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Clinical Focus

A Collaborative Model for Return to Academics After Concussion: Athletic Training and Speech-Language Pathology

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Purpose: In this article, we describe an academic concussion management protocol designed for grades Pre-K to 12, called Cognitive Return to Exertion (CoRTEx). Collaboration between the speech-language pathologist (SLP) and athletic trainer (AT) is highlighted.
Method: A description of CoRTEx is provided, and the need for collaboration is emphasized. A case study illustrates an example of how CoRTEx can be implemented at the individual student level.
Results: A total of 165 students went through CoRTEx from the pilot in April 2014 through December 2016. Referrals to CoRTEx were highest for football, blows to the head, and soccer. Anecdotal evidence suggests that CoRTEx provided necessary support for students and their families, although research is needed to provide objective data.
Conclusions: CoRTEx and other similar protocols can be used as models for SLPs to create their own academic concussion management protocols. For cases in which the injured student is an athlete, the SLP–AT collaboration is critical to carefully coordinate return to academics and return to play so that students are successful in school, as well as ready to safely return to sport. Suggestions are made for designing research studies that can provide empirical evidence for the efficacy of such academic concussion management protocols.

The role of speech-language pathologists (SLPs) in concussion management has been discussed recently in the literature (see Porter, Constantinidou, & Marron, 2014; Sirmon-Taylor & Salvatore, 2012; Sohlberg & Ledbetter, 2016). The responsibility for addressing the needs of students at the high school level, and for student athletes specifically, must be shared as no single profession can meet their diverse needs. Although SLPs and athletic trainers (ATs) rarely collaborate in the context of their typical job responsibilities, the management of brain injury is an area in which there is overlap between the two professional groups. SLPs and ATs both have a wealth of knowledge in brain-injury–related topics (including assessment and treatment), which suggests that collaboration could be an effective and rewarding opportunity that could benefit the student athlete.

Kasamatsu, Cleary, Bennett, Howard, and McLeod (2016) have investigated the role of the AT in providing academic support to adolescent student athletes. They found that although many ATs recommend a gradual return to academics (84.1% of surveyed ATs), only about half of that number actually had a formal return-to-academics protocol within their school district in order to follow through on that recommendation. The top rationale for not having a formal return-to-academics concussion management protocol was that the surveyed ATs believed that school professionals lacked understanding of concussion. SLPs were not considered in this article as school professionals who may have knowledge and expertise in the area of traumatic brain injury, but SLPs could fill the gap that the authors found in their article: "We recommend that a school professional…with training in academic accommodations and the response-to-intervention process should implement appropriate academic adjustments" (Kasamatsu et al., 2016, p. 160; also see Porter, Constantinidou, & Marron, 2014). The authors explained that although ATs are often the most qualified individuals to begin the return-to-academics process, they often do not have specific training in providing accommodations within the classroom that individuals who have been trained in special education possess.

Brain injury, particularly mild traumatic brain injury (of which concussion is generally considered a type),

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is not a rare occurrence in child and adolescent populations. The Centers for Disease Control estimates that 1.6–3.8 million sports-related concussions occur each year (McAvoy, 2012), making the total number of concussions sustained within a year's time much greater when considering causes other than sports. Because concussion is one of the most common types of traumatic brain injury in youth (Gioia, Isquith, Schneider, & Vaughan, 2009), a significant number of students in each school district throughout the United States are living with the symptoms of concussion at any given time (see Bradley-Klug, Garofano, Lynn, DeLoatche, & Lam, 2015). These symptoms can cause a marked disturbance in students' ability to perform academically and can lead to a number of negative consequences.

Interdisciplinary school-based teams that are trained to proactively manage return to academics after concussion are not prevalent, despite calls to action throughout the literature and data to suggest that concussion can be successfully managed with academic accommodations (Brown et al., 2014). The purpose of this article is twofold: (a) to describe the development and implementation of an academic concussion management protocol designed in a school district with over 6,000 students in southern Arizona, called Cognitive Return to Exertion (CoRTEx), and (b) to highlight the SLP–AT collaborative relationship that has emerged through the development of CoRTEx. Our protocol has been used to manage students' successful return to participation in school, as well as providing information that can be used to safely make return-to-play (RTP) decisions.

The Neurophysiology of Concussion

Definitions of the term *concussion* have evolved over time and vary throughout the literature. A relatively recent consensus statement is provided here because of its comprehensive nature. McCrory et al. (2013) defined concussion as follows:

> Concussion is a brain injury and is defined as a complex pathophysiological process affecting the brain, induced by biomechanical forces. Several common features that incorporate clinical, pathologic and biomechanical injury constructs that may be utilized in defining the nature of a concussive head injury include:
>
> 1. Concussion may be caused either 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. However, in some cases, symptoms and signs may evolve over a number of minutes to hours.
> 3. Concussion may result in neuropathological changes, but the acute clinical symptoms largely reflect a functional disturbance rather than a structural injury and, as such, no abnormality is seen on standard neuroimaging studies.
> 4. Concussion results in a graded set of clinical symptoms that may or may not involve loss of consciousness. Resolution of the clinical and cognitive symptoms typically follows a sequential course. However, it is important to note that in some cases symptoms may be prolonged. (pp. 250–251)

The "complex pathophysiological process" mentioned above is often referred to as the *neurometabolic cascade*. This is made up of a series of parallel processes that affect ionic balance, brain metabolism, and specific physiology, such as cerebral blood flow and axonal function (Giza & Hovda, 2001). Despite common belief, computerized tomography or magnetic resonance imaging cannot detect a concussion because concussion is a disruption in the function of the brain, not the structure (McAvoy & Werther, 2012). These imaging techniques can be used to detect more severe injuries to the brain that are on a larger, not cellular, level. Imaging technology and techniques are improving, however, and concerted efforts are being made to find effective ways of detecting concussion and monitoring its course.

The majority (80%–90%) of concussions improve to the point of symptom resolution within 7–10 days (Giza et al., 2013; McCrory et al., 2013). This timeline is generally longer for children and adolescents, with symptoms resolving within a period of 3 weeks (McAvoy, 2012; McCrory et al., 2013). This has been attributed to the fact that the developing brain of children and adolescents is more susceptible to damage than the more established brain of adults (Raikes & Smart, 2015). It is also possible for symptoms to persist for months (Brady & Brady, 2011; McAvoy & Werther, 2012), during which time the student should continue to be monitored and followed for any academic adjustments (discussed below) needed to be successful during the school day. Prolonged recovery time may necessitate a referral for more intensive accommodations, modifications, or specific school-based interventions.

In addition, children and adolescents who sustain damage to the brain have poorer long-term outcomes than do adults (Anderson, Catroppa, Morse, Haritou, & Rosenfeld, 2005; Duff & Stuck, 2012). Damage to a developing brain can affect future learning (Anderson et al., 2005; Eslinger, Grattan, Damasio, & Damasio, 1992; Raikes & Smart, 2015; Sady, Vaughan, & Gioia, 2011), which requires a significant amount of cerebral engagement and energy use (Gioia, Isquith, et al., 2009). Because concussion affects the brain's ability to regulate its functioning, learning and use of previously learned skills can be significantly and adversely affected (Duff & Stuck, 2012). Students may become frustrated when they experience difficulty with tasks that used to be simple for them, which can lead to behavior problems (Hux & Hacksley, 1996). A large part of a child's life is spent learning at school, and disruption of this process via concussion can have devastating consequences (DeMatteo et al., 2015; Ponsford et al., 2001).

Return to Play

Given the serious nature of the effects of concussion on a child's or adolescent's well-being, it is both logical and necessary that comprehensive guidelines have been put in place to protect the injured student athlete during decisions about when it is safe for them to RTP. Returning to sport too early can place the student at risk of prolonged recovery, poor academic outcomes, severe traumatic brain injury, and tragically, even death (Brady & Brady, 2011; Cantu, 1998; Rose, McNally, & Heyer, 2015; Sirmon-Taylor & Salvatore, 2012).

Throughout the United States, clear legislation regarding RTP decisions has been enacted (Heyer, Weber, Rose, Perkins, & Schmittauer, 2015). Arizona, where CoRTEx was developed, has comprehensive legislation regarding sports-related concussion in regard to RTP. The law (SB 1521) requires that an athlete be removed from play immediately if a concussion is suspected, and written clearance from a medical provider (defined as a physician, AT, nurse practitioner [NP], or physician assistant) is required for an athlete to RTP. It also requires concussion education for coaches, players, and parents, with Arizona being the first state to provide player-specific education (via Barrow Brainbook) with a requirement developed by Dr. Javier Cardenas) to pass a formal test before play. In addition, the Arizona Interscholastic Association (AIA) continually updates guidelines and policies such as those regulating heading in soccer (Amendment 25.2.5 Contact Rule/Heading Training—Definition of Contact/Heading Training) and has created a partnership that allows free computerized neurocognitive baseline and post-injury testing for all AIA-member schools, Immediate Post-Concussion Assessment and Testing (ImPACT; ImPACT Applications, Inc., Pittsburgh, PA). Professionals are encouraged to research legislation and potential resources specific to their state before developing an academic concussion management protocol.

Return to Academics

It is encouraging that schools are taking seriously their role in protecting student athletes who have sustained concussion in regard to RTP. However, despite the negative outcomes that can occur academically, relatively little attention has been paid to return to academics (DeMatteo et al., 2015; Heyer et al., 2015; Stewart, McQueen-Borden, Bell, Barr, & Juengling, 2012). It is time that schools take the student as seriously as the athlete:

> Despite the fact that the impact of the concussion on the individual will have a trickle-down effect to the educator through decreased outcomes and affect the long-term academic career of the individual, no attention is being drawn to this fact and little or no consideration is being given to how to address it from the education side. (Raikes & Smart, 2015, p. 29)

Our teachers and school administrators must be educated about the significant academic impact and associated risks that concussions can have (Giza et al., 2013; Halstead et al., 2013; Hux & Hacksley, 1996; Pierson & Canto, 2015; Rose et al., 2015). This education is particularly important because of the lack of legislation parallel to what is seen in RTP. Nebraska and Virginia are currently the only states in the United States to have legislation addressing return to academics after concussion (amendment to Nebraska's LB 260; amendment to Virginia's HB 1096). In 2011, the Protecting Student Athletes from Concussions Act (HR 469) was introduced to Congress, which would have included guidelines for managing the effects of concussion in terms of cognitive activity in the schools (Sady et al., 2011). It was not enacted, but given Nebraska's and Virginia's successes in recognizing the need to address academic needs after concussion, more proposed legislation in this area is likely. Legislation, however, is not always the answer, and may not be necessary if schools independently adopt protocols that address academic needs after concussion.

Regardless of whether there are legal mandates relating to the return of students to academics after concussion, best practice suggests that proactive and comprehensive management is vitally important: "A school with concussion policies and procedures implemented prior to a student sustaining an injury will be better prepared to manage a successful return" (Sady et al., 2011, p. 705).

Post-Concussion Symptoms

Although misconceptions about concussion continue to exist (Brady & Brady, 2011; Pierson & Canto, 2015), the fact that concussion is a brain injury that should be taken seriously is becoming more widely understood and accepted. Concussion can result in a wide variety of symptoms that can, in some cases, persist and affect social relationships as well as academics (Babikian, McArthur, & Asarnow, 2012; Bradley-Klug et al., 2015; Duff & Stuck, 2012; Hux & Hacksley, 1996; Raikes & Smart, 2015; Rose et al., 2015; Sirmon-Taylor & Salvatore, 2012). The consequences of not identifying and treating concussion, as mentioned above, can be severe; the risk of reinjury increases, recovery time is extended, academic performance can suffer, and the possibility of more severe traumatic brain injury or death increases (Cantu, 1998; Gioia, Isquith, et al., 2009; Sirmon-Taylor & Salvatore, 2012).

Post-concussion symptoms are often characterized within four general categories (similar to Reddy, Collins, & Gioia, 2008): physical, maintenance, emotional, and cognitive. Physical symptoms include headache, nausea, dizziness, balance problems, light sensitivity, sound sensitivity, and neck pain. Dizziness (particularly on-field dizziness) is important to note because it has been associated with protracted recovery (Lau, Kontos, Collins, Mucha, & Lovell, 2011). Maintenance symptoms generally relate to sleep—either sleeping too much or too little, difficulty maintaining sleep, or feeling drowsy. Emotional symptoms can vary greatly and range from an individual being more emotional (sad, nervous, angry) to apathetic. Cognitive symptoms are numerous and include difficulty concentrating or

remembering, slow processing, difficulty following directions, impaired word finding, and attentional difficulties, among others (Brady & Brady, 2011; Davies, 2011; Gioia, Isquith, et al., 2009; McAvoy & Werther, 2012; McAvoy, 2012; Sady et al., 2011; Stewart et al., 2012).

In order to track the presence of symptoms and their severity, a 0–6 point self-rating scale is accepted for use with individuals who have sustained concussion (McAvoy & Werther, 2012; Raikes & Smart, 2015). Rating scales allow for improvement to be tracked (Gioia, Isquith, et al., 2009) and conversely allows for symptom exacerbation to be identified. In the latter case, interventions should be immediately implemented to lessen cognitive exertion and assist recovery.

Effects of Cognitive Overexertion

Physical rest and cognitive rest have classically been considered important components of recovery in the acute phase of concussion (DeMatteo et al., 2015; Halstead et al., 2013; McCrory et al., 2013; Reddy et al., 2008; Sady et al., 2011). However, compared with the traditional approach of strict rest, a more active management approach is being taken for some specific cases depending on the individual's unique symptom profile and personal/family history (Collins, 2016; Gagnon, Grilli, Friedman, & Iverson, 2015). Majerske et al. (2008) found that moderate physical activity post-concussion was related to better outcomes than either low- or high-activity groups, suggesting that well-timed, intermediate levels of activity can be beneficial. It has been found that physical/cognitive rest (particularly prolonged rest) may be considered harmful in some cases or may simply result in no difference in outcome (Brown et al., 2014; Buckley, Munkasy, & Clouse, 2016; Collins, 2016; DeMatteo et al., 2015; Rose et al., 2015; Thomas, Apps, Hoffman, McCrea, & Hammeke, 2014). The potential harm of prolonged rest is particularly true in the case of students whose prescribed rest includes reduced school attendance, as missing days of school has been found to have real and measurable detrimental effects on academic performance, on-time graduation, and post-high school life (Bradley-Klug et al., 2015; Gottfried, 2013; Parsons, Bay, & McLeod, 2013).

When a student experiences cognitive symptoms, the goal is to keep the student engaged to the degree they are able without experiencing exacerbation of symptoms (Bradley-Klug et al., 2015; DeMatteo et al., 2015; Halstead et al., 2013; McCrory et al., 2013; Rose et al., 2015). Students who have sustained concussion, therefore, should have the opportunity to have the demands of school adjusted in a way that allows for cognitive engagement, but does not cause cognitive overexertion and slow recovery (Brown et al., 2014; DeMatteo et al., 2015; Halstead et al., 2013; Majerske et al., 2008; McAvoy & Werther, 2012; Ponsford et al., 2001; Sady et al., 2011). A reduction in demands allows the complex neuropathologic process described above the time and energy needed to resolve more quickly (Brown et al., 2014), aiding the neurorepair process. It may also reduce the chances of academic decline, as can occur in some cases (Hux & Hacksley, 1996; Popoli, Burns, Meehan, & Reisner, 2013). Students may experience a drop in grade point average (GPA) post-injury, which can cause multiple complications. Poor academic performance, however brief, can jeopardize some students' chances of being accepted into advanced classes or honor societies, receiving scholarships, or being accepted to college (or the college of their choice). Some students may be at risk of failing classes, extending time to graduation, or dropping out of school. Not completing high school is associated with a number of undesirable life outcomes, and every attempt should be made to retain students in high school, working toward successful completion of state requirements for graduation.

As alluded to above, cognitive overexertion can be an impediment to the neurorepair process and can exacerbate symptoms (DeMatteo et al., 2015; Halstead et al., 2013; Reddy et al., 2008; Sady et al., 2011). Some preliminary research suggests that students who sustain a concussion during the school year may take twice as long to recover than children who sustain a concussion during the summer (Doss et al., 2013). These researchers have gone so far as to say that the school environment and activities may be a "barrier" to recovery. It is important to note, however, that their School group had higher rates of preinjury depression/anxiety and ADHD than the Summer group, a likely significant confound.

The potentially deleterious effects of school participation can be lessened significantly through a well-organized, comprehensive approach to concussion management (Hux & Hacksley, 1996; Rose et al., 2015). One way to allow students to participate in school and simultaneously avoid cognitive overexertion is to make academic adjustments (Halstead et al., 2013; Majerske et al., 2008; Sady et al., 2011), which has been supported with empirical evidence (Brown et al., 2014). These adjustments should be developed in a timely manner and individualized for each student's unique needs and ability to tolerate cognitive activity (Raikes & Smart, 2015; Reddy et al., 2008; Rose et al., 2015; Stewart et al., 2012). Academic adjustments should correspond to the types of symptoms the student is experiencing, as well as symptom severity (Reddy et al., 2008). As the student improves, academic adjustments should be reduced in a fluid and flexible manner (as opposed to stage-based models) until the student returns to their baseline. In stage-based return-to-learn models such as those recommended by the Sports Concussion Institute, specific recommendations are made for each phase. For example, students are not considered for full-time school attendance until Recovery Stage 3; in a more flexible model, full-time school attendance, but with significant academic adjustments, could be considered at any time.

The remainder of this article describes the CoRTEx protocol, highlighting the SLP–AT relationship. In our district, it has been considered to be in the best interest of students to direct energy toward the implementation and maintenance of this comprehensive plan. CoRTEx is an interdisciplinary team effort led by individuals with years of

experience in traumatic brain injury. It is comprehensive in that professional development is provided to all district staff, there is a straightforward referral process, and the procedure for assessing and monitoring students is structured, precise, and timely. Education is provided on an ongoing basis for students and families. Academic adjustments that are suggested for students are directly from the concussion literature. In addition, clear and consistent communication with all relevant members of the team is a key component (Kasamatsu et al., 2016); this includes a mechanism for communication between medical providers and school personnel. CoRTEx, in addition to other protocols discussed later in this article, can be used as a template to create return-to-academics protocols in districts throughout the United States in response to the call in the literature to provide academic support to students who have sustained concussion.

CoRTEx

The academic concussion management protocol in Sahuarita Unified School District 30 was designed due to school counselors' concerns that a student athlete who had sustained a concussion was not performing well in school. The question was whether we had a mechanism to communicate clearly with teachers and make classroom accommodations. A 504 plan (Rehabilitation Act of 1973) was deemed the closest possibility, although the limitations of this approach were recognized in terms of concussion being an injury rather than a disability (Raikes & Smart, 2015), the transience and potentially short-lived nature of the impairments, the ever-changing degree and type of impairments (Gioia, Isquith, et al., 2009; Popoli et al., 2013; Sirmon-Taylor & Salvatore, 2012), and relative lack of monitoring for symptom resolution. At that point, the first author, who has experience working with individuals across the lifespan who have had brain injuries, began searching for information describing how the academic needs of students who had sustained concussion were being met in schools.

Although the impact of concussion on academic performance has been increasingly recognized, there was much less information at the time our protocol was being devised. The Colorado Department of Education's Reduce, Educate, Accommodate, Pace program (McAvoy, n.d.; McAvoy & Werther, 2012) and especially the Miami University program (Porter et al., 2014) were used as guides for the development of CoRTEx. These two programs were used in addition to general guidelines found throughout the literature, particularly the guidelines from the American Academy of Pediatrics as found in Halstead et al. (2013). We strongly believe that academic concussion management protocols must be personalized to meet the needs of the individual district. School districts vary, among other things, in size, resources (time, personnel), and administrative support for serving this student group (Heyer et al., 2015). As such, potential concussion management team developers are encouraged to research multiple programs before creating a protocol that will be most effective in their particular environment.

The issue of personnel deserves specific consideration here, as it is important to determine who has expertise in brain injury, is capable of leading a district-wide protocol, and is also strongly motivated to stay current in the quickly expanding scientific literature related to concussion. Experience in designing relevant academic adjustments; communicating clearly with students, families, school faculty, and staff (Bradley-Klug et al., 2015); and collaborating with health care providers is also necessary (Rose et al., 2015). Depending on the school district, possibilities may include a district-employed or affiliated physician, neuropsychologist, school psychologist, registered nurse (RN), SLP, physical therapist, or occupational therapist (Duff, 2009; Duff & Stuck, 2012; McAvoy, 2012; Pierson & Canto, 2015; Porter et al., 2014; Sirmon-Taylor & Salvatore, 2012; Stewart et al., 2012). Assuming that a student's physician will make all of the necessary recommendations (Kasamatsu et al., 2016) and that the information will be received and properly interpreted by the school is not practical. Getting the appropriate school personnel involved in decision-making allows for an effective continuum of care.

Guidelines for professionals who might consider being involved in an academic concussion management protocol are described below (Figure 1). Although based on the American Speech-Language-Hearing Association's Code of Ethics (American Speech-Language-Hearing Association [Ethics], 2016), the guidelines can be generalized to apply to all school-based professionals. The overarching principle is that one must only be involved in the academic concussion management protocol to the extent to which one has expertise. This can be conceptualized as occurring at three levels: primary, secondary, and tertiary. This protects both the student from being served by a professional lacking the prerequisite knowledge and skills, and also protects the professional from being asked to provide support that they are not capable of providing. In addition, it can help professionals who wish to have major roles in the protocol to identify areas for improvement or that need to be developed in order for them to serve in their preferred capacity.

The CoRTEx protocol was developed by an SLP with significant input from school counselors, ATs, athletic directors, coaches, school principals, and school psychologists. Support was provided by various individuals, including attendance personnel, health assistants, the district RN, community health providers, the Student Services Director, assistant superintendents, superintendent, and school board members. Parents were asked for feedback during the pilot period regarding whether the protocol's procedures were perceived to be effective and efficient. Many of these individuals, at some point, have since been a part of a student's interdisciplinary academic concussion management team.

Information about CoRTEx is distributed in a proactive manner. A letter describing the academic concussion management team's purpose and process is included in the

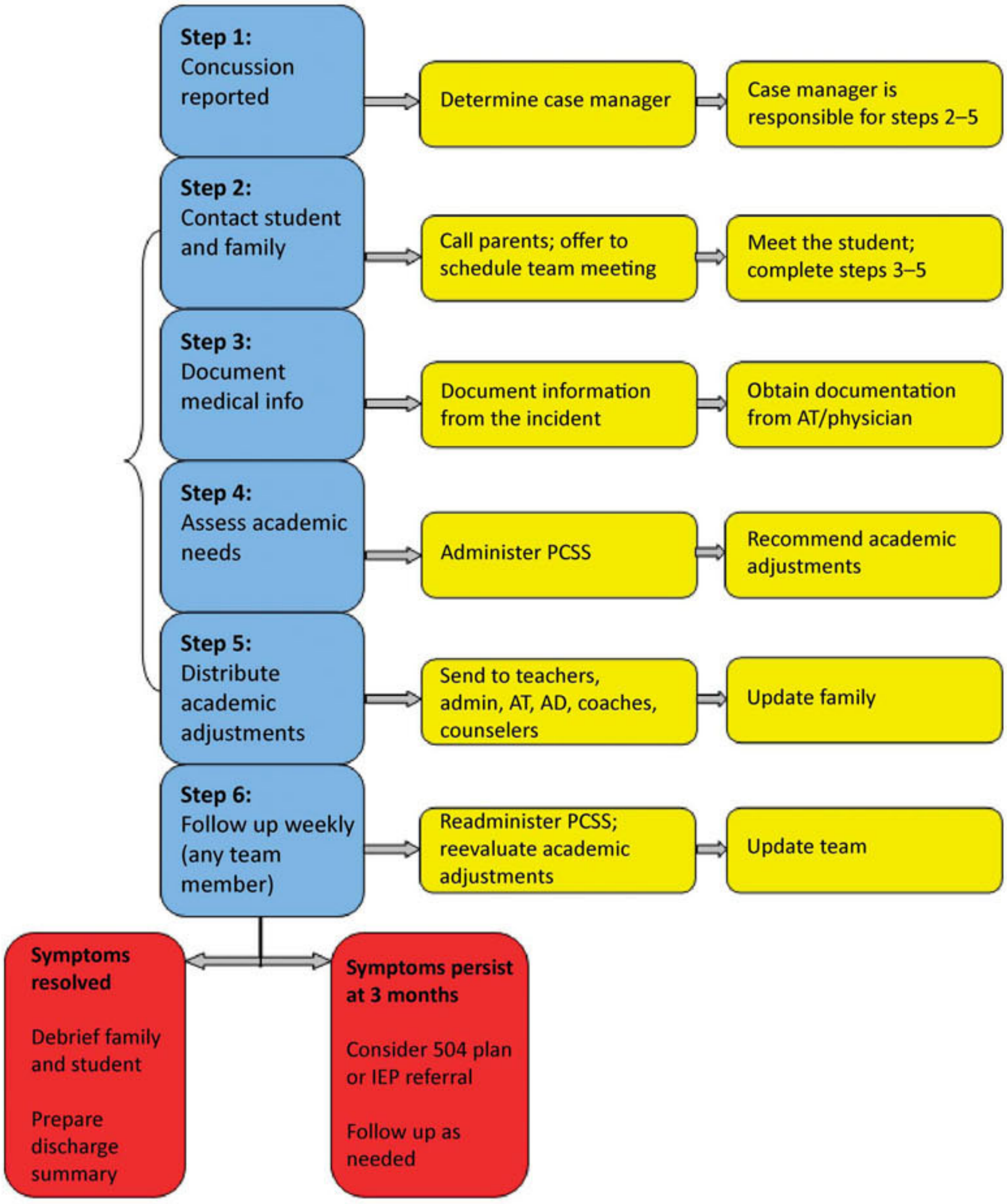
Figure 1. Proposed levels of participation in an academic concussion management protocol based on knowledge and expertise.

athletic packet for each student athlete in our district. To reach parents of nonathletes, short blurbs are included periodically in monthly school newsletters. At the beginning of each school year, the team leaders attend a staff meeting at each school site to provide general concussion education and specific information regarding the CoRTEx team and process. Ongoing education is provided to teachers and administrators with each case that is managed. In addition, the first author distributes a monthly newsletter updating key stakeholders regarding the number of students we have seen and the mechanism of each injury. Links to articles from the popular media as well as research articles are included in this newsletter to provide other avenues for ongoing professional development in the area of concussion. Finally, a website containing links to journal articles is under construction and will soon be linked to the district's internal website.

The collaborative relationship between the CoRTEx team leader (SLP) and the AT has emerged as a pivotally important piece of the concussion management process at the high school level. (CoRTEx is a Pre-K to 12th-grade protocol with slightly different procedures at the different levels. There are three team leaders, all SLPs, one who works at the primary level, one who works at a K–8 school, and one who works at the secondary level and preschool.) Referrals to CoRTEx thus far come largely from the AT (the second author), although a number of students who have sustained concussion outside of school athletics have been served. After the referral, the CoRTEx team leader meets with and provides the student active management until the student's symptoms have resolved. Symptom resolution is considered a return to the student's known baseline, not necessarily a score of zero in each symptom category. Ongoing communication with stakeholders occurs during this process, and a referral is made back to the AT when the student athlete can tolerate a full academic load without academic adjustments. The AT benefits from this procedure in that he or she is consistently informed regarding the student athlete's current symptoms and academic progress and can know with more certainty when a student athlete is ready to begin the RTP protocol (McAvoy, 2012). Beginning the RTP protocol at the right time is crucial. Too early, and symptoms may return or be exacerbated; too late, and a student athlete can begin to experience depression and anxiety associated with the disappointment of being unable to play, as well as a lack of physical outlet, reduced interaction with teammates, and disruption of routine (Buckley et al., 2016; Majerske et al., 2008; Popoli et al., 2013; Thomas et al., 2014). Getting a student athlete back to sport is critically important for emotional well-being, but must be done safely and in a way that protects health and cognitive functioning.

To aid discussion of this process in greater detail, the CoRTEx protocol flowchart is visually represented in Figure 2. After a referral is made, the team leader (or case manager), who is one of the district SLPs who have experience with brain injury, is assigned (see Hux & Hacksley, 1996). The team leader meets with the student as soon as possible, often the day of referral or the first day back to school. A parent consent form has recently been developed, and parents are urged to sign and return this form as soon as possible so the protocol can begin. Before the consent form was established, the parents could sign an opt-out form if they did not want their children to participate in the protocol. After the parent consent form is signed, information is gathered from and shared with the parent. This includes the reason a referral was made to the CoRTEx team, the purpose of the team, their child's reported symptoms, and possible academic adjustments to support their child. Concussion education is also provided, and parent feedback is sought in a collaborative process. The parents may participate after this initial contact in two ways: (a) request a full team

Figure 2. Cognitive Return to Exertion flowchart. AT = athletic trainer, PCSS = Post-Concussion Symptom Scale, admin = administrators, AD = athletic director, IEP = individualized education plan. Adapted from Nationwide Children's Hospital (n.d.).



meeting at the beginning of the process to include the team leader, administrator, teachers, and AT, followed by ongoing communication via phone and/or email, or (b) forgo the team meeting and agree to remain in contact via phone or email throughout the process.

The CoRTEx protocol includes an open-ended student interview template that is to be followed to ensure that specific information is gathered from each student, including the mechanism of injury, how the student felt immediately post-injury, whether there was loss of consciousness, whether the student was seen by a medical provider, whether a diagnosis or recommendations were given, what was hard for the student in school prior to the injury (if anything), and what is hard for them in school now. The Post-Concussion Symptom Scale (PCSS; see descriptions of this instrument in Alla, Sullivan, Hale, & McCrory, 2009; Gioia, Schneider, Vaughan, & Isquith, 2009; Giza et al., 2013; Majerske et al., 2008) is then administered with support as needed to clarify what is meant by the symptom label ("fatigue" and "drowsiness" seem particularly difficult for our students to differentiate, and many interpret "feeling like in a fog" quite literally). Additional information is gathered about the symptoms, such as when headaches occur, if they are taking pain relievers or sleep aids, if irritability is brought on by any specific causes, and whether difficulty concentrating or remembering are especially problematic in any

particular classes. General concussion education and symptom-specific education is provided (McSwan, 2016). As described earlier, symptoms can be considered to fall within four categories (see examples in Figure 3).

Potential academic adjustments are then discussed with the student as a way to support his or her unique symptom profile (a condensed sample from our extensive Academic Adjustments Worksheet is shown in Figure 4). The student is informed that relevant information will be shared with teachers, administrators, the health assistant, and the AT. A time is scheduled to follow up the next week. When the meeting has concluded, the student is given a folder that contains contact information for the team leader, a letter explaining the purpose of the CoRTEx team, a concussion education handout from the Center for Disease Control and Prevention's Heads Up for Concussion campaign, and a written copy of the recommended academic adjustments. If symptoms are noted that are outside the SLP's area of expertise, referral is immediately made to a concussion specialist. These professionals have backgrounds in sports medicine and sometimes specialize in pediatric sports medicine. We have three specialists in our area to whom we refer families. Additional specialists, such as vestibular therapists and neuropsychologists, may be needed as well.

Common examples of academic adjustments include sunglasses for light sensitivity, reduced computer use, peer note-takers, extended time for assignments and tests (usually associated with poor memory and concentration), reduced reading assignments (usually associated with difficulty focusing the eyes), a shortened school day per physician note, and being excused from classes that are medically contraindicated (as in a physician note excusing the student from physical education). The academic adjustments recommended to teachers are meant to be a reminder and/or validation that they can make reasonable adjustments within the general education classroom. If a teacher sees that a student may need more time to take a test, due (possibly) to problems with concentration, the teacher has the option to provide that adjustment without a formal special education or 504 plan. The adjustments provided to teachers are meant to be a "bank" from which they can choose modifications that will work within their class and can benefit the student in the short term. This is similar to a general education teacher allowing a student with a broken dominant arm to take an exam orally rather than in writing. Physicians, particularly those who specialize in pediatric sports medicine, are increasingly making excellent and targeted recommendations for academic adjustments that can be implemented at school. When this documentation makes it to the school (it often does not; see Canto & Pierson, 2015), the recommendations are used along with site-specific recommendations.

An example of an important but less frequently used academic adjustment is the rearrangement of the final exam schedule. When this is determined to be necessary, administrators and teachers work together to create a schedule that includes only one core class final per day. Or, if a student's symptoms preclude him or her from participating in finals, teachers arrange testing to occur at a later time. This provision requires administrative support because there is a specific grade change process that needs to be followed once final exams are complete.

Information regarding the student interview, parent interview, current symptoms, and recommended academic adjustments are documented in the subjective-objective-assessment-plan note format and emailed to members of the team, including administrators, school counselors, the health assistant, teachers, and the AT. Teachers are encouraged to ask for support in implementing adjustments relevant to their classes, and creative solutions are often sought with administrative guidance.

The team leader then meets with the student on a weekly basis, readministering the PCSS each time to monitor whether improvement is occurring. Academic adjustments are increased or decreased depending on symptoms (McAvoy, 2012). Once established, the process of conducting follow-up interviews and making changes to academic

Figure 3. Examples of symptoms that may occur after concussion. Concussion symptoms may have a negative impact on academic performance.

Physical Symptoms	Maintenance Symptoms	Emotional Symptoms	Cognitive Symptoms
•Headache •Nausea •Dizziness •Balance problems •Light/sound sensitivity •Neck pain	•Sleeping too much or too little •Difficulty maintaining sleep •Feeling drowsy	•Range from more emotional (sad, nervous, angry) to apathetic •Anxiousness	•Difficulty concentrating and remembering •Slow processing •Difficulty following directions •Impaired word finding •Attentional difficulties

Figure 4. Sample of academic adjustments that may be provided after concussion, based on each student's specific symptom profile.

Adjustments for Physical Symptoms	Adjustments for Maintenance Symptoms	Adjustments for Emotional Symptoms	Adjustments for Cognitive Symptoms
•Take scheduled breaks •Wear sunglasses •Excuse from assemblies •Avoid passing periods •Remove from PE and/or noisy classes	•Set later start time •Leave school early •Take rest breaks as needed	•Allow leaving class to de-stress •Reinforce positive behaviors •Reduce workload •Acknowledge the student's feelings	•Note-takers •Extra time •Assistive technology •Exemption from large projects •Providing prompts •Shortened readings •Alternative testing

adjustments can take as little as 5 min in uncomplicated cases. Updates are again emailed to relevant personnel, and parents are contacted via their preferred method. Symptom checklists are often scanned and emailed to parents so that they are fully informed and so that they can have documentation to show their child's physician during follow-up medical appointments. For cases that are complex or that seem to be going the way of protracted recovery, a release of information may be signed by the parent to allow communication between the physician and team leader or AT to ensure continuity of care and with the goal of speeding recovery. A referral may also be made to the appropriate concussion specialists within the community.

If a student continues to demonstrate concussion-related symptoms at 12 weeks post-injury, a referral to the school's 504 team is considered, as at that point, long-term accommodations may be needed (Popoli et al., 2013; Rose et al., 2015). The 504 coordinator is informed of this possibility before the 12-week mark so that they have prior knowledge of the student. CoRTEx team leaders may play a large role in suggesting relevant accommodations to be included in the 504 document and may attend the meeting, as well. However, active weekly management is no longer provided via the CoRTEx team. Consultation is provided as needed. There are also times that a 504 plan is implemented earlier than 12 weeks post-injury. This usually occurs for students whose physicians have prescribed prolonged absence from school or a shortened day. In general, it is considered appropriate for accommodations that are likely to be static and longer-lasting than typically seen with the CoRTEx protocol.

A discharge summary is completed for each student exiting the CoRTEx protocol. This document includes the following information: (a) the student's symptoms at intake, (b) academic adjustments that were provided, (c) the type of documentation gathered (symptom checklists, ImPACT results), (d) reason for discharge, (e) education provided to the student and family, (f) current grades in each class, and (g) additional recommendations. This summary is given to students who are 18 years of age or older. For younger students, the document is mailed home. A disclaimer is included in each discharge summary stating that RTP/physical activity recommendations must always be made by a qualified medical professional.

As mentioned previously, if the student is an athlete a referral is made to the AT at the point of symptom resolution. Approximately 70% of our referrals are student athletes, even though the mechanism of injury may be unrelated to their sport, as in a baseball player who sustained a concussion in a car accident while in season. In the case of student athletes who have gone through neurocognitive testing with the AT, the return to baseline is more objective than relying on symptom reports (Gioia, Isquith, et al., 2009). The AT may consult with a physician regarding interpretation of ImPACT scores. When the student athlete has returned to baseline, the AT begins the RTP process. The second author developed the following guidelines with physician input (similar to that seen in McCrory et al., 2009; see also Reddy et al., 2008).

The RTP protocol is initiated after the athlete is no longer under any academic adjustments (as recommended in McCrory et al., 2013, and Reddy et al., 2008). That is, an athlete is back to normal in the classroom (Brady & Brady, 2011). Each step must be separated by at least 24 hours.

Day One: The athlete must have 3–7 consecutive "normal" days. The number of days will be equal to the number of days that the athlete needed academic adjustments (3 days minimum, 7 days maximum). An athlete who needs more than 7 days of adjustments will need a physician's written release to return to participation.
Day Two: 10 minutes of jogging; after jog, the athlete must still be "normal."
Day Three: Athlete must report "normal" from 10 minute jog. If "normal," athlete will be put through 20 to 30 minutes of high intensity cardiovascular activity. After high intensity activity, athlete must still be "normal."
Day Four: Athlete must report "normal" from Step Three. If "normal," athlete will be allowed to return

to their sport but cannot have contact or do any activity that is live.

Day Five: If athlete reports that they are "normal" after Step Four, then they are allowed to return to full activity.

The concussion management process is considered successful if the student is able to maintain his or her pre-injury academic performance during the neurorepair process, return to a full academic load without adjustments, and safely RTP during a reasonable period of time so as to minimize the potential for social isolation and depression/anxiety symptoms. Since piloting the CoRTEx protocol in April 2014, we have actively managed 165 students with diagnosed or suspected concussion. In general, boys are referred to the CoRTEx team more often than girls. The top five sports or activities include football, direct blows to the head, soccer, falls, and car accidents. This can be compared with the study by Marshall, Guskiewicz, Shankar, McCrea, & Cantu (2015) in which incidence of concussion was also highest in football, with lacrosse and soccer following, and to Giza et al. (2013) in which the incidence rates (from highest to lowest) were as follows: football, ice hockey, soccer, basketball, and baseball/softball.

Case Study

A case study is presented here to give a better picture of how the CoRTEx process works with an actual student. The information that follows is based on a student who sustained a concussion during the 2014–2015 school year. It serves to reinforce how the process should proceed from initial referral to discharge. Some procedures have changed throughout the development of this process, and many cases have proven to be significantly more complex. Identifying information—student name, dates, sport during which injury occurred—have been altered for confidentiality purposes.

Eric, a 10th-grade student, hit his head on the mat multiple times during wrestling practice. He did not inform his coach, but experienced symptoms later that evening and sought medical care from an NP the next day. He was told he could not RTP. Eric's mother contacted the AT and brought Eric to school to be assessed via ImPACT approximately 48 hours after the injury. Results suggested neurocognitive changes in memory composite (verbal), memory composite (visual), visual motor speed composite, reaction time composite, and total symptom score (81 out of 132). Symptoms included the following (scale 0–6): headache (6), nausea (3), vomiting (1), balance problems (4), dizziness (5), fatigue (4), trouble falling asleep (1), sleeping less than usual (3), drowsiness (4), sensitivity to light (6), sensitivity to noise (6), irritability (4), sadness (4), nervousness (4), feeling more emotional (5), feeling slowed down (5), numbness/tingling (2), difficulty concentrating (5), difficulty remembering (3), and visual problems (6).

The AT made a referral to the CoRTEx team. General concussion education was provided to the student and parent, as well as symptom-specific education. Good sleep hygiene and nutrition were emphasized. Emotional symptoms were discussed, and open lines of communication were established with Eric's mother and the CoRTEx team leader as an outlet to discuss the emotions related to being unable to wrestle and feeling generally unwell (a referral was made to a neuropsychologist but not followed). A number of academic adjustments were recommended to address Eric's specific symptom profile. He agreed to the following: using sunglasses for light sensitivity, reducing noise in the classroom as much as possible, allowing Eric to take work to a quiet room as needed, taking exams in a smaller/quieter environment, providing notes prior to lectures, and allowing extra time for tests and assignments. To address dizziness and balance problems, it was suggested that Eric avoid passing periods and go to each class after the final bell with a pass. Eric's mother signed a release of information to allow the CoRTEx team leader to communicate directly with Eric's NP. In addition to the topics noted above, the NP was consulted regarding Eric's blurry vision and numbness/tingling in his hands. The NP planned to schedule a follow-up appointment to further examine those concerns.

A week later, at the second interview, Eric reported that he noticed he could go a couple of days without headache and then they would return. He felt like he might have engaged in too much physical activity by running around the park with his nieces and nephews. He acknowledged an increase in symptoms with physical exertion. Compliance at school was better; he was following the academic adjustments that had been put in place. His main complaint during the interview was difficulty with sleep. We reviewed common techniques for improving sleep (such as no screen time at least 1 hr before bed), and this information was shared with Eric's NP to address more thoroughly. Eric was also scheduled to take the PSAT during the upcoming week, so Eric's options for that assessment were discussed. Eric's mother was consulted regarding the PSAT, as well. Symptoms in week two included: headache (3), nausea (1), dizziness (2), fatigue (1), trouble falling asleep (2), sleeping more than usual (2), sensitivity to light (1), sensitivity to noise (1), sadness (1), feeling more emotional (2), difficulty remembering (1), difficulty concentrating (1), and visual problems (1). Recommended academic adjustments from the previous week continued with the following changes: (a) sunglasses were no longer needed, and (b) either excuse from the PSAT or limit activity to just the test on that day.

At the third interview, Eric reported that he was feeling much better. His updated symptom checklist reflected that he was asymptomatic. The AT readministered ImPACT, and the results of ImPACT and the symptom checklist were scanned and emailed to the NP. The NP examined Eric and provided medical clearance for RTP.

The AT began the RTP protocol. Eric progressed through the protocol smoothly and with no return of symptoms. He was able to return to wrestling before the end of the season. In academic matters, his grades remained

consistent through the process with As, Bs, and Cs. Eric was discharged from the academic concussion management team and has enjoyed a full return to all high school activities.

Conclusions and Future Directions

Parent and student feedback for CoRTEx has been overwhelmingly supportive. Parents are often grateful to have their child's injury taken seriously at school, and many can benefit from education regarding how concussions can affect school performance. Parents and students also feel reassured that there is at least one knowledgeable person at the school who can act as the primary point of contact about this issue. The process of coordinating medical appointments and communicating with each teacher (which can be as many as six in our district), administrators, ATs, coaches, attendance clerks, and health assistants is overwhelming for already busy parents. This burden can be lessened by having a dedicated, passionate, well-trained, and knowledgeable team and team leaders who can collect and disseminate relevant information to those who need to know. The feeling of relief can be immense, and the service a school can provide to parents of an injured child cannot be measured by quantitative data alone.

That being said, it is important that research be conducted to determine whether a school-based academic concussion management protocol such as CoRTEx is effective in the sense of truly maintaining student academic outcomes (e.g., statistical comparison of preinjury and post-injury GPA) and whether recovery time is shortened with active management. Specific to CoRTEx, we continually monitor student grades as part of our protocol, but have not reported the data here that we have used to determine whether academic progress has actually remained stable in the mathematical sense (e.g., no measurable change in GPA) as this was not designed as a research study. No change in GPA would indicate that appropriate adjustments were provided to maintain academic performance; if GPA goes down significantly, it is possible that there were not enough academic adjustments to adequately support the student. Conversely, if GPA goes up significantly, it could be interpreted as an excessive use of academic adjustments past what was necessary. As a clinician, however, in some cases it is desirable that GPA would go up significantly, as in the case of a student who was failing a majority of his or her classes before the concussion. A number of interventions can be put in place to help a struggling student in addition to the academic adjustments suggested by the CoRTEx team with the intention of improving academic performance. For example, one of our students was referred by a CoRTEx team leader back to the special education team due to difficulty with reading; he had been exited from special education in the past but was continuing to struggle. Once his concussion symptoms resolved, a psychoeducational evaluation was conducted, and he was again placed on an individualized education plan. With appropriate placement, this student has been much more successful.

GPA can be a problematic outcome measure for other reasons as well. An analysis of preinjury and post-injury GPA would require tracking and accounting for potentially confounding factors (such as the provision of additional interventions for previously struggling students) that we have provided but not documented systematically as part of our protocol. In addition, if recovery occurs across a semester boundary, one would be comparing GPA for different classes. This is a significant problem as students often have vastly different classes from semester to semester with varying levels of difficulty. With the example above, a student may move from general education classes to special education classes or vice versa. A student may start or stop taking Honors or Advanced Placement classes. Even the jump between levels of English or math classes can result in a dramatic difference within individual students in terms of their grades.

In regard to recovery time, we have not conducted an analysis of time to recovery as we feel that weekly meetings are not often enough to be sensitive to when recovery can be said to occur. We also tend to be conservative about following students through symptom resolution, which may artificially increase a time-to-recovery measure. We have also found, anecdotally, that preinjury mental health status seems to be a significant factor in relation to recovery time, adherence to recommendations, school performance, school attendance, and even disenrollment from school. If appropriate educational outcomes are determined and successfully measured, and confounds accounted for, types of academic concussion management protocols could be compared to create a template that is considered best practice. However, at this time, the best way to go about this appears unclear.

When considering expanding or improving upon CoRTEx or other such academic concussion management protocols, another area to potentially incorporate is the growing body of research regarding active concussion rehabilitation (which includes cognitive rehabilitation; Sohlberg & Ledbetter, 2016). It is now widely considered among concussion researchers and practitioners that concussion is a condition that can be treated, as opposed to rest being the only prescription (Collins, 2016). A thorough description of treatments that are being used to treat vestibular, ocular, cognitive/fatigue, posttraumatic migraine, cervical, and anxiety/mood symptoms is beyond the scope of this article, but it is important to consider how schools might be able to implement some of these rehabilitation principles to further improve student outcomes.

As for the immediate future of CoRTEx, we are currently in the process of moving toward increasing the comprehensiveness of our baseline testing. This would include our current practice of ImPACT testing, along with additional components such as balance testing and near point convergence. This would allow us to more objectively gauge the changes in a student post-injury and more effectively develop a plan to assist their recovery. It would also

provide valuable information to area physicians who specialize in concussion management and who conduct similar assessments post-injury. The plan is to begin at the high school level in contact athletes, move to noncontact athletes, and then consider baselines for the student population as a whole. The decision to move forward with universal baseline testing is pending the release of the new consensus statement from the 5th Annual Consensus Conference on Concussion in Sport that took place in Berlin, Germany on October 27–28, 2016.

In conclusion, the concussion management process can provide necessary support for students and their families and is rewarding for school personnel. Relationships among personnel, such as that between the SLP and AT, can be developed and strengthened through working together toward the shared goal of student success after concussion.

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