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Concussion Management and Evaluation by Health Care Providers

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Concussion Management and Evaluation by Health Care Providers

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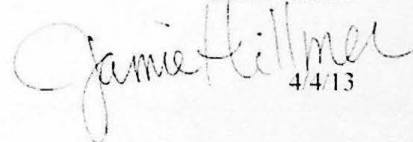
Title Concussion Management and Evaluation by Health Care Providers

Department Nursing

Degree Master of Science in Nursing

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Jamie Hillmer

A handwritten signature in cursive script that reads "Jamie Hillmer".

4/4/13

Abstract

Around 300,000 sports-related concussions are reported each year in the United States; however, the number may be between 1.6 to 3.8 million recreational and sport-related concussions, since many go unreported (Halstead, Walter, and the Council on Sports Medicine and Fitness, 2010; Scorza, Raleigh, & O'Connor, 2012). Concussions are a serious injury that can lead to prolonged symptoms and cumulative cognitive deficits in adolescent athletes. Concussion management has gained national attention due to recent legislation passed in 38 states regarding youth concussion laws (Sanford Health, 2011). This literature review intent was to condense relevant research on concussion evaluation and management in adolescent athletes. CINAHL, PubMed, Medscape, and other reputable internet sites were searched using key words: concussions, mild TBI, head injury, adolescents, youth athletes, high school athletes, nurse practitioner, family practice, diagnosis, evaluation, management, and return to play guidelines. A poster was presented to; physicians, nurse practitioners, and physician assistants. It included a brief introduction, purpose, methodology, and SD legislation information. Clinical implications of concussion included on the poster were: signs and symptoms, modifying factors, graduated return to play guidelines, and a clinical exam algorithm. Feedback was provided via a brief four question survey completed by the health care providers. The results showed that this information did increase the knowledge of concussion evaluation and management in adolescent athletes and current legislation in SD. Health care providers need to continue to seek out educational opportunities to stay up to date on concussion management and return to play guidelines for adolescent athletes.

Introduction

Two adolescent athletes collide on a playing field, hitting heads; one is slow to get up. What should happen next? The athlete should immediately be taken out of the competition. The athlete should be evaluated, if it is suspected that the athlete has a concussion or is having any signs and symptoms consistent with a concussion, removal from play is critical. The athlete will then need to be cleared by a licensed medical health professional before being allowed to return to play. This is consistent with new legislation passed in over half of states in the US since 2009 (Sanford, 2012).

Approximately 1.6-3.8 million sports and recreation-related traumatic brain injury (TBI's) occur in the United States each year; many are not treated in the hospital or emergency department (CDC, 2012b). Concussions are considered to be a mild TBI and primary care providers need to be knowledgeable about the evaluation and treatment. Children are starting to play sports at a younger age and are playing harder and more aggressively than ever. This can lead to concussions, especially in contact sports, involving collisions and high speeds. Concussions are an epidemic in American youth sporting activities. Therefore, the objective of this literature review will focus on the most effective methods for rural primary care providers to diagnose and manage concussions in adolescents to improve recovery and decrease long term side effects of mild TBI.

Purpose

The purpose of this literature review is to condense relevant studies on the evaluation and management of concussions in adolescent athletes. This reviews intent is to help answer the question; what are the most effective methods to use in rural primary clinics to evaluate and

manage concussions in order to improve recovery and return young athletes to play safely?

Concussion management has gained recent attention due to legislation passed in 38 states regarding youth concussion laws (NFL, 2012). This legislation has three main factors; educate youth athletes and their parents and have them sign a concussion information form, immediate removal of any athlete thought to have suffered a concussion, and clearance by a licensed medical professional before returning to athletics (NFL, 2012).

This law was enacted to help protect youth who have a concussion. Young athletes are vulnerable, they are growing and their brains are still developing. It is essential to identify common strategies used to treat and manage concussions to lead to positive outcomes. Concussions are rarely life threatening, however, the outcome of these injuries can last a life time (CDC, 2012b). Signs and symptoms of a concussion may include being dazed or disorientated, headache, nausea or vomiting, or memory disturbances. These symptoms may be short-lived or persist for weeks (Ferullo & Green, 2010). However, a number of adverse outcomes have been reported, including prolonged symptoms (lasting longer than three months), depression, or cumulative cognitive deficits (Makdissi, 2010). This is why it is critical for health care practitioners to evaluate and implement appropriate treatment plans in young athletes.

Healthcare provider knowledge about the recent legislation and about current recommendations for management for concussions is essential. Currently; South Dakota (SD), North Dakota (ND), Minnesota (MN), Nebraska(NE), and Iowa (IA), have enacted concussion legislation since 2009 (Sanford Health, 2011). It is crucial for healthcare providers in those states to understand the role they play in the new legislation. For example, in SD, the law specifically states any athlete that exhibits signs, symptoms, or behaviors consistent with a concussion or suspected of sustaining a concussion will be removed from play. The athlete

cannot return to play until they no longer exhibit signs or symptoms of a concussion, they have been evaluated by a licensed healthcare provider trained in the evaluation and management of concussions, and receives written clearance to return to play from the health care provider (Sanford Health, 2011).

This literature review will include various definitions of concussions and also definitions for second impact syndrome and post-concussion syndrome. A chart with the most common signs and symptoms in concussions will be included. Numerous tools for assessing concussions have been used to aid in diagnosis and managing concussions. These can be divided down by type including: symptom checklists, neuropsychological tests, postural stability testing, and sideline assessment tools. Examples of each type will be further discussed and the frequency of use in current research will be noted. Not one single tool has been found to be entirely effective; combining tools has proven to be more beneficial, specifically if there are baseline measurements that can be used for comparison (Scorza, et al., 2012).

Finally, the literature review will lead to development of a framework for evaluation and return to play guidelines. The evaluation will include a thorough history of the events and an assessment in the clinic setting. This will also be a time when the athlete, parents, and possibly coaches/teachers are educated on what to observe for as the athlete returns to school and sports. A detailed return to play guideline tool will also be included. This will require a team approach to get the athlete back on the field. Communication between the healthcare provider, athlete, parents, coaches, teachers, athletic trainers, and anyone else involved with the care of this athlete will be essential to provide for the best possible recovery and outcome.

A poster will be developed to help highlight the most frequently used tools and guidelines to diagnose and treat concussions. An easy to follow framework will be displayed on the poster for practitioners to follow in practice for concussion management and return to play (RTP) guidelines. This will be based on the most current evidenced based information gathered from peer-reviewed journal articles and research.

Significance

Around 300,000 sports-related concussions are reported each year in the United States; however, the number may be between 1.6 to 3.8 million recreational and sport-related concussions, since many go unreported (Halstead, Walter, and the Council on Sports Medicine and Fitness, 2010; Scorza, et al., 2012). Currently there is no mandatory reporting system for youth athletes that sustain a concussion. With more and more young adolescents being active and participating in sports activities the risk for concussions increases. One key to solving the problem is education, in order to provide for better recognition and management of concussions. This is essential for the athletes, parents, coaches, athletic trainers, school administrators, physicians, nurse practitioner's (NP), physician assistants (PA), and other health care professionals. A great resource developed in 2005, by the CDC, it is titled "Heads Up: Concussion in Youth Sports" and provides information on preventing, recognizing, and responding to concussions (CDC, 2012a).

With the recent legislation passed in numerous states it is essential for health care providers to know their role in concussion evaluation and management. Most states new legislation state that athletes need to be cleared by a licensed health care provider trained in concussion management before returning to play (Sanford, 2012). Many health care providers

may be unaware of the most recent guidelines, and those are the ones that are most at risk, if they don't have formal training in concussions they should not be returning young athletes to play (Gallegos, 2012). This literature review is developed to provide current guidelines in concussion management and also promote rural health care practitioners to become familiar with the laws in each individual state.

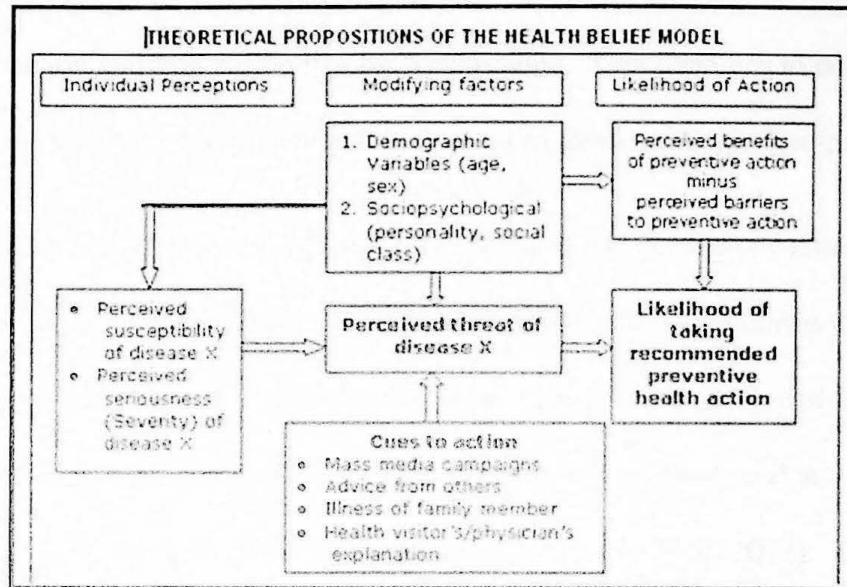
Much research is still needed on the most effective way to diagnose and manage concussions in young athletes. The Zurich Consensus Statement (2008), identifies many areas for future research including: pediatric injury and management models, strategies for rehabilitation, what tools should be used for assessment and management, for example, the effectiveness of the SCAT2. Another area of research is the long-term effects of concussions, especially in young athletes; studies are being done on older professional athletes. Further research will lead to improved guidelines for athletes of all ages.

Theoretical Framework

The Health Belief Model (HBM) can be used for problem behaviors that evoke medical concerns (Current Nursing, 2012). Concussions are one serious injury that can occur to any young athlete at any time during practice or competition. Prevention can be promoted using helmets, mouth guards, and proper techniques. Education should be the primary source of prevention; it is also an integral part in managing concussions. Therefore, the HBM will be utilized to show how concussion education is essential to diagnosis and management in concussions.

McEwen and Wills (2011) state that the HBM focuses on attitudes and beliefs of people; it is based on theories from the behavioral sciences to predict health behaviors. The main

concepts are based on perceptions of a particular illness. These perceptions include the severity of the potential illness, susceptibility to the illness, the perceived benefits of preventative action, and the barriers to taking the action (Current Nursing, 2012).



Halstead, et al. (2010), states that many athletes, parents, coaches still believe that concussions can be “toughed out” and that young athletes are invincible and don’t report these injuries to healthcare providers. This reinforces that many athletes, parents, and coaches still need to recognize the seriousness of concussions. Often athletes don’t present to a healthcare provider until parents notice changes in their behavior or until signs and symptoms of concussions has persisted for days to weeks (Patel & Reddy, 2010). Parents, athletes, and coaches need to be educated that all concussions are serious. By utilizing the HBM it will increase the awareness about concussions and the side effects which will in turn increase perceptions of perceived seriousness and susceptibility of concussions.

Education on concussions is being provided based on the new legislation. Again, using SD as an example, the SD High School Association (2012) has developed education resources

for coaches, athletes, parents, and health care providers on its website. First coaches have to watch a video titled, "Concussion in Sports, What you need to Know." This needs to be done yearly for the educational requirement. The athletes and parents each have a form which includes; what is a concussion, what are the signs and symptoms of a concussion, what to do if you have a concussion and prevention tips on concussions. This form has to be read, signed, and given to the school yearly by the athlete and the parent to allow participation in school activities.

Information included for health care providers are; explanation of state law, side line evaluation forms, in the office evaluation forms, and return to play guidelines/forms developed by a team of physicians at Sanford HealthCare Center. These were developed to help providers meet the standard of care for concussion in youth athletes and can be found at <http://www.sanfordhealth.org/MedicalServices/Concussions> (Sanford, 2012). These tools in addition to the provider's assessment skills will lead to individualized concussion management plan of each young athlete.

The susceptibility of concussions is very high, they not only are a result of sport activities, but may also be caused by falls, motor vehicle accidents, or other trauma. Patel and Reddy (2010), state that concussions can also occur in non-contact sports as a result of sudden acceleration, deceleration, or rotational forces affecting the brain. All athletes are at risk for suffering a concussion, recent research shows that young athletes are more susceptible to concussions than older athletes due to ongoing neurocognitive development that occurs through adolescence (Marar, McIlvain, Fields, & Comstock, 2012). These facts show that concussions can happen to anybody and should demonstrate to the public that there is a threat of condition as demonstrated by the threat of the disease in the HBM model.

Mass media campaigns have been developed for concussions. These include the “Heads Up – Concussion in Youth Sports” and the National Football League’s assistance with youth concussion legislation. This information is provided to the public which allows the decision to be made to focus on prevention of concussions. The information along with new concussion laws in the majority of the states allows coaches, parents, and athletes to make decisions to sit the athlete out of sport activities if concussion or the possibility of one exists.

Definitions

It is almost impossible to define a concussion with simple terms, however, a definition is needed so that young athletes, parents, coaches, and others involved will recognize a concussion and seek treatment from a health care professional. Concussion can be defined as a mild traumatic brain injury caused by a bump, blow, or jolt to the head that alters the way your brain typically functions (CDC, 2012b). Another definition is that concussions occur after a blow to head resulting in an immediate and short-lived loss of consciousness followed by a brief period of amnesia (Porth & Matson, 2009). There are so many variations in the definitions for concussions, this may partly be why it is so difficult to effectively evaluate and manage young athletes with concussions.

The most frequently used definition for concussion in this literature review was found to come from the Consensus Statement on Concussion in Sport held in Zurich, in 2008. They define concussion as a “complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces. McCrory, et al (2009), state the definition for concussion may also include:

1. Concussion may be caused either by a direct blow to the head, face, neck, or a blow elsewhere in the body with an “impulsive” force transmitted to the head.
2. Typically results in the rapid onset of short-lived impairment of neurological function that resolves spontaneously.
3. May result in neuropathological changes but the acute clinical symptoms largely reflect a functional disturbance rather than a structural injury.
4. Results in a grades 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. In a small percentage of cases, however, post-concussive symptoms may be prolonged.
5. No abnormality on standard structural neuroimaging studies is seen in concussion.”

Second Impact Syndrome (SIS) is an immediate and can be deadly short term consequence of returning an athlete too early after a concussion and sustaining a second concussion (Williams, et al, 2012). Yard and Comstock (2009) state that adolescent athletes that return to play prior to being fully recovered may suffer from negative outcomes, including serious lifelong physical and mental health problems or even death. SIS according to Harmon, et al. (2013), “is thought to involve a loss of auto regulation of the brain’s blood supply, leading to vascular engorgement, marked intracranial pressure, brain herniation and ultimately coma or death.” It is only been associated with adolescents, athletes younger than 20 years old. The literature leads to a large debate, does SIS really exist?

Paul McCrory (2001) wrote a journal article on that very question, in the conclusion he recommended to stop using the term SIS and refer to the syndrome as diffuse cerebral edema. In his research he found very few documented SIS cases that had a prior head injury or ongoing concussion signs and symptoms documented that would support the concept of SIS. Halstead, et al. (2010), also mentions the debate on whether cerebral edema is due to two separate collisions or a single injury. The Zurich Consensus Panel (2008) does not mention or use the term SIS anywhere in its document.

Harmon, et al. (2013) also questions if SIS really exists, however, since the association of signs and symptoms have completely resolved. This is also in accordance with McCrory (2001), who also recommends that all signs and symptoms following a concussion should be fully resolved before returning to activity. This will likely decrease the likelihood of a young athlete suffering from SIS. Since d'Hemecourt (2011) states that most experts concur that an initial incident preceded the catastrophic second event and was marked by incomplete recovery of symptoms.

So many experts in this field are still trying to figure out if SIS is a true physiologic process. Therefore, is it really that important to include the term SIS in concussion management? Shouldn't the focus just be more on preventing further injury or harm in adolescent injuries? The main concept to take away from this information is to make sure that young athletes are exhibiting no signs and symptoms. Therefore, they are able to play at full potential to prevent further injury.

Post-Concussion Syndrome is a term used to define the condition of lengthy and persistent concussive symptoms (Ferullo & Green, 2010). Typically signs and symptoms of a

concussion resolve in seven to ten for most individuals (Halstead, et al, 2010). Post-concussion syndrome is another complication that can lead to long term adverse effects that is also mentioned in the literature. It is another term used with concussion management that is hard to define and with no definite reasons why some people suffer from it. It includes persistent signs and symptoms such as; headache, dizziness, insomnia, exercise intolerance, cognitive intolerance, depressed mood, irritability, anxiety, memory loss, poor coordination, fatigue, or noise and light sensitivity that last weeks to months after the injury (Harmon, et al., 2013).

Moser, Schatz, and Jordan (2005), completed a study on 238 high school students; 82 with no previous concussions and 56 that have had a concussion over 6 months ago. Neuropsychological testing was done at baseline and then those athletes who had a concussive injury were tested again at seven days. The results showed that recently concussed athletes performed poorly on attention and concentration, the interesting fact, it was similar to what athletes that had suffered two or more concussions also scored. Grade point averages were also compared and were lower in recent concussions and those with two or more concussions. This study showed that cumulative effects do develop in high school athletes. With decreased cognitive function, these adolescents are probably more irritable, anxious and possibly depressed, mild signs and symptoms they don't even recognize as long term effects from a concussion.

Process

Evidence based practice (EBP) is the combination of clinical expertise with the best scientific evidence from nursing and medical research (Mateo & Kirchhoff, 2009). These practices are becoming the standard level of care for all patients. EBP's are developed according

to the compilation of research findings and based on outcomes of patient care, considering the benefits and harms to the patient (Mateo & Kirchhoff, 2009). Health care providers need to implement the latest EBP's to keep practice current and provide the best clinical outcomes for the patients. This suggests that health care providers need to acquire exceptional research skills.

Health care providers have a plethora of research at their fingertips with access to the internet and electronic resources. It is crucial for them to further develop research skills to further enhance information gathering experiences. Mateo and Kirchhoff (2009) identify four phases in the search for evidence: "preparation and planning, mining the literature databases, beyond the literature databases: mining the internet, and pulling it all together."

The first phase of this review included developing a searchable question using the PICO method, which is defined as P = patient, population, problem, I = intervention, C = comparison, and O = outcome (Mateo & Kirchhoff, 2009). The PICO question developed for this literature review is as follows; in adolescents what are the most effective methods to use in rural primary care clinics to evaluate and manage concussion signs and symptoms to improve recovery and decrease long term side effects of concussions.

The second phase involved identifying literature databases that contain peer-reviewed journals. CINAHL, PubMed, and Medscape are excellent databases that contain a great deal of information from nursing and other health science journals. Key words used to identify research for concussion management and evaluation included: concussion, mild TBI, head injury, adolescents, young athletes, high school athletes, nurse practitioner, family practice, diagnosis, evaluation, management, and return-to-play guidelines.

Around sixty journal articles were reviewed, trying to use the most recent research, so one limit was articles dated 2008-current. However, significant findings in articles dating back to 2001 were utilized in this literature review. Of the twenty four journal articles referenced in this review, six were published between 2001 and 2006; the remaining eighteen sources were from 2009-2013. All of the articles were retrieved from CINHAHL or PubMed.

The third phase in included searching the entire internet, it is crucial to make sure each web site contains high quality, reliable information. For example, web sites from the Centers for Disease Control or Sanford Health contain reputable information on concussion evaluation and management. UpToDate is another emerging website, that is evidenced based and physicians are constantly reviewing and editing the information to provide the latest standards of care (UpToDate, 2011). Various organizations publish position statements on concussion management and it is essential to review this, for example, the American Medical Society for Sports Medicine or the National Athletic Trainers Association. These groups have valuable professionals researching and conducting studies on this topic. In total nine internet sources contributed valuable information for this literature review.

Finally, the fourth phase entailed compiling all the information gathered together. Another vital skill for healthcare providers is to be able to understand the research and be able to efficiently organize and evaluate the information to make sure it will support the PICO question. Developing a poster to share this information with other health care providers and receiving feedback on the project.

Review of Literature

Background

Concussions have become such a large concern in sports around the world that there have now been three worldwide symposiums. The first was in Vienna (2001), the second in Prague (2004), and the most recent in Zurich in November 2008 (McCrary, et al, 2009). Numerous journal articles or resources reviewed for this literature review referred to these symposiums (d'Hemecourt, 2011; Ferullo & Green, 2010; Grady, 2010; Halstead, et al., 2010, Harmon, et al., 2013; Hunt & Ferrara, 2009; Karlin, 2011; Makdissi, 2010; Sanford Health, 2011; Scorza, et al., 2012; Yard & Comstock, 2009; and Zonfrillo, et al., 2012). McCrary et al (2009) created a summary of the findings from Zurich and stated this document is not a standard of care, but it should be used as a guide along with sensible medical practice. The Zurich Consensus Statement (2008) focused on three questions specifically regarding pediatric management of concussions: "Which symptoms scale is appropriate for this age group, which tests are useful, how often should baseline testing be performed in this age group, and what is the most appropriate RTP guideline for elite, non-elite child and adolescent athletes?"

Young athletes with concussions are a very different population to care for, compared to adults with concussions. The pathophysiology of concussions is yet to be fully understood. Much of the literature refers to a "neurometabolic cascade." An injury occurs to the brain at the cellular level by disrupting and increasing the permeability of the neuronal cell membranes (Kirkwood, Yeates, & Wilson, 2006; Patel & Reddy, 2010). It is during this time, that the brain is more susceptible to further injury until the recovery is complete at the cellular level.

Researchers believe it is even more crucial in young athletes, where they are still gaining knowledge and growing.

So why are more concussions being reported in young athletes? A few theories why pediatric and adolescent populations are more at risk for suffering from a concussion include; “immaturity of the developing central nervous system, having a larger head to body ratio, thinner cranial bones, a larger subarachnoid space in which the brain can move freely and differences in cerebral blood volume” (Karlin, 2011). Another theory has to do with adolescents not being fully developed or a decrease in strength due to immaturity. Karlin (2011), states that decreased development of neck and shoulder muscles in adolescents may inefficiently disperse the energy from the head impact to the rest of the body. With over 7.2 million high school students participating in sports in the 2009-2010 school years, there is a huge risk of injury during athletics (Marar, et al., 2012). Management of concussions by healthcare providers needs to be effective and based on the most current guidelines since concussions are bound to occur.

Healthcare Provider Knowledge

Provider knowledge about concussion management is a concern regarding the new concussion laws enacted in many states. MN, ND, and SD laws state that the young athlete must be evaluated by a health care provider that is trained in the evaluation and management of concussions and given written return to play instructions (Sanford Health, 2011). In rural areas, this could be a problem, especially if the area is served by a limited number of health care providers. Zonfrillo et al. (2012), state that in some settings, primary care providers may be the only available resource for ongoing management, so it is critical they be familiar and comfortable with concussions and coordinate care to specialists as necessary.

Data indicate that pediatricians, family practice physicians, emergency physicians, and pediatric and family practice NP's report that they may not have adequate training or knowledge regarding concussion management in children and adolescents. One study by Bazarian (2001) surveyed providers on their knowledge regarding concussion management. The survey consisted of case studies of pediatric concussion patients and when return to sports was appropriate. The author found that of the 662 that were asked about what source they used to return the athletes to play, 122 used a guideline, 101 listed journals, 75 said experience, 33 cited residency training, and 23 listed continuing medical education. Although this study was conducted prior to the worldwide symposiums on concussion management this goes to show that a standard guideline needs to be promoted in the medical community for RTP guidelines.

Concussion laws will dramatically increase the number of young athletes who need clearance by a medical health provider (Zonfrillo, et al., 2012). A study, limited to a single care network, surveyed 145 providers, 92% of these providers had referred at least one concussion in the last three months, to a neurologist or neuropsychologist (Zonfrillo, et al., 2012). Reasons for referral were due to being uncomfortable with management, did not have sufficient time or resources, not perceive it to be their role, or did not believe setting was suitable for ongoing management (Zonfrillo, et al, 2012). This may be acceptable in an urban area, however, a rural area may mean the young athlete has to travel hundreds of miles for treatment. It really is the provider and healthcare facilities responsibility to gain education, develop or obtain appropriate evaluation forms, patient handouts based on current research. This will allow all young athletes to receive the standard of care in concussion evaluation and management.

So which health care providers are evaluating and managing concussions in high school athletes? Meehan, d'Hemecourt, Collins, and Comstock (2011), completed a descriptive

epidemiology study on 1056 high school athletes that suffered from sport related concussions. It found that 94.4% of concussions were assessed by certified athletic trainers (ATC's) and 58.8% by primary care physicians. This study also looked at RTP and found that physicians and ATC's utilize similar RTP intervals for athletes. Also noted was that 8.2% of concussed athletes were managed by orthopedic surgeons, NP's, and PA's. This reinforces the fact that many health care providers need to seek out further training in concussion management to effectively manage young athletes in accordance with new legislation. One limitation to note from this study is that all high schools included did employ an ATC.

Signs and Symptoms

Signs and symptoms are another key area to determining the severity of the concussion and when return to play to appropriate for youth athletes. Concussion grading scales have varied over the years, with more than twenty five different scales published (Halstead et al, 2010). Concussion severity was once based on loss of consciousness (LOC), amnesia, and confusion; they then progressed to being simple concussion vs. complex concussion. The main focus of the scales was to recognize more severe concussions or those more likely to lead to adverse outcomes to help providers manage those injuries (Makdissi, 2010). Currently according to the 2008 Zurich Consensus statement the use of severity scales have been abandoned and more emphasis is put on symptom resolution (McCrory, 2009).

The majority of the literature reviewed did note that classification scales of concussion severity have been discontinued. Scorza, et al. (2012), state "an ideal classification system would determine severity at the time of injury, provide prognostic information, and help RTP

decisions.” This could be an ideal avenue for research in the future, developing a classification scale that would guide providers with management and RTP strategies.

While 2008 Zurich Consensus did abandon the severity scales, the group did develop a list of “modifying factors.”

Table 1: Modifying Factors

Factors	Modifiers
Symptoms	Number - How Many? Duration - How long did the symptoms last? Greater than 10 days? Severity - How bad are they?
Signs	Prolonged loss of consciousness – greater than 1 minute, amnesia?
Sequelea	Concussive convulsions?
Timing	Frequency - How many concussions in lifetime? Timing - Did concussions occur close together? Recent - When was the most recent concussion?
Threshold	Do repeated concussions occurring with progressively less impact force or slower recovery after each successive concussion?
Age	Child or adolescent (<18 years old).
Comorbidity & Pre-morbidity	Migraine, depression, or other mental health disorders, ADHD, learning disabilities, or sleep disorders.
Medications	Psychoactive drugs or anticoagulants.
Behavior	Dangerous style of play.
Sport	High-risk activity, contact and collision sport, or high sporting level.

McCrorry, et al., (2009). Consensus statement on concussion in sport-the third international conference on concussion in sport held in Zurich, November 2008. *Journal of Clinical Science*, (16), 755-763. doi: 10.3810/psm.2009.06.1721

These modifying factors need to be included in the detailed history obtained by providers in the clinical setting. McCrorry et al. (2009), states that athletes displaying any modifying factors should be managed in a multidisciplinary manner coordinated by a provider trained in managing concussions. This is also relevant to current concussion legislation because MN, ND,

and SD laws state that high school athletes have to have written RTP guidelines by a health care provider trained in the evaluation and management of a concussion.

The 2008 Zurich Consensus Panel agreed that the diagnosis of acute concussion involves the following domains: clinical symptoms, physical signs, behavior, balance, sleep, and cognition (McCrory, 2009). Halstead, et al. (2010) utilize four categories for signs and symptoms of concussion: physical, cognitive, emotional, and sleep (Appendix A). The most consistent signs and symptoms across the review of literature include: headache, loss of consciousness (LOC), confusion, memory loss, fatigue, and balance difficulties (Bazarian, et al., 2001; CDC, 2011; CDC, 2012a; CDC, 2012b; d'Hemecourt, 2011; Ferullo & Green, 2010; Grady, 2010; Halstead, et al., 2010; Harmon, et al., 2013; Karlin, 2011; Kirkwood, et al., 2006; Makdissi, 2010; Makdissi, et al. 2010; Marar, et al., 2012; McCrory, et al., 2009; Meehan III, 2011; Moser, et al., 2005; Patel & Reddy, 2010;. Scorza, et al., 2012; Yard & Comstock, 2009). It is also important to note that signs and symptoms may not occur at the time of injury; they may develop hours after the event (Grady, 2010). A diagnosis of concussion should be made if the athlete complains of any single or combination or signs or symptoms.

A descriptive epidemiology study was done in the US utilizing high school athletes in 20 sports over two academic years 2008-2010 by Marar et al. (2012). This study looked at 1936 concussions and the most commonly reported concussion symptom was headache (94.2%), followed by dizziness (75.6%), and concentration difficulty (54.8%), other symptoms included confusion, light sensitivity, and nausea (Marar, et al., 2012). Comparing this to another study which sampled 1,015 male Australian football players, between 16-35 years old, and 88 concussions were observed (Makdissi, et al., 2010). It also found headache to be the most common reported symptom. Makdissi, et al. (2010) found that athletes typically report 3.7

symptoms per concussion, the other symptoms like fatigue lethargy, "fogginess", sleep disturbance, confusion/disorientation, visual disturbance, amnesia, and nausea reported were consistent with what Marar et al. (2012) found as well.

Underreporting is a crucial mistake many young athletes, parents, and coaches may make. Halstead, et al. (2010), states that multiple issues complication recognition of a concussion, such as; not recognizing symptoms due to poor understanding of concussion or for cognitive impairment from the injury itself. The signs and symptoms may be vague: a chronic dull headache, depression, anxiety, trouble sleeping, or having trouble concentrating at school, the athlete may just attribute these feelings to something else. Cognitive stress, such as school work may make the attention or memory deficits more noticeable to parents, coaches, or teachers (Grady, 2010). Also young athletes may not share signs or symptoms due to fear of activity restrictions and not being able to compete at all (Halstead, et al., 2010).

Neuropsychological Testing

"Neuropsychological testing is the gold standard in documenting deficits in cognitive function," (Grady, 2010). Neuropsychological testing typically involves various tests on the cognitive abilities (memory, attention, language, visual spatial, etc.), tests of psychological functioning (personality interviews, psychiatric symptom scales, etc.), and some testing of sensory and motor functioning (Randolph, McCrea, & Barr, 2005). It can be done using pencil and paper testing or newer computerized versions. A neuropsychologist also completes a thorough history and evaluated any other data, such as neuroimaging or lab work to develop a diagnosis and treatment plan. This literature review found that neuropsychological testing is a critical part of concussion management (d'Hemecourt, 2011; Ferullo & Green, 2010; Field, et al.,

2003; Grady, 2010; Halstead et al., 2010; Harmon, et al., 2013; Hunt & Ferrara, 2009; Karlin, 2011; Kirkwood, et al., 2006; Makdissi, et al., 2010; McCrory, et al., 2009; Meehan III, et al., 2011; Moser, et al., 2005; Patel & Reddy, 2010; Randolph, et al., 2005; Scorza, et al., 2012; and Yard & Comstock, 2009).

In an ideal world, every young athlete would have neuropsychological testing after a concussion. However, in the rural areas locating or being seen by a neuropsychologist may be about impossible due to distance and cost for some families. That is why it is essential for primary care providers to gain knowledge on concussion evaluation and management for young athletes. With the newer computerized programs training can be done so that medical professionals can complete the neuropsychological testing.

Dr. Mark Lovell and Dr. Joseph Maroon developed ImPACT; Immediate Post-concussion Assessment and Cognitive Testing, computerized testing to objectively measure cognitive function in athletes suffering from a concussion (Carroll & Rosner, 2011; ImPACT, 2013). It includes a health history questionnaire, a section on current concussion signs and symptoms, neurocognitive section with six modules, and a graphic display of the data (ImPACT, 2013). The test looks at many aspects of cognitive functioning in athletes that include: attention span, working memory, sustained and selective attention time, response variability, non-verbal problem solving, and reaction time.

The test takes approximately twenty minutes and can be administered by an ATC, school nurse, and health care providers as long as the training for test administration is completed. Carroll and Rosner (2011) state that ImPACT is the gold standard for tracking athletes healing and recovery, it is now used by more than one hundred pro-teams, more than five hundred

colleges, and more than fifteen high schools nationwide. Since concussion management is complex, it is ideal to have baseline testing to compare with the post-injury testing to objectively track an athlete's progress (ImPACT, 2013).

Neuropsychological tests are typically designed for adults, but are utilized in adolescent athletes. A cross-sectional study was completed on 198 high school football players in grades 9th-12th (Hunt & Ferrara, 2009). The purpose was to see if age was a factor in NP testing in adolescent athletes. This study showed that NP test scores varied the most at 15.22 years of age or in the 10th grade. This proves that young athletes are still developing cognitively; meaning that yearly baseline NP testing would be most effective. Hunt and Ferrara (2009) do state that a longitudinal study should be completed to verify the finding of this study.

Field, Collins, Lovell, and Maroon (2003), completed a prospective study from 1997 - 2000, on 371 college athletes and 183 high school athletes to compare preseason with post-concussion NP and signs and symptoms recovery patterns. The high school athletes reported a significant increase in signs and symptoms at 24 hours, three days, and five days post-concussion, where the college group was limited to within 24 hours and at three days. This same study showed that high school students had a much slower NP recovery. The college aged athletes had significant memory deficits only in the first 24 hrs compared to the high school athletes demonstrating memory impairment for at least seven days after the injury. This study shows that younger athletes may need a longer RTP timeframe to allow for complete recovery before resuming participation.

The SCAT2 is a standardized method of evaluating athletes 10 years and older for a concussion, it includes a symptom scale, Glasgow Coma Scale, cognitive assessment, and a

balance/coordination assessment (SCAT2, nd.). The SCAT2 can be used immediately for a sideline assessment and then in the clinical setting to monitor progression. Although the SCAT2 does not single handily diagnose a concussion or state when RTP should occur, it is a good tool to show how the athlete is recovering. The SCAT2 is endorsed by the 3rd Consensus on Concussion in Zurich 2008. It is available free, online at <http://www.sportconcussions.com/html/SCAT2.pdf>. It could easily be used by health care providers and implemented into an electronic medical record. This would provide continuity of care if different providers were providing care to the same athlete. It would allow the athletes to undergo the same testing and to make sure things were progressing in a positive manner and the athlete was not declining in a specific area.

Graduated Return to Play Guidelines

Initially in the clinical setting the primary intervention should be behavior modification counseling (Grady, 2010). Physical and cognitive rest is the prescription for treatment in concussions in all the literature reviewed. Physical rest means no sports, recess, gym class, or any activity that could cause further injury to the brain. Cognitive rest means not partaking in school work, watching television, computers, video games, texting, or listening to music. Concussed adolescent athletes that have a decreased reaction time may need to be restricted from driving as well (Halstead, et al., 2010)

When all signs and symptoms of a concussion have resolved during rest the athlete may begin a graduated RTP protocol. The 2008 Zurich Consensus Panel promotes a step wise mode.

Table 2: Graduated Return to Play Guidelines

Rehabilitation Stage	Functional Exercise	Objective
No Activity	Complete physical and cognitive rest	Recovery
Light aerobic activity	Walking, swimming, or stationary cycling keeping intensity to less than 70% of maximum predicted heart rate. No resistance training.	Increase heart rate
Sport specific exercise	Light training drills. Examples; skating drills in hockey, running drills in soccer, ball handling skills in basketball. No head impact activities,	Add movement
Noncontact training drill	Progression to more complex training drills. Examples, passing drills in football and ice hockey. May start progressive resistance training.	Exercise, coordination, and cognitive load
Full contact practice	Following medical clearance participate in normal training activities.	Restore confidence, assessment of functional skills by coaching staff
Return to play	Normal game play	

McCrory, et al., (2009). Consensus statement on concussion in sport-the third international conference on concussion in sport held in Zurich, November 2008. *Journal of Clinical Science*, (16), 755-763. doi: 10.3810/psm.2009.06.1721

It is a six step pathway, where each step needs to take a minimum of 24 hours and the athlete must remain asymptomatic to move up the next day. If the youth athlete has return of any signs and symptoms, physical and cognitive rest should be implemented for 24 hours. When asymptomatic again the athlete can resume at the last level in the RTP progression that was tolerated (Karlin, 2011). The progression may take days, to weeks, to months, depending on how the athlete tolerates the increase in activity level and modifying factors (Harmon, et al., 2013). Two main concerns when returning youth athletes to play too soon are SIS and post-concussion syndrome, where signs and symptoms may persist for weeks to years.

Individualized RTP is essential for all athletes, even more important for adolescents, with their still developing brains. Most of the guidelines have been developed for adult athletes so being a little more cautious and taking more time to progress through the RTP steps seems logical for youth athletes. One study completed by Yard and Comstock (2009) was a prospective cohort study in 100 US high schools that had a certified athletic trainer (ATC). Over three years

1308 concussions were reported with at least 40.5% of concussed athletes returning to play prematurely under the American Academy of Neurology guidelines and 15% under the Prague (2004) RTP guidelines. ATC's may not refer to RTP guidelines, or may not have the authority to keep athletes out of play, or may feel pressured by coaches, parents, or athletes to go against recommended RTP guidelines (Yard & Comstock, 2009).

School management is another issue in dealing with concussion in adolescent athletes. Concussion signs and symptoms may worsen with increased cognitive strain, returning to school is generally not recommended until symptoms are mild or absent at rest (Grady, 2010). The return to school should have similar guidelines to RTP; it should be a gradual return. It should be done concurrently with physical RTP so that if either activity causes recurrent signs and symptoms, rest again can be initiated. Young athletes possibly should start a few hours of light school work at home, then half days at school, and then a normal academic load. Teachers need to be aware of the concussion and may need to provide temporary learning accommodations, such as additional time to complete assignment (Grady, 2010).

The health care provider needs to communicate with the academic staff to make sure the athlete attains the appropriate recovery. In rural areas the primary provider is going to have to make the effort and communicate with the school system. Karlin (2011) states that schools could utilize a certified athletic trainer to be the resource person for the athlete, parents, coaches, teachers, and physician. The CDC "Heads Up" program has a great website just for teachers and school personnel that contains information on what to watch for when concussed students return to school (CDC, 2012a). Education for schools on concussion management is just as important as educating the public because of the close contact and important role they play in the students' lives. Concussion management is going to take an entire team approach in an adolescent athlete.

Graduated returns to play guidelines are mentioned over and over again in current research (Bazarian, et al., 2001; Carrol & Rosner, 2011; d'Hemecourt, 2011; Ferullo & Green, 2010; Field, et al., 2003; Grady, 2010; Halstead et al., 2010; Harmon, et al., 2013; Karlin, 2011; Kirkwood, et al., 2006; Makdissi, 2010; Makdissi, et al., 2010; Marar, et al., 2012; McCrory, et al., 2009; Meehan III, et al., 2011; Patel & Reddy, 2010; Sanford Health, 2011; Scorza, et al., 2012; Williams et al., 2012; Yard & Comstock, 2009; and Zonfrillo, et al., 2012). However, the question is how many physicians actually provide concussed athletes with written guidelines for RTP. William, et al (2012) conducted a study that surveyed 101 coaches, one question pertained to sending an athlete that had suffered a concussion to a physician and if they returned with written RTP guidelines. It was noted that around 70% of the athletes sent for evaluation returned to the coaches with written RTP information, this is consistent with other research (Williams, et al, 2012).

Clinical Assessment

A clinical exam is the critical time for evaluation and diagnosis of the concussion. Evaluation of the injury should begin on the field of competition or practice. Young athletes need to be monitored for several hours up to 24 hours following the event, since signs and symptoms may not develop immediately after the injury. Athletes, parents, coach should be instructed to go to an emergency department if the athlete experiences repeated vomiting, severe or progressively worsening headache, seizure activity, unsteady gait, slurred speech, weakness in numbness in extremities, or any other unusual behavior (Halstead, et al., 2010). These could be more suggestive of a structural problem, such as cerebral edema, and may require neuroimaging and emergent work up. This literature review is going to focus on the clinical exam by a

primary care provider. However, the algorithm (Appendix B) developed for the poster does incorporate the immediate field examination.

In the clinical setting, it is essential to start with a thorough history and physical examination. The systematic review of symptoms from the athlete and parent is a crucial part of the exam since objective medical evidence is lacking with concussion (Kirkwood, Yeates, & Wilson, 2006). Using the OLDCARTS acronym, onset, location/radiation, duration, character, aggravating factors, relieving factors, riming and severity would be one efficient way to assess concussion signs and symptoms (Seidel, et al, 2011).

The provider needs to complete a symptom evaluation to see what signs and symptoms the athlete is currently having and if any have already resolved. The most commonly used is a 22 item symptom list used with a Likert Scale graded from 0 to 6, being the most severe (Halstead, et al., 2010). The SCAT2 (Appendix C) utilizes the 22 item symptom list. It is a standardized tool to assist in concussion evaluation and management. It includes a symptom evaluation, cognitive assessment, and balance and coordination examination, all things the health care provider in the clinical setting should complete.

In the clinical setting it is important when taking the history to consider differential diagnosis in examining the youth athlete. Those may include; heat-related illness, dehydration, hypoglycemia, acute exertional migraine, headache disorders, conduct disorder, depression, ADHD, sleep disorders, or cerebellar or brain stem lesions (Patel & Reddy, 2010). It is important to remember to review the modifiers (Table 1) with the athlete and parents. Knowing if young athletes suffer from any learning disabilities or suffer from ADHD or depression is important in evaluation and management of a concussion. d'Hemecourt (2011) states that pre-

injury learning disabilities have been connected with decreased cognitive function after concussion.

Secondly is the physical exam which should include a neurologic assessment and full cognitive evaluation. Testing all cranial nerves should be included in the clinic assessment. Balance assessment could be completed by using the Balance Error Scoring System (BESS) which includes: a double leg stance, single leg stance, and tandem stance (SCAT2, nd). Coordination could be tested by the finger to nose test. Cognition can be tested by using the Standardized Assessment of Concussion (SAC). It includes immediate memory, repeating groups of words, and concentration by repeating numbers backward (SCAT2, nd).

Imaging is another controversial topic in concussion diagnosis and management of concussions. Recently, the risk of radiation from neuroimaging, especially in children has gained national attention. The need for imaging in the diagnosis of concussion remains a clinical decision. Grady (2010), states that if a provider is concerned for an alternative diagnosis after the clinical history and physical examination then imaging is warranted. Patel and Reddy (2010), state imaging is needed in athletes with focal neurologic deficits, those with progressively worsening signs and symptoms, failure of signs and symptoms resolution in greater than two weeks, severe acute headache, or LOC greater than a few seconds.

Three articles reviewed state that no structural abnormalities are seen on imaging when a concussion has occurred (Grady, 2010, Makdissi, 2010, and Patel & Reddy, 2010). This is likely due to the fact that concussion is more a metabolic and functional disturbance rather than a structure injury to the brain (Karlin, 2011). One study that included 1056 sport related concussion in high school athletes over the 2009-2010 school year, noted that 1 out of every 5

young athletes received a CT scan during the assessment (Meehan, et al., 2011). Therefore, imaging is a decision that will be made by the health care provider based on history and physical exam.

Discussion

Interpretation

Concussion evaluation and management is an area in healthcare that will be evolving for years to come. There is no tool or test that can specifically diagnose a concussion. It is the health care provider's role to take a thorough history of the events leading up to the head injury and to complete a full physical and cognitive exam. Providers need to recognize that signs and symptoms will vary between athletes and to recognize modifying factors that put youth at a greater risk for injury if they continue to play with a concussion.

Makdissi (2010), states that athletes found to have any modifying factors may need a more conservative slower RTP program. This reinforces the idea that each young client suffering from a concussion needs an individualized plan of care. Field, Collins, Lovell, and Maroon (2003), compared recovery of college athletes versus high school athletes, the data suggest that more conservative treatment plan and assessment should be done for high school athletes, due to the fact that high school athletes had significant memory impairment up to seven days after the injury. RTP guidelines are proposed for people of all ages so being more conservative with adolescent athletes is the way to go.

The Midwest is full of rural areas, so not all youth sports events are going to have a trained medical professional available. This increases the risk of concussions in young athletes due to the fact that they are often not assessed or identified. This is where provider education

needs to fill the void. Concussion legislation has led to mass media campaigns and concussion education before participation in youth sports. However, education is a huge part of a health provider's role, especially for the adolescent athlete and parents. Karlin (2011) states that the pre-participation physical examination is an ideal time for the clinician to instruct the athlete and parents on signs and symptoms of concussion, immediate removal from play, and initiation of cognitive and physical rest. This would also be an ideal time to perform NP baseline testing. Therefore the baseline would be determined in case a concussion would occur sometime during the year.

Williams, et al. (2012), state that all providers that care for athletes must work together with high school coaches to develop a complete neurologic assessment for management of concussed athletes. NP testing may be one key to managing concussions. ImPACT testing is something that should be considered at all high schools across the country to better assist in the management of concussions. However, cost is likely to be a variable along with time. Finding health care providers that are willing to complete the ImPACT administration and interpretation education is another issue that needs to be addressed. Along with the time issue, if the test takes twenty minutes to administer, getting a large number of athletes tested will be an issue. A simpler testing for health care providers may be to utilize the SCAT2 which is available at no cost and only takes five to ten minutes to complete. It is used more to gauge recovery and make sure the athlete is improving after the concussion has occurred.

Concussion evaluation and management is still very controversial partly due to the fact that no one medical test aids in diagnosis, it's difficult to measure the severity, and not one evidenced based RTP guidelines has been promoted. With over 7.2 million high school students participating in sports in the 2009-2010 school years, there is a huge risk of injury during

athletics (Marar, et al., 2012). Healthcare providers need to take the initiative to seek out educational activities to gain knowledge on concussion evaluation and management because concussed athletes will be coming through the clinic doors.

Outcome/Dissemination

A poster was created that included a brief introduction to concussions, provided statistics how on significant concussion are in youth athletes. An abbreviated purpose of this literature review was shared with the intended audience. A short methodology on what databases and key words were used to conduct the literature review. South Dakota Senate Bill 149 was explained in detail so that these health care providers understand their current role. Clinical practice implications were shown on an algorithm (Appendix B). Charts were used to display; signs and symptoms, modifying factors, graduated return to play, and the SCAT2.

The poster was presented in a medical clinic which includes five family practice physicians, two internal medicine physicians, two hospitalists, and three pediatricians. There are thirteen specialty physicians, including orthopedics, ear, nose, and throat, podiatry, urology, general surgery, physiatry, and obstetrics and gynecology. The clinic also includes two NP's and eight PA's. So a total of thirty five providers had an opportunity to view the poster and complete a four question evaluation.

The poster was displayed in conference room area, where meetings are held and where the providers eat lunch daily. It was displayed for ten days and a four question evaluation was available to be completed. Out of the thirty five available providers, ten completed the evaluation forms. Verbal feedback was also gathered from several providers.

The evaluation form can be found in Appendix D. The following tables displays the result of the evaluation form in regards to the poster.

Table 3: Concussion Poster Evaluation

Question	1 strongly disagree	2 disagree	3 neutral	4 agree	5 strongly agree
The poster increased my knowledge about concussion evaluation and management in adolescent athletes.	0	0	0	2	8
The poster enhanced my knowledge about the South Dakota SB 149, concussion legislation for youth athletes.	0	0	0	1	9
Do you feel that written RTP guidelines should be required for adolescent athletes after a concussion?	0	0	2	2	6
The poster presented information that I would consider implementing into my own practice.	0	0	1	4	5

The third question also addressed what sources are currently being used for return to play guidelines. All ten respondents chose guidelines, eight chose experiences, four chose residency training, two chose journals, and no one selected other.

Overall, the poster was received well and effective. The purpose was to expose this group of health care providers to the new legislation in SD and make sure they were aware of their role to provide written return to play guidelines. With 90% of the respondents strongly agreeing to enhance their knowledge on SD SB 149, I feel this was achieved. The evaluation tool showed that respondent's knowledge on concussion evaluation and management increased over two-thirds which is notable. With more research, standard RTP guidelines will be

developed for youth athletes and make it more likely to be followed by health care providers. With 90% of respondents considering implementing information from the poster into their clinical practice shows that the information was informative and relevant.

Implications for Nursing

Practice and Education

NP's need to seek out ways to gain knowledge on concussion evaluation and management to stay current and to be in accordance with recent legislation. NP's first role is to educate the parents, young athletes, teachers, coaches, and others involved. Being able to evaluate and diagnose concussions in youth athletes is a role of the NP. The young athlete will need to provide a thorough history and a complete physical exam needs to be completed. NP's may want to become certified to be able to implement IMPACT testing in their practices or become familiar with SCAT2 and implement that. Being consistent and utilizing the same tool on concussed clients will make them more proficient in caring for this population. NP's will also need to adopt a graduated return to play guidelines and enforce this with young athletes and their parents. Each plan will need to be individualized to the signs and symptoms they present with. NP's must always have the opportunity to refer the patient if signs and symptoms are not improving with appropriate interventions. However, using the same evaluation techniques and RTP guidelines will provide all patients with a high level of care.

Policy

Recent legislation has brought concussion policies to the forefront especially in youth athletics. Now the issue will be enforcing the legislation. This goes back to educating the youths, parents, coaches, and others. Concussions need to be treated with cognitive and physical

rest and then graduated return to play guidelines. Other policy issues could be adopting this to all youth sports, not just school sponsored activities. It would also include club sports and even younger children that participate in soccer, baseball, hockey, or other sports. Sports may require safer protective equipment, such as helmets and mouth guards. An example would be a monitoring device on a football helmet, which would display when they suffered an excessive force to the head.

Policies for providers could be to establish reimbursement for providing concussion education programs for schools. Or possibly requiring a certain number of continuing education hours on concussion evaluation and management for those providers caring for concussed clients. Legislation should not be enacted to be restrictive; it should make the choices clearer for coaches, parents, and athletes on when to just sit it out. Its purpose should be to increase awareness in the community and try to prevent concussions or repetitive trauma and long term consequences of concussion. Policies that require education for the provider in concussion management may seem like overkill for already busy rural primary care providers, but in the end it will make them better providers.

Research

There are numerous areas for research in the area of concussions in youth athletes. First, is actually what is happening in the brain during the concussion, what is happening at the cellular level? There are many hypothesis and ideas but no definite pathophysiology. Also, why are some adolescent athletes more susceptible, suffer from more severe concussions, or are impacted by SIS or post-concussion syndrome? This is a very difficult task, since the diagnosis is

partially based on subjective data. Each child is going to handle the signs and symptoms differently, so management models need to be researched and developed.

Research has shown that adolescents that have ADHD, learning disabilities, or depression may suffer decreased cognitive function after a concussion. This needs to be addressed in research due to the number of children being diagnosed with one or all of these problems. The long term effects of concussion are still unknown, further longitudinal research is needed on all ages of athletes (Halstead, et al., 2010). Concussions may produce long term effects that these young athletes will need to deal with the rest of their lives; they need to be aware of the risks. Further studies would be warranted to see how many current providers are utilizing the stepwise return to play guidelines from the Zurich Consensus Statement (2008). There are many more areas related to concussion such as; NP testing, what tools should be used for assessment, return to play guidelines, and concussion grading scales; this list could go on and on.

Summary/Conclusions

With approximately 300,000 sports-related concussions being reported yearly in the United States (Halstead, et al., 2010; Scorza, et al., 2012), the need for effective concussion evaluation and management is critical. More and more youth athletes are participating in sports and are more aggressive than ever. The clinical exam for determining the diagnosis of concussion is a critical step. Signs and symptoms vary greatly, depending on what the young athlete is experiencing and also what they feel is important to report to the health care provider. A thorough history and physical exam focusing on neurological symptoms is key. The health care provider needs to be efficient by utilizing the same tools repeatedly to provide a standard of care in dealing with concussions in youth athletes.

Young athletes and concussions are a complex challenge, because the brain is still developing. Recent research has shown that all concussions are serious and being young does not make people indestructible. Health care providers should make education about signs and symptoms and management of concussions a priority when caring for adolescent athletes. They also need to seek out educational opportunities to learn more about concussion evaluation and management in adolescent athletes so that they are familiar with tools used to aid in diagnosis and are able to implement the most current recommendations in RTP guidelines. Concussion evaluation and management like most other things in healthcare will continue to evolve and improve with more research and evidenced based practices being determined.

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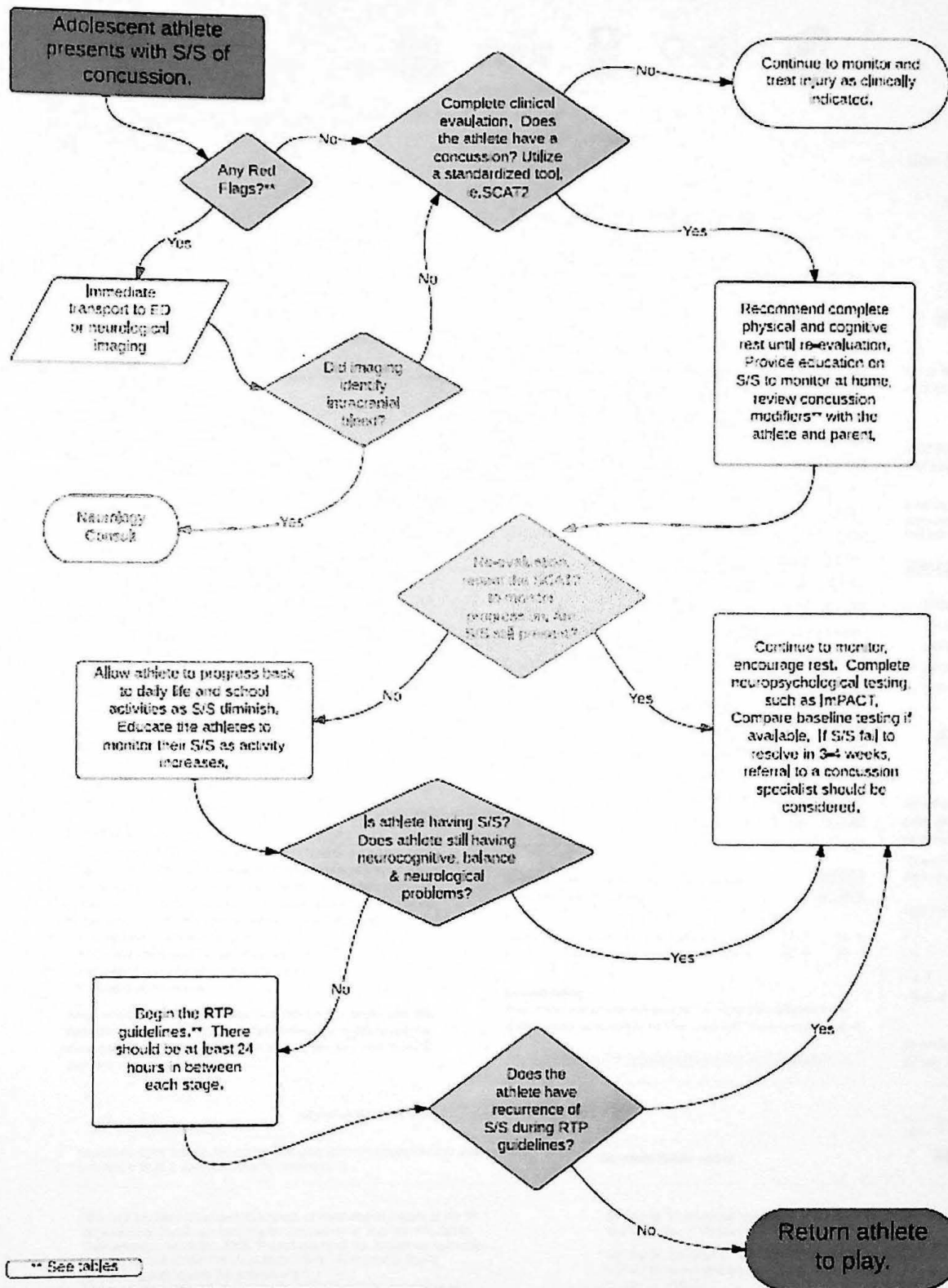
Author	Zonfrillo, M. R., Master, C.L., Grady, M. F., Winston, F. K., Callahan, J.M., & Arbogast, K.B.	Year	2012
Title	Pediatric providers' self-reported knowledge, practices, and attitudes about concussion.	Journal	<i>Pediatrics</i>
Volume	130	Pages	1120-1125
DOI	doi:10.1542/peds/2012-1431	Keywords	Concussion, Pediatric providers, Knowledge, Practices, Attitudes
Abstract	Objective: To determine pediatric providers' self-reported knowledge, practices, and attitudes about concussion. Methods: A cross-sectional survey of pediatric providers was conducted. Results: Most providers (80%) reported that they had received specific training on concussion. However, many providers (40%) reported that they were not confident in their ability to diagnose concussion. Conclusions: Pediatric providers' self-reported knowledge, practices, and attitudes about concussion are mixed. Further education and training are needed to improve pediatric providers' knowledge and skills in the management of concussion.		

Appendix A- Signs and Symptoms of a Concussion.

Physical	Cognitive	Emotional	Sleep
Headache	Feeling mentally "foggy"	Irritability	Drowsiness
Nausea	Feeling slowed down	Sadness	Sleeping more than usual
Vomiting	Difficulty concentrating	More emotional	Sleeping less than usual
Balance problems	Difficulty remembering	Nervousness	Difficulty falling asleep
Sensitive to light	Forgetful of recent information		
Sensitive to noise	Answers questions slowly		
Dazed	Repeats questions		
Stunned			

Halstead, M. E., Walter, K. D., and The Council on Sports Medicine and Fitness, (2010). Sports-related concussion in children and adolescents. *Pediatrics* (126), 597. doi:10.1542/peds.2010-2005.

Appendix B - Algorithm for Concussion Evaluation and Management.



** See tables

Adapted from McCrory, et al, 2009 & Sanford Health, 2011.

Appendix C – SCAT2

SCAT2



FIFA



Sport Concussion Assessment Tool 2

Name _____

Sport/team _____

Date/time of injury _____

Date/time of assessment _____

Age _____ Gender M F

Years of education completed _____

Examiner _____

What is the SCAT2?

This tool represents a standardized method of evaluating injured athletes for concussion and can be used in athletes aged from 10 years and older. It supersedes the original SCAT published in 2005. This tool also enables the calculation of the Standardized Assessment of Concussion (SAC)¹ score and the Maddocks questions² for sideline concussion assessment.

Instructions for using the SCAT2

The SCAT2 is designed for the use of medical and health professionals. Preseason baseline testing with the SCAT2 can be helpful for interpreting post-injury test scores. Words in *italics* throughout the SCAT2 are the instructions given to the athlete by the tester.

This tool may be freely copied for distribution to individuals, teams, groups and organizations.

What is a concussion?

A concussion is a disturbance in brain function caused by a direct or indirect force to the head. It results in a variety of non-specific symptoms (like those listed below) and often does not involve loss of consciousness. Concussion should be suspected in the presence of **any one or more** of the following:

- Symptoms (such as headache), or
- Physical signs (such as unsteadiness), or
- Impaired brain function (e.g. confusion) or
- Abnormal behaviour.

Any athlete with a suspected concussion should be REMOVED FROM PLAY, medically assessed, monitored for deterioration (i.e., should not be left alone) and should not drive a motor vehicle.

Symptom Evaluation

How do you feel?

You should score yourself on the following symptoms, based on how you feel now.

	score	0	1	2	3	4	5	6
Headache	0	1	2	3	4	5	6	
"Pressure in head"	0	1	2	3	4	5	6	
Neck Pain	0	1	2	3	4	5	6	
Nausea or vomiting	0	1	2	3	4	5	6	
Dizziness	0	1	2	3	4	5	6	
Blurred vision	0	1	2	3	4	5	6	
Balance problems	0	1	2	3	4	5	6	
Sensitivity to light	0	1	2	3	4	5	6	
Sensitivity to noise	0	1	2	3	4	5	6	
Feeling dazed/down	0	1	2	3	4	5	6	
Feeling like "in a fog"	0	1	2	3	4	5	6	
"Don't see right"	0	1	2	3	4	5	6	
Difficulty concentrating	0	1	2	3	4	5	6	
Difficulty remembering	0	1	2	3	4	5	6	
Fatigue or low energy	0	1	2	3	4	5	6	
Confusion	0	1	2	3	4	5	6	
Drowsiness	0	1	2	3	4	5	6	
Trouble falling asleep if applicable	0	1	2	3	4	5	6	
More emotional	0	1	2	3	4	5	6	
Irritability	0	1	2	3	4	5	6	
Sadness	0	1	2	3	4	5	6	
Nervous or Anxious	0	1	2	3	4	5	6	

Total number of symptoms (Maximum possible 22) _____

Symptom severity score _____

(Add all scores in table, maximum possible: 22 x 6 = 132)

Do the symptoms get worse with physical activity? Y N

Do the symptoms get worse with mental activity? Y N

Overall rating

If you know the athlete well prior to the injury, how different is the athlete acting compared to his/her usual self? Please circle one response.

no different very different unsure

Standardized Assessment of Concussion (SAC)

0 1
0 1
0 1
0 1
0 1

of 5

Repeat back as many words as you can

Repeat back as many words as you can

Repeat the words at a rate that you think you will be tested

Spoken word list

- baby
- finger
- monkey
- penny
- perfume
- blanket
- sunset
- lemon
- iron
- insect

of 15

Repeat when I am done, give order of how I would say 9-1-7

One point possible for digits should be read at

- digit lists
- 1-4-5
 - 4-9-6-8
 - 5-2-7
 - 6-1-8-4-3
 - 9-6-4
 - 7-2-4-8-5-6

Repeat order. Start with 1/1 say December

Jan 0 1

of 5

Maddocks score is validated for sideline diagnosis of concussion only and is not included in SCAT 2 summary score for serial testing.

Concentration score

This tool has been developed by a group of international experts at the 3rd International Consensus meeting on Concussion in Sport held in Zurich, Switzerland in November 2008. The full details of the conference outcomes and the authors of the tool are published in British Journal of Sports Medicine, 2009, volume 43, supplement 1. The outcome paper will also be simultaneously co-published in the May 2009 issues of Clinical Journal of Sports Medicine, Physical Medicine & Rehabilitation, Journal of Athletic Training, Journal of Clinical Neuroscience, Journal of Science & Medicine in Sport, Neurosurgery, Scandinavian Journal of Science & Medicine in Sport and the Journal of Clinical Sports Medicine.

McCrea M. et al. Summary and agreement statement of the 2nd International Conference on Concussion in Sport, Prague 2004. British Journal of Sports Medicine, 2005, 39: 196-204.

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McCrea M, Randolph C, Kelly J. Standardized Assessment of Concussion Manual for administration, scoring and interpretation. Waukesha, Wisconsin, USA.

Maddocks, DL, Dickler, GD, Selinger, MM. The assessment of orientation following concussion in athletes. Clin J Sport Med, 1995, 5(1):32-3.

Guskiewicz KM. Assessment of postural stability following sport-related concussion. Current Sports Medicine Reports, 2008, 2: 24-30.

6 Balance examination

This balance testing is based on a modified version of the Balance Error Scoring System (BESS). A stopwatch or watch with a second hand is required for this testing.

Balance testing

"I am now going to test your balance. Please take your shoes off, roll up your pant legs above ankle (if applicable), and remove any ankle taping (if applicable). This test will consist of three twenty-second tests with different stances."

(a) Double leg stance:

"The first stance is standing with your feet together with your hands on your hips and with your eyes closed. You should try to maintain stability in that position for 20 seconds. I will be counting the number of times you move out of this position. I will start timing when you are set and have closed your eyes."

(b) Single leg stance:

"If you were to kick a ball, which foot would you use? (This will be the dominant foot) Now stand on your non-dominant foot. The dominant leg should be held in approximately 30 degrees of hip flexion and 45 degrees of knee flexion. Again, you should try to maintain stability for 20 seconds with your hands on your hips and your eyes closed. I will be counting the number of times you move out of this position. If you stumble out of this position, open your eyes and return to the start position and continue balancing. I will start timing when you are set and have closed your eyes."

(c) Tandem stance:

"Now stand heel-to-toe with your non-dominant foot in back. Your weight should be evenly distributed across both feet. Again, you should try to maintain stability for 20 seconds with your hands on your hips and your eyes closed. I will be counting the number of times you move out of this position. If you stumble out of this position, open your eyes and return to the start position and continue balancing. I will start timing when you are set and have closed your eyes."

Balance testing - types of errors

1. Hands lifted off iliac crest
2. Opening eyes
3. Step, stumble, or fall
4. Moving hip into > 30 degrees abduction
5. Lifting forefoot or heel
6. Remaining out of test position > 5 sec

Each of the 20-second trials is scored by counting the errors, or deviations from the proper stance, accumulated by the athlete. The examiner will begin counting errors only after the individual has assumed the proper start position. **The modified BESS is calculated by adding one error point for each error during the three 20-second tests. The maximum total number of errors for any single condition is 10.** If a athlete commits multiple errors simultaneously, only one error is recorded but the athlete should quickly return to the testing position, and counting should resume once subject is set. Subjects that are unable to maintain the testing procedure for a minimum of **five seconds** at the start are assigned the highest possible score, ten, for that testing condition.

Which foot was tested: Left Right
(i.e. which is the non-dominant foot)

Condition	Total errors
Double Leg Stance (feet together)	of 10
Single leg stance (non-dominant foot)	of 10
Tandem stance (non-dominant foot in back)	of 10
Balance examination score (30 minus total errors)	of 30

7 Coordination examination

Upper limb coordination

Finger-to-nose (FTN) task: "I am going to test your coordination now. Please sit comfortably on the chair with your eyes open and your arm (either right or left) outstretched (shoulder flexed to 90 degrees and elbow and fingers extended). When I give a start signal, I would like you to perform five successive finger to nose repetitions using your index finger to touch the tip of the nose as quickly and as accurately as possible."

Which arm was tested: Left Right

Scoring: 5 correct repetitions in < 4 seconds = 1
Note for testers: Athletes fail the test if they do not touch their nose, do not fully extend their elbow or do not perform five repetitions. Failure should be scored as 0.

Coordination score of 1

8 Cognitive assessment

Standardized Assessment of Concussion (SAC)

Delayed recall
"Do you remember that list of words I read a few times earlier? Tell me as many words from the list as you can remember in any order."

Circle each word correctly recalled. Total score equals number of words recalled.

Test	Alternative word list		
elbow	candle	baby	finger
apple	paper	monkey	penny
carpet	sugar	perfume	blanket
saucer	sandwich	sunset	lemon
bubble	wagon	iron	insect

Delayed recall score of 5

Overall score

Test domain	Score
Symptom score	of 22
Physical signs score	of 2
Glasgow Coma score (E + V + M)	of 15
Balance examination score	of 30
Coordination score	of 1
Subtotal	of 70
Orientation score	of 5
Immediate memory score	of 15
Concentration score	of 5
Delayed recall score	of 5
SAC subtotal	of 30
SCAT2 total	of 100
Maddocks Score	of 5

Definitive normative data for a SCAT2 "cut-off" score is not available at this time and will be developed in prospective studies. Embedded within the SCAT2 is the SAC score that can be utilized separately in concussion management. The scoring system also takes on particular clinical significance during serial assessment where it can be used to document either a decline or an improvement in neurological functioning.

Scoring data from the SCAT2 or SAC should not be used as a stand alone method to diagnose concussion, measure recovery or make decisions about an athlete's readiness to return to competition after concussion.

Athlete Information

Any athlete suspected of having a concussion should be removed from play, and then seek medical evaluation.

Signs to watch for

Problems could arise over the first 24-48 hours. You should not be left alone and must go to a hospital at once if you:

- Have a headache that gets worse
- Are very drowsy or can't be awakened (woken up)
- Can't recognize people or places
- Have repeated vomiting
- Behave unusually or seem confused, are very irritable
- Have seizures (arms and legs jerk uncontrollably)
- Have weak or numb arms or legs
- Are unsteady on your feet, have slurred speech

Remember, it is better to be safe.

Consult your doctor after a suspected concussion.

Return to play

Athletes should not be returned to play the same day of injury. When returning athletes to play, they should follow a stepwise symptom-limited program, with stages of progression. For example:

1. rest until asymptomatic (physical and mental rest)
2. light aerobic exercise (e.g. stationary cycle)
3. sport-specific exercise
4. non-contact training drills (start light resistance training)
5. full contact training after medical clearance
6. return to competition (game play)

There should be approximately 24 hours (or longer) for each stage and the athlete should drop back to the previous asymptomatic level if any post-concussive symptoms recur. Resistance training should only be added in the later stages.

Medical clearance should be given before return to play.

Box	Test domain	Time	Score
		Date tested	
		Days post-injury	
SCAT2	Symptom score		
	Physical signs score		
	Glasgow Coma score (E + V + M)		
	Balance examination score		
	Coordination score		
SAC	Cerebellar score		
	Concentration score		
	Delayed recall score		
SAC Score			
Total	SCAT2		
Symptom severity score (max possible 132)			
Return to play			Y N Y N Y N Y N

Additional comments

Concussion injury advice (To be given to concussed athlete)

This patient has received an injury to the head. A careful medical examination has been carried out and no sign of any serious complications has been found. It is expected that recovery will be rapid, but the patient will need monitoring for a further period by a responsible adult. Your treating physician will provide guidance as to this timeframe.

If you notice any change in behaviour, vomiting, dizziness, worsening headache, double vision or excessive drowsiness, please telephone the clinic or the nearest hospital emergency department immediately.

Other important points:

- Rest and avoid strenuous activity for at least 24 hours
- No alcohol
- No sleeping tablets
- Use paracetamol or codeine for headache. Do not use aspirin or anti-inflammatory medication
- Do not drive until medically cleared
- Do not train or play sport until medically cleared

Clinic phone number

Patient's name

Date/time of injury

Date/time of medical review

Treating physician

Contact details or stamp

Appendix D – Poster Evaluation.

Concussion Evaluation and Management in Adolescent Athletes.

Jamie Hillmer RN, BSN, FNP-S

Please rate the poster by circling the number that best corresponds to your answer:

1 = strongly disagree 2 = disagree 3 = neutral 4 = agree 5 = strongly agree

- 1. The poster increased my knowledge about concussion evaluation and management in adolescent athletes.

1 2 3 4 5

Comments:

- 2. The poster enhanced my knowledge about the South Dakota SB 149, concussion legislation for youth athletes.

1 2 3 4 5

Comments:

- 3. Do you feel that written return to play guidelines should be required for adolescent athletes after a concussion?

1 2 3 4 5

If you agree what source are you using for returning athletes to play (circle all that apply)

Guidelines Journals Experience Residency Training Other

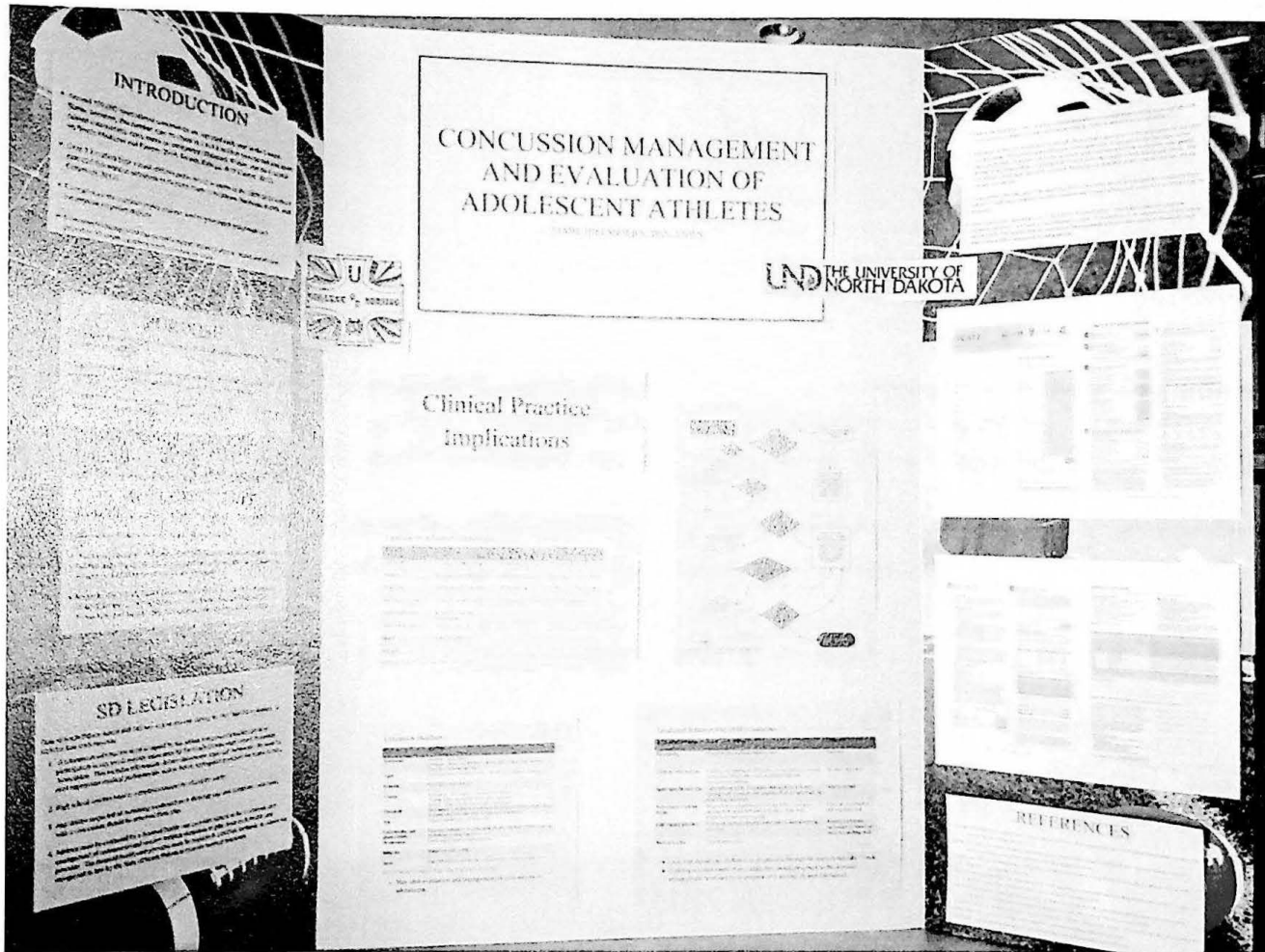
Comments:

- 4. The poster presented information that I would consider implementing into my own clinical practice.

1 2 3 4 5

Comments:

Appendix E – Picture of Poster Presentation



Room CRSC 103
Location, Thesis/Independent Study
Cabinet

Concussions



CSC11554