussions and catastrophic brain injuries in youth and high school sports, states have recognized concussions as a public health concern. The State of Washington was the first to initiate concussion legislation (e.g., Lystedt Law), and other states followed suit with similar concussion prevention requirements. At present, all 50 states have some form of concussion legislation.

Currently, state concussion laws address the concerns in high school sports. Moreover, there is a legislative trend where bills are introduced to address the concerns in youth sports such as Oregon's Jenna's Law. For most states, concussion laws are composed of the following: immediate removal from play, annual training and education of coaches, athletes and parents, clearance from medical professional to return to play (RTP), and in some cases return to learn (RTL) protocols.[6] Consequently, annual training, education, and awareness continue to be high priority requirements for state concussion laws; however, the extent on how information is distributed varies from state to state. It is apparently clear that coaches, parents, educators, and youth still require more concussion information that focuses on signs, symptoms, prevention, and treatment.

States have a responsibility to ensure that concussion prevention, evaluation, and treatment are being addressed by all organizations and stakeholders at all levels. Despite good intentions, not all states have the ability to monitor concussion education, much less document concussion-related injuries. Concussion accountability is the responsibility of all stakeholders, especially those working with teaching or coaching youth. Children participating in sports, recreational activities, or simply playing on playgrounds can sustain concussions; unfortunately, these may go unreported if the stakeholders are not properly educated.

Youth organizations should implement guidelines and protocols that address concussion management and care for concussed youth. Finally, a youth's primary mission is schooling, and as such, educators and school systems need to address a return to academic learning for youth recovering from a concussion. To this end, the purpose of this review was three-fold: (1) describe

the rise in concussion for youth, (2) describe current prevention and treatment strategies used with youth populations, and (3) promote specific RTL strategies for concussed youth.

INCREASE IN SPORTS AND NONSPORTS-RELATED CONCUSSION FOR YOUTH

There are approximately 38 million children participating in organized, community-supported athletic programs annually.[7] Emergency department (ED) visits for concussions have increased 62% between 2001 and 2009, and researchers have estimated that between 1.6 and 3.8 million sports-related concussions occur each year in the United States.[8] Statistics show that highest rates of emergency department visits for sports concussion occur in youth aged 10–14 yrs, followed by those aged 15–19 yrs.[7]

Nonsports-related concussions have also increased exponentially over the years. More specifically, sports and recreational-related concussions, particularly for youth 18 yrs or younger, have increased. Most visits for youth younger than 10 yrs were directly related to nonsports- and recreational-related activities, such as skateboarding, riding bicycle, falls, and playground activities.[8] Most of these concussions occur more often at home, school, or the play ground.[5] For instance, during 2001–2009, an estimated 2,651,581 children 19 yrs or younger were treated annually for sports and recreational-related injuries.[8,9] For males and females 9 yrs or younger, concussions most commonly occurred during playground activities or when bicycling. Perhaps even more convincing is the fact that no school-related concussion studies have been completed, and most, if not all concussions, were reported based on sports and emergency department data.

Researchers analyzing administrative health records of more than 8 million members of a large private-payer insurance group found that the highest incidence of concussions was seen in patients aged 15–19 yrs (16.5/1000), followed by 10–14 yrs (10.5/1000).[4] The authors further surmised that overall there was an increase of 60% in concussion between 2007 and 2014 with the largest increases in the 10–14 yrs (143%) and 15–19 yrs (87%).[4] From this, education, awareness, prevention, and continued concussion surveillance needs to be the responsibility of schools, health care facilities, and community organizations.

MAXIMIZING RECOVERY FROM CONCUSSIONS THROUGH EDUCATION

Being educated about concussions and its signs and symptoms will likely increase an individual's level of awareness, understanding, and behavior on the seriousness of concussions in youth.[10] For the pediatric athlete, the influential role that parents play dictates that they need to be active participants as well. It is therefore necessary that education and awareness of concussions and concussion-like signs and symptoms be provided to most individuals who have direct and indirect impact with children and adolescents ages 4–14 yrs.

In a study of on-field management of concussions for children, researchers found that the on-field management of sports-related concussions was questionable and suboptimal for children and youth.[11] Youth with a suspected concussion were not formally assessed and continued to participate with concussion symptoms. More than 90% of parents and youth were unaware of return-to-play guidelines from the organization, suggesting that the education of stakeholders on what is a concussion, how to manage a concussion, and when it is safe to RTP is necessary to ensure the well-being of participants.[11]

Other researchers further posited that "the more people know about a concussion before it happens, the more likely it is that the concussion will be managed correctly from the start, reducing potential complications from returning to activities too soon" (p. 710).[12] Education and recognition remains the most important components of improving the care of athletes with concussions.[11] One way to increase awareness of concussions is to provide a concussion education and awareness program to administrators, coaches, parents, teachers, childcare providers,[13] and recreation directors and evaluate their ability to recognize the signs and symptoms as well as who to contact when a head injury is suspected.[11] Moreover, coaching education was predictive of the ability to recognize signs and symptoms of sport-related concussion.[14]

Every effort to become educated is important, but so is the actual behavior we exhibit as a parent, coach, family member, or friend when a concussion is suspected. Completing concussion educational programs has its benefits on knowledge and awareness; however, what is most critical is the individual's behavior when confronted with a youth with a concussion, or his or her own concussion. For example, concussions of high school student athletes continue to be underreported or never reported to a coach, athletic trainer, or medical professional because of concussion knowledge and attitudes.[15] In another study, it was determined that underreporting and pressure from coaches, teammates, fans, and parents influenced their reporting of concussions for college athletes across seven sports.[16] The authors found that college athletes who experienced pressure from all four sources were more likely to continue playing and not notify others, compared with those who were not influenced by others or only from one source (i.e., coaches or teammates).[17] The extent to which such behaviors can be generalized to youth remain to be seen; however, there is that possibility that pressure from adults may negatively influence a youth's behavior about concussion reporting despite the potential hazard.

TREATMENT STRATEGIES FOR YOUTH

It is imperative that professionals understand that children and youth cannot be treated the same as an adult with a concussion; instead, children and youth need to be treated based on their age.[18] Specifically, the following considerations need to be addressed regarding differences between youth and adults, including: (1) physiological development, (2) impact forces and protective abilities, (3) physical and cognitive recovery, (4) effects on school and learning, and (5) potential for long-term effects of concussions.[18] These considerations have a profound effect on how youth and adult concussions are treated.

Understanding the etiology and epidemiology of concussions has become critical, particularly with young children. Compared with adults, children's brains differ anatomically, physiologically, and emotionally and therefore management and treatment differ. This lack of physiological development also has implications on how young children absorb the impact

forces and how they are able to protect themselves from potential harm of a concussion.[18] The immature musculoskeletal system, such as a less developed neck, shoulder, and core musculature can increase the potential for injury, because a youth's upper muscular structure may not be able to absorb the force or impact of a concussion. Compared with adults, children's brains differ anatomically and physiologically. In addition, children are at different stages of emotional development. Therefore, management and treatment of concussion must be adjusted to accommodate for these differences.[16] A youth's brain may not have the plasticity to diffuse tensile and shearing forces to the brain, thus increasing the likelihood of potential concussions.[18,19]

The amount of time for recovery for youth is much longer than an adult's recovery time.[20] Specifically, literature for the past 10 yrs demonstrated that youth and high school athletes take much longer than 10 days to clinically recover and return to sports.[1] Youth's symptoms may last longer, change from day to day, and may have long-term effects on health, behavior, interpersonal skills, and school. Therefore, youth may require extended periods of rest and limited exertion as part of their recovery. Although most children and youth can fully recover from a single concussion, recovery takes time, in some cases days, weeks, and even months.[16]

Postconcussive symptoms (PCSs) associated with youth also differ from adults. The duration and course of postconcussive symptoms for youth included physical symptoms as the immediate and predominate symptom after injury, emotional symptoms developed later during recovery, and cognitive symptoms lasting throughout.[21] Similarly, there are other instances whereby the physical, emotional, and cognitive attributes will be affected by concussions. Identifying these concussion signs and symptoms can increase the likelihood of facilitating a safe and successful return to daily activity after a concussion. Once specific signs and symptoms are identified, the parent and stakeholders will have a better understanding of what strategies for treatment to implement. Ability to recognize specific signs and symptoms related to concussions is advisable for all individuals working, teaching, or coaching youth (Table 1).

TABLE 1. Observable signs and reportable symptoms of a concussion

Observable signs of a concussion	What a parent, coach, and teacher may observe in an individual with a concussion	• Vacant stare/ glassy eyed • Appears dazed or stunned • Slow to respond to questions • Slow speech • Forgets instructions • Behavior changes • Emotional changes • More irritable • Disoriented • Appears confused • Lethargic • Loss of consciousness
Reportable symptoms of a concussion	What an individual with a concussion may report to parent, coach, and teacher	• Headache • Dizziness • Blurred vision • Sensitivity to light or noise • Nausea • Feeling like in a "fog" • Difficulty concentrating • Difficulty remembering • Feeling confused • Fatigue or slowed down • Nervous or anxious

MULTIFACTORAL APPROACH TO TREATMENT AND RECOVERY

Cognitive rest and physical rest are considered the cornerstone of concussion treatment and recovery. The basis for prescribing rest is to minimize concussion symptoms and energy demands of the brain, hence promoting recovery. However, the literature on cognitive and physical rest is inconsistent on what type of rest and for how long.[22]

Previous thoughts of cognitive rest included limiting activities such as texting, TV, video games, computer work, and even reading.[1] A child may feel the cognitive symptoms, particularly with cognition such as feeling foggy, slowed down, difficulty concentrating, slowed speech, easily distracted, and difficulty remembering. Cognitive or mental fatigue is another potential reason for symptom exacerbation. Because of the neurometabolic cascading effects of a concussion, the brain energy demands are not balanced, leading to an energy crisis.[21] Previous thinking recommended allowing the brain to rest, getting the child enough sleep, and no additional forces to the head/brain to reduce the energy demands of the concussed brain. Other researchers found that there are measurable effects on cognitive functioning including decreased learning and memory, mental fatigue, difficulty with new learning or content, decreased attention, and slowed processing speed and reaction time.[14,23] Currently, complete cognitive rest for an overextended time is not supported because prolonged rest can interfere with the healing process; therefore, it leads to prolonged recovery and potentially increase the risk for social, behavioral, and emotional problems.[20]

Physical rest implies that the child is removed from any form of physical activity including physical education classes, sports, exercising, and recreational activities (i.e., surfing, skateboarding, jogging, etc). Researchers have suggested that 24–48 hours are the minimum required amount of time a child should go without any form of physical activity.[22] The range of time associated with no physical activity is based on the average amount of hours a child may or not seem to have symptoms. Once the child is asymptomatic, a gradual and monitored return to physical activity can be implemented.[18] Conversely, other researchers have noted that prolonged physical inactivity may be detrimental and argue for some form of early monitored physical activity as part of the recovery process.[24]

It is not known if all youth organizations in the United States have adopted and implemented some type of concussion action plan and an RTP protocol. Although some variations might be presented, the Zurich RTP guidelines essentially contain a

TABLE 2. Gradual RTP protocol[22]

Step	Aim	Activity	Goal
1	Symptom limited activity	Daily activity and lifestyle that do not provoke symptoms	Reintegration back to school and life
2	Light aerobic exercise	Walking or stationary bicycle at a slow to medium pace	Increase heart rate
3	Sport-specific exercise	Running or individual skill drills. No contact	Add movement
4	Noncontact training drills	Harder skill specific drills, noncontact team drills, weight training	Exercise, coordination, increase cognitive demands
5	Full contact practice	After medical clearance, normal practice, contact allowed	Restore confidence and functional skills
6	Return to sport	No restrictions, normal game play	

gradual progression back to playing without any restrictions. The progressions incorporated aerobic activity for cardiovascular fitness- and sports-specific activity to incorporated cognitive readiness, as well as confidence in returning to sport (Table 2).[22] The progressions or steps are separated by a 24-hour period, and if the youth with a concussion experiences any symptoms or problems, they must rest for 24 hours before reattempting step.

The gradual RTP protocol was primarily designed for student athletes and professional athletes to safeguard their return to full activity or game play. In community or recreational activities, this type of gradual return to participation may not be available, or participants are simply uninformed about the process. Currently, there is no literature that supports the use of the graduate RTP protocol in youth populations, particularly in the age range of 5–11 yrs.

The authors would recommend that youth organizations, recreational leagues, and community groups explore the use of a Concussion Action Plan (CAP). The CAP provides a possible solution to address the problem of inconsistent or suboptimal care of the youth with a concussion and raises awareness to the stakeholders involved within the organization. The CAP ensures that participants receive a standard of care when a concussion event occurs, defined roles of stakeholders during the management and treatment for a concussion, and is necessary for liability purposes (Table 3).

RETURN TO LEARN

"*Learning* is the centerpiece of child and adolescent development. Children's organ of learning is their brain; any adverse event that impairs the brain functioning, temporarily or permanently, poses a significant threat to learning."[12] Approximately, 70% of youth concussions affect the frontal lobe of the brain, where key functions include intellectual tasks, learning, and retention.[26] It is therefore conceivable that environmental factors and time of day within school can trigger symptoms and obstruct learning. There is ample evidence to suggest that overloading a concussed brain can lead to worsening of symptoms and even a protracted recovery.[12] After a concussion, 30% of concussed students reported a decline in school performance or an effect on school attendance. Because concussions for children and youth are individualized and unique, determining an appropriate recovery length of time is difficult. The inconsistencies associated with the actual number of days missed are largely due to the limited amount of RTL research being conducted.[27]

Despite all 50 states and the District of Columbia having some form of a sport-related concussion law and RTP, only seven states have any provisions that specifically highlight the importance of RTL for concussed youth. Moreover, although each state has RTP guidelines and protocols that systematically provide a step-by-step process in allowing youth to RTP, the vast majority have limited to no RTL approaches for concussed youth. Although the authors believe that it is important that states consider both RTP and RTL in their state statutes, expansion of concussion laws specifically recommending RTL may not be necessary.[6]

Unlike a sprain or a fractured limb, a concussion is an injury that cannot be seen. A child with a concussion may appear

TABLE 3. Minimal components of a concussion action plan

Education policy	The CAP should document the education and awareness policies for coaches, parents, officials and athletes. The CAP should also document what method and content will be given and a form to acknowledge that the individual did receive the information on concussions.
When to call emergency medical system (911)	The CAP should document under what circumstances should the EMS be activated and under what circumstances may a delayed referral be appropriate. A guideline for immediate and delayed referral maybe found in the NATA position statement.[25]
Emergency transportation plan	The CAP should document a detail emergency transportation plan of the venue. The plan will be described to EMS dispatch when 911 is called. The plan should also outline the roles of the coaches during emergency situation.
RTP policy after a recovery from a concussion	The CAP should also detail RTP policies for the organization. Medical clearance from an appropriate health care provider must be obtained in writing. The plan should also outline a monitored RTP program.
Documentation	The CAP should contain forms for coaches to complete. Documentation of event and steps taken during the injury and recovery should be documented for liability purposes.

EMS, emergency medical system; NATA, National Athletic Trainers Association.

normal, although physically, cognitively, and emotionally the individual is not healthy. Because of this, changes in a student's thinking, learning, and behavior may be blamed on other causes (e.g., mental fatigue or difficulty concentrating may be misinterpreted as laziness or disinterest). Some students may become anxious and depressed because they cannot function to their premorbid condition. Because of the metabolic imbalance and energy crisis occurring in the concussed brain, the likelihood of mental fatigue, overexertion, and exacerbated symptoms makes academic activities a challenge for the concussed youth. Aside from mental fatigue, other causes of that affect academic performance are delayed processing speed and vestibular-ocular dysfunction.

Determining which classroom adjustments may be beneficial for the concussed youth may be determined according to signs and symptoms the person with a concussion is reporting.[28] The definition of classroom adjustments is interventions that can be provided within the academic environment that are flexible and temporary. Figure 1 describes some reasonable classroom adjustments to help student with a concussion academically.[28]

A literature review on the evaluation and management of acute concussion for young children was conducted in which the following was reported: because young children differ physically, cognitively, and emotionally from adults, age-specific validated diagnostic tools are required and management of concussions in children should focus on returning to learn before considering returning to play.[23] Although RTP protocols have been mandated and adopted by athletic teams at high school, college, and professional levels, the RTL component for young children is less agreed upon and no formula exists.[23] Consequently, researchers reported that this was largely due to RTL being an individual process and not associated with how RTP can be institutionalized.[23] In concussion management, both RTP and RTL are common and important terms, but they are not parallel processes.[23]

Researchers have suggested that 40%–73% of students with a concussion require academic adjustments once they return to school.[27] In this regard, when students experience difficulties returning to school after a concussion, elementary through high school educators and administrators are unprepared on how to support their re-entry.[29] Perhaps one factor associated with their unpreparedness is the lack of communication and follow-up between youth, parents, administrators, physicians, athletic trainer, and coaches. Because it is well known that individuals will react differently when symptomatic and such symptoms will affect academic performance, communication and collaboration between stakeholders are strongly recommended. Any decision to allow a student or child to return to school requires a concussion management team (CMT) or multidisciplinary team approach to managing a concussion in schools and to maximizing recovery time. The recommendation for establishing a CMT provides the catalyst for transitioning the student back to

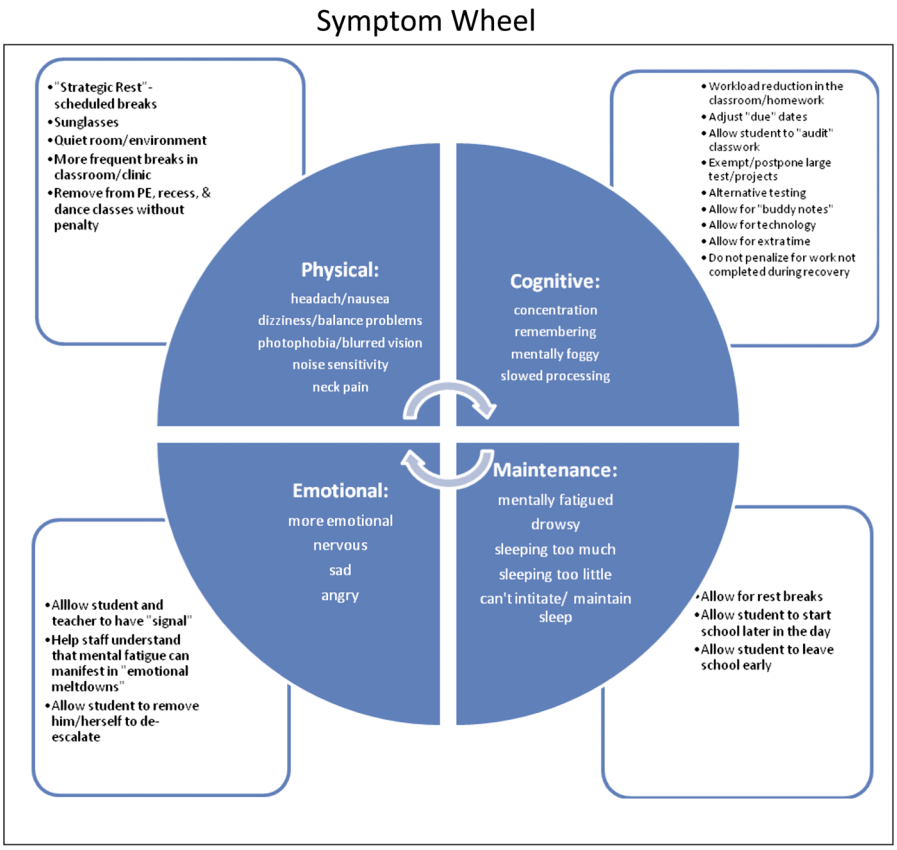

FIGURE 1. Reasonable classroom accommodations for a student with a concussion. McAvoy K BB. GetSchooledonconcussion.com. Available at: http://wwwgetschooledonconcussionscom/homehtml.

school. Collaborating between these members on a concussed student's success in the classroom requires communication, role release, flexibility and compassion, and understanding of all possible options such as federal laws.[29] The CMT consists of members that create the family team, medical team, and school team (Fig. 2).

The family team consists of the student's immediate family members, peers, and friends. They are important to the re-entry process to school after a concussion. The family team acts as advocates for the student with a concussion, ensuring appropriate reintegration into school and that proper academic adjustments are in place. The family team also provides feedback on the student's condition and behavior outside of school.

The medical team is composed of an athletic trainer (if applicable), physician, neuropsychologist, physical therapist, and other medical professionals as needed to provide appropriate medical care. The medical team is vital in recommending treatment and management strategies when the concussed student re-enters school. Communication is critical between the school team and medical team; however, Family Educational Rights and Privacy Act and Health Insurance Portability and Accountability Act guidelines make communication challenging.

The school team is the other piece to the overall CMT for a concussed student. The school team includes teachers, counselors, administrators, health aides, or paraprofessionals. The school team is vital in implementing flexible academic adjustments to help the concussed student succeed in the classroom. A challenge for educators is that not all classroom adjustments will be uniform in all classes. Because of teaching styles, teaching pace, and class content, not all recommended classroom adjustments can be implemented.

Unfortunately, educators may not always obtain the necessary information about concussions since much of what was previously published may have more applicability to coaches and athletic trainers but not educators.[26] Therefore, as part of the CMT, it is important to educate all those involved in the treatment and evaluation of a concussed youth in school. Consequently, the strongest predictor of a school system having an RTL policy is frequent communication between educators and athletic trainers.

The CMT has access to several RTL models that have shown to be effective and efficient in addressing the learning needs of a concussed youth. Several notable RTL models include the following: REAP (Reduce Educate Accommodate Pace) Project, BrainSTEPS, and Brain 101. Such RTL models have direct benefits for the CMT members in making sure that appropriate and adequate adjustments or accommodations are being made.

The authors encourage that CMT members should meet before the start of the academic year to set guidelines, protocols, referrals, and communication options for youth who are concussed to ensure that all adjustments or accommodations are available and present upon his or her return. At the very least, the CMT should create a "concussion watch list," which consists of youth who experienced a concussion and have returned to school. More importantly, it is important to note that both the concussed youth and the educator in the classroom are supported by the CMT through this transition back to school. A more formal approach would be to construct an educational infrastructure based on the following essential components: (1) defining and training an interdisciplinary CMT, (2) professional development of school and medical communities on concussion management in schools, (3) identification, assessment, He and progress monitoring protocols, (4) availability of a flexible set of intervention strategies or daily adjustments to facilitate a youth's recovery needs, and (5) systematized protocols for active and continuous communication among all CMT members.[23]

When the severity of a concussion promotes prolonged recovery, elevation of symptoms, or difficulty and challenges in school persists, CMT members may consider the implementation of the Section 504 plan or, if needed, an individualized education program. A Section 504 plan consists of identifying areas of concern or weakness, creating academic accommodations, and monitoring progress. This plan can be constructed with the input from all CMT members. The classroom teacher,

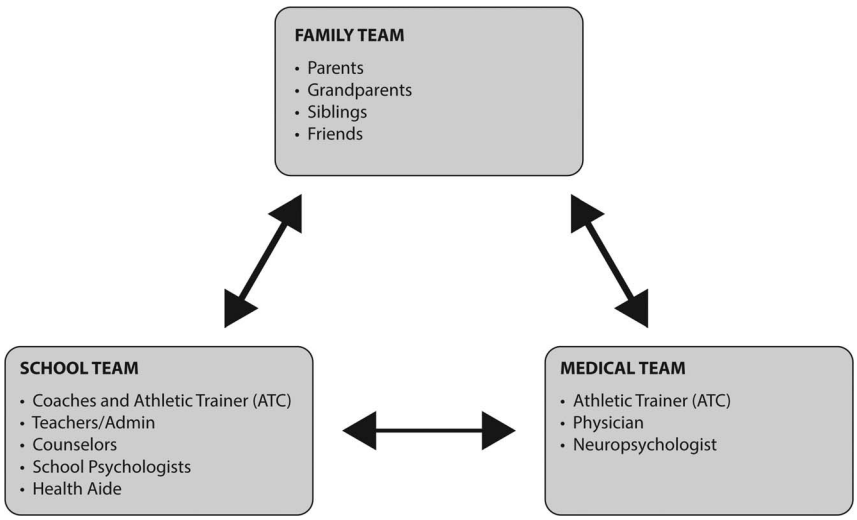

FIGURE 2. Team approach to concussion management involves communication between team members to determine what services are best to help the student succeed while recovering from concussion.

youth, and parents can assist with monitoring progress with the necessary adjustments.[28] Conversely, an individualized education program is a much more detailed plan in which a formal assessment needs to be conducted by a multidisciplinary team (different from CMT). The individualized education program is a formal document, process, and program specific to meet the needs of a youth who may have a permanent or temporary disability. Even with these federal safeguards, the authors believe that through the CMT, academic adjustments and accommodations can be successfully implemented for a concussed youth in school without the extreme measures of a 504 plan or individualized education program.

CONCLUSION AND RECOMMENDATIONS

Concussions and *m*TBI in youth have increased considerably over the years. The youth and adolescent groups seem to lead this increase in concussions. The impact of concussions has been felt at professional, college, and high school levels; however, for those youth who may or may not participate in sports or athletics, the impact of not adequately addressing a concussion has profound negative implications on education and quality of life.

States have initiated concussion-related laws to curb the possible catastrophic events of concussions. Such laws often consider "return to play" protocols and have mandated specific steps in concussion management such as immediate removal, clearance from a health care provider trained in concussion management, monitoring, education, and awareness before allowing the youth to RTP. The notion of a step-by-step concussion monitoring protocol ensures that physical rest and cognitive rest are being provided, limits to interaction with electronics that can increase symptoms are set, and a slow return to physical activity is in place. Gradual RTP protocols associated with youth may mirror similar protocols found at the college and even professional levels, yet it is important to note that recovery time in youth is not identical to adults. Therefore, it is incumbent for those educators, coaches, parents, physicians, athletic trainers, school personnel, and friends to understand the difference between an adult and youth in concussion recovery.

Learning is the center of youth and adolescent development. Successful gradual return to school requires collaboration from a CMT. Considering "return to learn," the team provides the necessary input in determining the amount of academic adjustments needed for the youth as he or she returns to school. A youth's ability to transition back to school requires that specific adjustments are made by educators to allow for the youth to acclimate himself or herself to educational tasks without increasing symptoms. The close monitoring of the youth is necessary during the transition back to school and in the adjustments made during classes. Education and awareness of concussions for parents, friends, school personnel, and administrators are necessary for those individuals to assist with the immediate care of a concussion. Moreover, although the RTP protocol has profound benefits to student athletes after a concussion, the authors would argue that RTL should be a priority for youth as they return to daily activity. Both RTP and RTL are mutually exclusive, and therefore, one should be completed before the other.[30] Lastly, we understand that there is a paucity of research in the area of RTL, and therefore, more research should be conducted in this area.

Recommendations

Based on the information provided, the authors would like to recommend the following:

1. Continue to educate all stakeholders of youth organizations on the importance of concussions management to provide immediate care and support.
2. Continue to advocate for the RTL protocol for youth that includes a framework for organizations and schools to implement.
3. Establish school-based concussion management plans and identify a cadre of school-based personnel that make a CMT.
4. Investigate and research clinical evaluation models, measures, trajectories, and treatment specifically for the 5–11-yr-old population.

REFERENCES

1. McCrory P, Meeuwisse W, Johnston K, et al: Consensus statement on concussion in sport - the 3rd international conference on concussion in sport held in Zurich, November 2008. *PM R* 2009;1:406–20
2. Menon DK, Schwab K, Wright DW, et al: Position statement: definition of traumatic brain injury. *Arch Phys Med Rehabil* 2010;91:1637–40
3. Yeates KO: Mild traumatic brain injury and postconcussive symptoms in children and adolescents. *J Int Neuropsychol Soc* 2010;16:953–60
4. Zhang AL, Sing DC, Rugg CM, et al: The rise of concussions in the adolescent population. *Orthop J Sports Med* 2016;4:2325967116662458
5. Karlin AM: Concussion in the pediatric and adolescent population: "different population, different concerns". *PM R* 2011;3(10 suppl 2):S369–79
6. Halstead ME, McAvoy K, Brown BE: Expanding concussion laws not necessary for return to learning after concussion. *Pediatrics* 2016;138. Available at: http://pediatrics.aappublications.org.eres.library.manoa.hawaii.edu/content/138/6. Accessed September 21, 2018
7. Glang A, Koester MC, Beaver SV, et al: Online training in sports concussion for youth sports coaches. *Int J Sports Sci Coach* 2010;5:1–12
8. Prevention CfDCa: Nonfatal traumatic brain injuries related top sports and recreation among persons aged ≤19 years - United States, 2001–2009. *US Department of Health and Human Services, Morbidity and Mortality Weekly Report* 2011;60:1337–42
9. Bryan MA, Rowhani-Rahbar A, Comstock RD, et al: Sports- and recreation-related concussions in US youth. *Pediatrics* 2016;138. Available at: http://pediatrics.aappublications.org.eres.library.manoa.hawaii.edu/content/138/6. Accessed September 21, 2018
10. Haran HP, Bressan S, Oakley E, et al: On-field management and return-to-play in sports-related concussion in children: Are children managed appropriately? *J Sci Med Sport* 2016;19:194–9
11. Halstead ME, Walter KD, Council on Sports Medicine and Fitness: American Academy of Pediatrics. Clinical report—sport-related concussion in children and adolescents. *Pediatrics* 2010;126:597–615
12. Sady MD, Vaughan CG, Gioia GA: School and the concussed youth: recommendations for concussion education and management. *Phys Med Rehabil Clin N Am* 2011;22:701–19, ix
13. Briss PA, Sacks JJ, Kresnow M, et al: A nationwide study of the risk of injury associated with day care center attendance. *Pediatrics* 1994;93:364–8
14. Valovich McLeod TC, Schwartz C, Bay C: Sports related concussion misunderstood among youth coaches. *Clin J Sport Med* 2007;17:140–3
15. Register-Mihalik JK, Guskiewicz KM, McLeod TC, et al: Knowledge, attitude, and concussion-reporting behaviors among high school athletes: a preliminary study. *J Athl Train* 2013;48:645–53
16. Kirkwood MW, Yeates KO, Wilson PE: Pediatric sport-related concussion: a review of the clinical management of an oft-neglected population. *Pediatrics* 2006;117:1359–71
17. Kroshus E, Garnett B, Hawrilenko M, et al: Concussion under-reporting and pressure from coaches, teammates, fans, and parents. *Soc Sci Med* 2015;134:66–75
18. Davis GA, Purcell LK: The evaluation and management of acute concussion differs in young children. *Br J Sports Med* 2014;48:98–101
19. Shrey DW, Griesbach GS, Giza CC: The pathophysiology of concussions in youth. *Phys Med Rehabil Clin N Am* 2011;22:577–602, vii
20. Schatz P, Moser RS: Current issues in pediatric sports concussion. *Clin Neuropsychol* 2011;25:1042–57
21. Giza CC, Hovda DA: The neurometabolic cascade of concussion. *J Athl Train* 2001;36:228–35
22. McCrory P, Meeuwisse W, Dvorák J, et al: Consensus statement on concussion in sport-the 5th International Conference on Concussion in Sport held in Berlin, October 2016. *Br J Sports Med* 2017;51:838–47

23. Iverson GL, Gioia GA: Returning to school following sport-related concussion. *Phys Med Rehabil Clin N Am* 2016;27:429–36
24. Leddy J, Baker JG, Haider MN, et al: A Physiological approach to prolonged recovery from sport-related concussion. *J Athl Train* 2017;52:299–308
25. Guskiewicz KM, Bruce SL, Cantu RC, et al: National Athletic Trainers' Association Position Statement: management of sport-related concussion. *J Athl Train* 2004;39: 280–97
26. Graff DM, Caperell KS: Concussion management in the classroom. *J Child Neurol* 2016;31:1569–74
27. O'Neill JA, Cox MK, Clay OJ, et al: A review of the literature on pediatric concussions and return-to-learn (RTL): implications for RTL policy, research, and practice. *Rehabil Psychol* 2017;62:300–23
28. McAvoy K BB: GetSchooledonconcussion.com. Available at: http://www.getschooledonconcussions.com/home.html. Accessed September 21, 2018
29. Lyons VH, Moore M, Guiney R, et al: Strategies to address unmet needs and facilitate return to learn guideline adoption following concussion. *J Sch Health* 2017;87:416–26
30. Halstead ME, McAvoy K, Devore CD, et al: Returning to learning following a concussion. *Pediatrics* 2013;132:948–57