ASSESSMENT AND MANAGEMENT OF CONCUSSION IN YOUTH SPORTS: A PRIMARY CARE MODULE

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Concussion Management and Assessment in Young Athletes: A Primary Care Module

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ABSTRACT

Concussion is a common sports injury in young athletes with the potential to cause negative consequence for the athlete due to improper concussion management and premature return-to-play. Primary care providers are often responsible for diagnosing, treating, and making return-to-play decisions for young athletes. Despite the recent onslaught of literature advocating for physical rest, cognitive rest, graduated return-to-play protocol, and appropriate referral, many providers neglect to include these recommendations in their treatment plan and patient education.

An educational program "Concussion in Young Athletes: A Module for Primary Care Providers" was developed and delivered to primary care providers to address and improve these areas in practice. The module included three video vignettes to assess current and potential changes to provider treatment recommendations and an online PowerPoint Presentation. Data were collected for six weeks with 15 providers participating. Sixty-four percent of practicing providers diagnosed or treated a young athlete in the past year. One third of providers indicated they neither received concussion training during their MD, NP, or PA preparation nor completed training outside of their preparation. In the pretest, seventy-three percent neglected to include a return-to-play protocol in their recommendations for resuming sport. This was reduced to 40% following the module. In the pretest, one third of providers failed to refer an athlete with persistent concussive symptoms to a specialty provider. While little change was observed in the overall number of providers recommending physical rest, cognitive rest, and at school accommodations, notable improvements were made in the number of providers recommending return-to-play protocols and appropriate referrals for athletes with prolonged concussive symptoms. Comparing the cumulative pre and posttest scores, following the module providers scored an average of +2.7 points, or 11%, higher. After the module all providers (n=15, 100%)

reported planning to make changes to their practice and general increases in knowledge and confidence were seen. After viewing the module, provider responses revealed improved practice recommendations and implemented return-to-play protocols. Results of the module indicated that additional educational opportunities for primary care providers should be advertised, offered, and possibly required to improve practice of managing concussions in young athletes.

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A special thank you to my dissertation committee for seeing me through this long and arduous process. I could not have done it without your continued assistance and support. I hope I never have to do this again. But if I do, if my supervisory committee is half as dedicated as you all are, I know I'll be just fine.

DEDICATION

Lacking children and/or spouse, I have decided to dedicate this disquisition to myself. I thank myself for my tireless efforts in conducting this practice improvement project. On the other hand, perhaps the lack of spouse, significant other, or children allowed me to complete this project. Or, perhaps it was this practice improvement project that has prevented me from obtaining said spouse and/or children. Either way, this one was all me.

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CONCEPTUAL AND OPERATIONAL DEFINITIONS

Conceptual Definitions

Primary Care Provider. A primary care provider is a licensed physician, nurse practitioner, or physician assistant working within a family practice clinic.

Rural Clinic. For this study, rural pertains to clinic areas outside of less populated areas with limited access to health care.

Young Athlete. For the purpose of this study, the term young athlete refers to a child or adolescent that participates in either school based or recreational organized sport.

Knowledge Transfer. The means by which providers receive new information and practice recommendations as established through evidenced based practice literature.

Operational Definitions

Rural Clinic. For this study, rural refers to clinics that reside in areas of population equal to or less than 20,000.

Young Athlete. For the purpose of this study, a young athlete refers to a child or adolescent between the ages of five and eighteen.

CHAPTER 1: CONCUSSION IN YOUNG ATHLETES

Introduction and Statement of the Problem

In recent years, concussion in youth sports has gained considerable attention in the media, healthcare, and state legislation. While many state governments and health care institutions focus on the need to educate coaches, parents, and athletes on concussion and the risks of premature return-to-play, not enough attention is directed at ensuring primary care providers (PCP) receive proper training and are following current recommendations for assessing and managing concussions in young athletes. Concussions are a common occurrence in young athletes (Center for Disease Control and Prevention [CDC], 2011; Noble & Hesdorffer, 2013), comprising nearly 15% of all sport-related injuries in high school athletes (Meehan III, D'Hemecourt, Collins, & Comstock, 2011). Primary care providers, particularly those in rural settings with limited access to specialists or athletic trainers, are often the sole provider to diagnose, manage, and make return-to-play decisions (Zonfrillo et al., 2012). Inappropriate management of concussion can potentially leads to severe and long lasting complications (CDC, 2011). Insufficient knowledge transfer to practicing providers (Lebrun et al., 2013), inconsistency in PCP experience and training, and the recent onslaught of published research and guidelines on concussions has led to uncertainty and variability in management of concussions (Giza et al., 2013). Some providers may lack adequate training and resources to diagnose and treat young athletes with concussions (Zonfrillo et al., 2012). As such, PCPs would benefit from an educational program consistent with current evidence based guidelines to properly diagnosis and manage treatment of young athletes with concussion.

To meet the demonstrated need a practice improvement project was proposed and developed, an educational module directed towards primary care providers. The module, created

under the supervision of the Sanford Sports Medicine Clinic and supervisory committee, served to educate providers on assessment of the concussed young athlete, treatment recommendations, indications for referral, and return-to-play protocol.

The Fourth International Conference on Concussion in Sport describes concussion as a type of brain injury defined by a "complex pathophysiological process produced by biomechanical forces affecting the brain" (McCroy et al., 2013, p. e56). Concussions are typically caused by a direct hit to the head, face, or neck or by a force that is transmitted to the head (McCroy et al., 2013). Following the injury, a complex pathophysiologic process affects the brain leading to electrical and chemical changes (McCroy et al., 2013) causing a hypometabolic state that may persist for up to four weeks following the initial injury (Halstead & Walter, 2010). Neurological impairment from concussion occurs rapidly, minutes or hours following the injury, though the effects generally are short lived and resolve spontaneously within seven to ten days (McCroy et al., 2013). The exact process of neuroimpairment is unknown; several theories exist that attempt to explain this injury. Concussions differ from other forms of traumatic brain injury in that no structural damage is visible with current imaging techniques. For this reason, concussions are considered "functional injuries" as compared to "structural injuries" (McCrory et al., 2013, p. e56).

Signs and symptoms of concussion fall into four areas: cognitive, affective, somatic, and sleep disturbance (Herring, Cantu, Guskiewicz, Putukian, & Kibler, 2011). Cognitive symptoms of concussion include confusion, amnesia, loss of consciousness, disorientation, feeling dazed, mental fogginess, inability to focus, inability to learn new material, delayed response, and slurred speech (Herring et al., 2011). Affective symptoms of concussion include emotional liability, irritability, fatigue, anxiety, and depression. Somatic signs and symptoms of concussion include

headache, dizziness, disruption of balance, nausea, vomiting, blurry vision, sensitivity to light, and sensitivity to sound. Individuals with concussion may also have trouble with sleep such as difficulty fall asleep, excessive sleep, or inability to sleep as long as normally (Herring et al., 2011).

Purpose of the Study

The purpose of this practice improvement project is to develop, implement, and evaluate an educational program consistent with evidence based practice guidelines and under the direction of the Sanford Sports Medicine Clinic to expand the knowledge of the PCP in assessing and managing concussions in young athletes. Hypothetically, by supplementing provider knowledge and improving practice, the risk of complications associated with inappropriately managed concussions will decrease.

Significance for Practice

A large number of young athletes participate in sports. An estimated 30-45 million children and adolescents participate in organized sports in the United States with some children participating in sports as early as ages three or four (Karlin, 2011). With so many young athletes participating in organized sports and concussion being a common sports injury, primary care providers can expect to see young athletes present with concussions in their practice. Young athletes are often seen in the primary care setting, according to one study 60% of concussed athletes sought evaluation and treatment from their PCP (Meehan III et al., 2011). While many young athletes may initially present to an emergency department for evaluation of concussion, PCP are often responsible for follow up evaluation(s) and management of concussion symptoms. As such, PCPs are often required to make decisions regarding return to school and return to sports (Kaye, Gallagher, Callahan, & Nance, 2010). Despite the importance of the role PCPs

often play in concussion management of young athletes, many PCPs may lack sufficient training to diagnose and manage young athletes with concussions (Zonfrillo et al., 2012).

Risk of Concussion in Young Athletes

The CDC estimates that 1.7-3.8 million people experience a concussion each year in the United States, over 300,000 of these are sports or recreation related injuries (CDC, 2011). Many believe this figure to be grossly underestimated as many concussions go unrecognized and unreported (Noble & Hesdorffer, 2013). The majority of sports related concussions occur in athletes less than 20 years of age (Noble & Hesdorffer, 2013). In every age group, male athletes sustain the highest overall incidence of concussion, likely due to increased participation in high contact sports such as football and rugby (Giza et al., 2013). However, when compared to their male counterparts participating in the same sport, females are at a higher risk for suffering a concussion (Giza et al., 2013). For example, within the sport of soccer, there is a higher risk of concussion for female soccer players than male soccer players (Giza et al., 2013).

Younger athletes are at increased risk of experiencing a concussion (CDC, 2011) and having prolonged symptoms compared to older athletes (Covassin, Elbin, Harris, Parker, & Kontos, 2012). According to the CDC, children and teens are one of the subpopulations most likely to suffer a traumatic head injury, including concussions (CDC, 2011). The brain of a young athlete is still developing and may be more vulnerable to effects of concussions (Halstead & Walter, 2010). Children often experience more severe concussions and take longer to recover from concussions compared to adults (CDC, 2011; Marsh, Fraser, & Marsh, 2013). According to a study by Zuckerman et al (2012), recovery times of athletes ages 13-16 were significantly longer in three of the four neurocognitive measure than compared to athletes ages 18-22. The reasons for the differences between child and adult concussions are unclear; however, the

developing body of a child may potentiate part of the risk. Children have larger head-to-body ratios than adults and under developed neck and shoulder musculature that may reduce part of the force imparted on the head during a concussion injury (Karlin, 2011). Children also have a larger subarachnoid space leading to increased area for the brain to move during concussion injuries (Karlin, 2011). The developing brain of a child is also less myelinated and more elastic leading to an increased risk for shear injury (Karlin, 2011). Much of the research regarding concussion in athletes has been conducted using athletes that are in high school or older. Much less is known about treating concussion in children. Given the increased risk of concussions and increased time to recover from concussions in younger athletes, experts recommend a more conservative approach to management (Scorza, Raleigh, & O'Connor, 2012).

Current Treatment Recommendations for Acute Concussion

According to the International Conference on Concussion in Sport, the mainstay treatment recommendations for concussion management include physical rest and cognitive rest until asymptomatic followed by a graduated return-to-play protocol (McCroy et al., 2013). Physical rest includes restricting the athlete from participating in aerobic exercise, sport-specific training, competition, and other activities that increase heart rate (Graham, Rivara, Ford, & Spicer, 2014). Athletes engaging in physical activity with active concussion symptoms will often experience worsening of symptoms and in some cases prolonged recovery times (Graham et al., 2014). Also for a certain time following a concussive injury, the brain is at higher risk for repeater and increased injury. Reducing physical activity at this time lessens the risk for repeat injury during this time of vulnerability (Graham et al., 2014). Cognitive rest is also part of acute concussion treatment recommendations. Cognitive rest entails restricting or limiting activities that require increased concentration (Graham et al., 2014). This may include class attendance,

schoolwork, or even video games. Having a return-to-play or return to physical activity plan is also part of concussion treatment recommendations. Consensus opinion recommends athletes avoid physical activity until completely symptom free at rest and without the use of medications. Once this objective is met, it is recommended the athlete follow a return-to-play protocol (Graham et al., 2014). The International Conference on Concussion in Sport consensus statement recommends following a six step protocol (McCroy et al., 2013). The protocol begins with no activity and gradually increasing the amount of physical activity and contact in stepwise fashion until the athlete may resume normal game play. Return of symptoms at any level of the protocol will require the athlete to seek reevaluation and restart the protocol beginning with no physical activity (McCroy et al., 2013). The goals of concussion treatment are to allow for complete brain healing, prevention of further injury, and safe graduated return-to-play (Graham et al., 2014).

Inappropriately Managed Concussion

The potential consequences of improperly managed concussions can have serious short and long-term effects. Improperly managed concussions are associated with delayed recovery (McCroy et al., 2013) and poorer health outcomes (Graham et al., 2014). Death, permanent brain injury, delayed recovery, and persistent late-life effects are possible consequences of improper concussion management (Lebrun et al., 2013). The risk of adverse health outcomes increases when a person incurs multiple concussion or repetitive head injuries, particularly when a second concussion follows shortly after the primary concussion or head injury (Lebrun et al., 2013). As such, it is necessary that providers properly assess and manage patients suspected of having a concussion.

More studies are finding that stressing a concussed brain through cognitive tasks may worsen concussion symptoms and prolong recovery (Halstead et al., 2013). In theory, cognitive activities further stress the brain and leads to overexertion. The school environment itself may place strain on the recovery brain by exposure to bright lights, computers screens, and noisy cafeterias and hallways (Halstead et al., 2013). Failure to prescribe cognitive rest and return to school recommendations could potentially prolong a student-athlete's recovery time (Helstead et al., 2013). Young athletes that are prescribed one week of total physical and cognitive rest regardless of the timing of the concussion, whether days, weeks or months ago, were found to have improved computer neurocognitive scores and decreased symptom reporting following this time period (Moser, Glatts, & Schatz, 2012).

Second Impact Syndrome

Second impact syndrome is a possible and deadly consequence should an athlete return-to-play or sustains a second concussion prior to complete healing of the first, specifically during the first week following the primary concussion (De Los Angeles Whyte, Benton, & Whyte, 2013,). The theory behind this phenomenon suggests that following a concussion the brain may be susceptible to extremes in blood pressure (Scorza et al., 2012) caused by a loss of "cerebrovascular autoregulation" (Marsh, Fraser, & Marsh, 2013, p. 500). After sustaining a second head injury or concussion, the brain experiences a catecholamine surge possibly leading to "vascular congestion, cerebral edema, increased cranial pressure, and ultimately coma or death" (Scorza et al., 2012, p. 129). Fortunately, second impact syndrome occurs rarely and its actual incidence is unknown (De los Angeles et al., 2013). However, all guidelines emphasize that no athlete suspected of having a concussion should return-to-play while symptomatic (Scorza et al., 2012).

Following a concussion, long term monitoring is necessary to ensure child safety and development. Possible residual effects of concussion include sleep disturbance, learning disability, anxiety, and depression (Marsh et al., 2013). Children should also be monitored for post-concussive syndrome, a condition consisting of cognitive, physical, and emotional difficulties that persist between one and six weeks following a concussion (Marsh et al., 2013). For children with persistent symptoms of concussion, appropriate management of concussion should include a referral to a specialist. The appropriate time to refer to a specialist differs in the literature. Some state referral to a specialist should occur when symptoms do not appear to be resolving within three to five days or there is a concern about the severity of the symptoms (Marsh et al., 2013). Other sources recommend referral for symptoms that persist beyond the expected recovery time of ten to fourteen days (CDC, 2011).

Concussion in Rural Communities

In some settings, the PCP may be the only provider available to manage initial concussion symptoms and return-to-play decisions (Zonfrillo et al., 2012). This is thought to be true of PCPs in rural communities. The distance from larger health complexes and providers specializing in concussion management may limit the young athlete's access to specialty care. Younger athletes in rural populations also have the disadvantage of lacking an athletic trainer or other team health care provider to aid in return-to-play decisions. According to the National Association of Athletic Trainers, only 42% of high schools in the United States have access to an athletic trainer (Meehan III et al., 2011).

State Legislation

As of January 30, 2014, Mississippi became the last of all 50 states and the District of Columbia in the United States to pass legislation on youth sport concussion (Thies, 2014). This

news is a welcome advancement in a combined effort to prevent, manage, and limit complications of concussions occurring in youth sports. While most state legislation refers to the need for coach, athlete, and parent education, little legislation is directed at ensuring provider education and training. Under North Dakota law, students with signs or symptoms of a concussion are required to be examined by "a licensed, registered, or certified health care provider whose scope of practice includes the diagnosis and treatment of concussion" (North Dakota Century Code, 2011). The student may be allowed to play after obtaining written authorization from said provider and submits the form to the coach or athletic trainer (North Dakota Century Code, 2011). With increased awareness of the dangers of concussion in young athletes and the requirement for athletes to be evaluated and cleared by a healthcare provider, PCPs can expect to see an increase in the number of concussed athletes they evaluate and manage (Tomei, Doe, Prestigiacomo, & Gandhi, 2012). In a study conducted in 2012, researchers comparatively analyzed state-level concussion legislation and review of current practice in concussion (Tomei et al., 2012). At the time of the study, 42 states and the District of Colombia had current legislation on concussion in youth sports. At that time researchers found that while all states encouraged coaches to receive education on concussions, only 48% required coaches receive formal concussion education such as online training or in the classroom (Tomei et al., 2012). Of the states surveyed, 88.7% of states required that parents receive education on concussions and 86% of states required athletes receive concussion education (Tomei et al., 2012). For most of these states, the parent and student education refers to an information sheet to be read and signed. No state requires formal education, either classroom or online, of the parent or student-athlete. The study did not mention any instances in which providers were required to receive supplemental educational. Thirteen of the states surveyed required that the

healthcare provider participating in concussion care be "trained in the recognition and management of concussions" to be eligible to treat athletes with concussions. However, the type and extent of training was not specified (Tomei et al., 2012, p. 3). An act passed in 2010 (Chapter 166 of the Acts of 2010) made Massachusetts the first state to mandate provider education regarding concussions by September 2013. As part of a concussion awareness law, providers must verify that they have received "Department-approved training" in traumatic head injury assessment and management or have received equivalent training as part of their licensure or continuing education (Head Injuries and Concussions in Extracurricular Athletic Activities, 2010). As most legislation requires either physicians or other health care providers to provide medical clearance for athletes to return-to-play, concussion awareness and education must also include health care providers involved in concussion management (Tomei et al., 2012).

CHAPTER 2: LITERATURE REVIEW

Review of Related Literature

A literature search was conducted reviewing studies and information on concussion assessment, management, current guidelines, and provider competence. The literature search included primarily online sources such as ProQuest, Ebsco, Google Scholar, Medline, and the Center for Disease Control (CDC) website. In order to preserve the integrity and relevance of research to current practice, this literature search included only studies published from 2009 to current. Key words used to facilitate the search included concussion, assessment, management, guidelines, youth sport, return-to-play guidelines, mild traumatic brain injury, PCP, provider education, discharge education, concussion assessment tool, and second impact syndrome.

According to the Fourth International Conference on Concussion, concussion experts named physical rest, cognitive rest, and graded return-to-play programs as the cornerstone of concussion management prior to clearing an athlete to return-to-play (McCroy et al., 2013). Many studies found that health care providers are not prescribing these most basic features of concussion management and many illustrate a need for provider education and support tool concerning activity restrictions, cognitive rest, and patient information (Giebel et al., 2011;Lebrun et al., 2013; Zonfrillo et al., 2012).

Current Practices

Giebel, Kothari, Koestner, Mohney, and Baker (2011) conducted research on emergency physician and resident emergency physician practices on concussion management. They discovered approximately 75% of physicians did not use a nationally recognized guideline in their evaluation (Giebel et al., 2011). Of the 23% that used a certain guidelines, the Academy of Neurology guideline was the most used guidelines and the Cantu guideline was the second most

used guideline. As part of the survey, physicians were presented with two scenarios and asked to provide recommendations for return-to-play. The first scenario consists of a high school athlete that sustains a concussion with a five second loss of consciousness. Based on the information provided by the scenario, 9% of providers returned the athlete to play the same day of injury if the athlete was asymptomatic, 31% returned the student the next day if asymptomatic, 27% returned the student after one week if asymptomatic, and 33% stated the athlete could return-to-play only after clearance from a physician (Giebel et al., 2011). Differing approaches to concussion management may arise from use of different guidelines. Cantu guidelines allow athletes to return-to-play after a week if asymptomatic. The Zurich guidelines recommend no same day play and a graduated return-to-play program 24 hours after being asymptomatic (Giebel et al., 2011). Current consensus in sports medicine is to use the Zurich guidelines. According to the Cantu guidelines, 40% of providers allowed the player to return-to-play prematurely predisposing the athlete to longer recovery and other potential dangers. The second scenario consists of the athlete from the first scenario who receives a second concussion a month later from an elbow to the head while playing basketball (Giebel et al., 2011). Based on this scenario, 6% of providers would permit the athlete to return the same day if asymptomatic, 7% would return the athlete the next day if asymptomatic, 21% would return the athlete to play in a week, and 67% would return the athlete only after clearance by a physician. According to the Cantu guidelines, 13% of providers returned the athlete to play prematurely. The researchers concluded that emergency medicine facilities might benefit from standardized evaluation of patients with concussion from sports and follow a graduated return-to-play protocol (Giebel et al., 2011).

In a study conducted by Lebrun et al. (2013), researchers evaluated and compared the knowledge base of family physicians in two locations (Alberta, Canada and North/South Dakota) on sport concussion knowledge, clinical practices, and the need for continuing medical education . Researchers concluded that despite the availability of up to date published guidelines detailing concussion diagnosis and management, many providers might be using practices inconsistent with current guidelines and recommendations (Lebrun et al., 2013). As such, researchers recommend, "more deliberate educational efforts and training opportunities for family physicians to optimize physician management of this common condition, enhancing patient care in this population" (Lebrun et al., 2013, p. 58). While many of the results were similar between the two regions, researchers found some notable differences. Of the two populations surveyed, a majority of Canadian and American physicians (96.3%, 94.5%) reported diagnosing and treating concussions in their practice (Lebrun et al., 2013). More American (26.7%) than Canadian (8.8%) physicians tended to use outdated concussion grading scales (Lebrun et al., 2013). According to the study, only 9.4% of American physicians in this region reported using the most recent Zurich Guidelines for diagnosing and managing concussions in practice (Lebrun et al., 2013). Concerning management of concussions, a majority of Canadian (83.8%) and American physicians (75.5%) always recommended physical rest (Lebrun et al., 2013). Far fewer providers advised cognitive rest as part of management (47.5% Canadian, 28.4% American) (Lebrun et al., 2013). This study reported that a majority of providers indicated a desire for additional education on concussion, and Continuing Medical Education (CME) courses and CME online modules were the preferred manner of education delivery for continuing education (Lebrun et al., 2013).

In the 2012 study by Zonfrillo et al., researchers evaluated the self-reported knowledge, practices, and attitudes about concussion in pediatric providers The study found that while pediatric PCPs often care for children with concussion, they might lack sufficient training, infrastructure, and support tools for appropriate management. The survey was distributed to 145 pediatric primary care and emergency medicine providers within a single, large pediatric care network (Zonfrillo et al., 2012). Of the providers surveyed, 91% had cared for a patient with either an acute or a non-acute concussion within the past three months (Zonfrillo et al., 2012). A majority of these providers (92%) referred at least one patient with acute concussion within the last three months. PCPs referred most often to sports medicine clinics (67%) or neurologist/neuropsychologist (46%). Reasons PCPs referred include lack of comfort with concussion management (49%), lack of resources (47%), and lack of time for adequate management of concussion (17%). Some PCPs (4%) felt it was not their role to manage concussions and others (30%) indicated their setting was not an appropriate setting to manage concussions. Many pediatric primary care and emergency providers (72%) indicated they lacked access to decision support tools for concussion such as clinical pathways or protocols (Zonfrillo et al., 2012). Of these providers, 96% felt that such resources would be helpful in practice. A significant number of providers (40%) indicated they lacked concussion discharge instructions, and all of these providers stated they would find such tools useful in practice. As a means of decreasing barriers to managing concussion in practice, researchers recommend that PCPs receive continuing education, management guidelines, and provider support systems as ways to improve and standardize care of the patient with concussion practice (Zonfrillo et al., 2012).

Return to Activity

Following a concussion, athletes must refrain from physical exertion until asymptomatic at rest. With the brain in a proposed "energy crisis" physical activity further increases the demand exacerbating symptoms and delaying full recovery (Halstead & Walter, 2010). Despite the well-documented and disseminated dangers, premature return-to-play (RTP) is a frequent occurrence. According to one study, premature return-to-play occurred in as many as 40% of high school athletes (Yard & Comstock, 2009). The Concussion Consensus in Zurich 2012 recommends the use of a graduated return-to-play process. This is a 6-step process, which each step recommends a 24-hour asymptomatic period prior to advancing to the next step. With each step, more physical and cognitive stressors are allowed. Once the student-athlete has gone through each step asymptomatically, the student may be cleared to return to full play (Karlin, 2011). Two studies of importance to the literature review identify the need for improved discharge instructions for children seen in emergency departments for concussion. Both studies were retrospective in design and based on chart documentation. One such study, published in 2014 by De Maio et al., evaluated provider discharge practices pertaining to children seen in a children's emergency department following a concussion. Despite the well-documented and emphasized importance of physical rest and activity restriction following a concussion, nearly two thirds of patients had no mention of activity restriction on their discharge paperwork. Of the patients given activity restrictions upon discharge, the degree of restriction was highly variable. Restriction varied from no return to sport in one, two, or more weeks. Patients that were concussed because of a sports injury were more likely to receive activity restrictions than those that sustained a concussion from a non-sport injury. Some limited activity based on a specific period, until symptoms resolve, or until clear by a physician. Most patients were given

instruction to follow up with their PCP or with a subspecialist however, the suggested follow up time was also highly variable (De Maio et al., 2014). The study demonstrates the need for additional efforts to ensure appropriate follow up and activity restrictions in children as a means of improving health outcomes. The study did not include any analysis of cognitive rest instruction.

A second study of similar design also demonstrated the need for improved discharge instructions for pediatric patients seen in an emergency center following a concussion (Sarsfield, Morley, Callahan, Grant, & Wojcik, 2013). Of the 204 eligible patients diagnosed as having a head injury, most (95.1%) received instruction to follow up with a physician. One hundred thirteen of these were considered "highly likely" to have a mild traumatic brain injury (mTBI) or concussion. Only 31.9% received activity restrictions and 24.8% received information on time restrictions for those highly suspected of having a concussion. Children that sustained a concussion from a sport related injury were significantly more likely to receive return to sport restrictions and removal from play than did children with concussion from motor vehicle accidents (MVC) or other injury (Sarsfield et al., 2013). Thirty patients received a concussion from a sport-related injury; of these 53.5% received activity restrictions and 46.7% received time restrictions. Only 33% of patients with MVC concussions received activity restrictions. The study concluded that current discharge practices were inadequate when compared with current guidelines such as the Zurich Consensus of 2012, which calls for activity and time restrictions. The study illustrated the need for improved discharged instruction, particularly for children that acquire concussion from non-sport related injuries. Even though children may obtain concussions from non-sport venues, this does not mean they are not currently participating in sports. Children are also active in play whether at home or school and subject to further injury.

As such, providers must prescribe activity restrictions for all children (Sarsfield et al., 2013). Neither study evaluated provider recommendations concerning cognitive rest.

Return to School

Following a concussion, athletes will often report increased symptoms with cognitive activities. This is a logical occurrence as concussions are more of a functional injury rather than a structural injury. Student-athletes will often report difficulty attending school and focusing on schoolwork. To prevent symptoms from worsening and to facilitate recovery, recent guidelines recommend a period of cognitive rest. This may entail a time away from school, allowing additional time to complete assignments and tests. The athlete must also avoid certain activities in the home environment such as watching television, playing video games, and using a computer. Even reading for leisure may exacerbate symptoms (Halstead & Walter, 2010). Appropriate guidance from medical providers is needed to transition student-athletes back into an academic environment and facilitate recovery of the child or adolescent following a concussion (Halstead et al., 2013).

Brown et al. examined the relationship between cognitive activity levels on the duration of post-concussion symptoms (2014). The study found that increased cognitive activity was associated with longer recovery from concussion. Researchers concluded that cognitive rest is an important part of concussion management (Brown et al., 2014).

Another study specifically assessed pediatric PCPs on their understanding of cognitive rest in children with concussions and to describe their concussion management practices (Arbogast et al., 2013). The study found that a majority of provider survey participants (62%) identified cognitive rest as an important part of concussion management (Arbogast et al., 2013). However, only two of the 84 respondents actually described cognitive rest in detail. A

retrospective electronic medical record (EMR) review of the same facility found that only 11% of patient charts included written recommendations for cognitive rest and 27.5% received instructions for return to school in EMR for patients that were evaluated for first time concussions (Arbogast et al., 2013). While a majority of providers verbalized the importance of cognitive rest, only 2% were able to detail what cognitive rest actually means in practice. This gap between knowledge and implementation further highlights the need for additional support tools for providers in practice specific to cognitive rest recommendations (Arbogast et al., 2013) In the same population approximately 50% were given return to activity instructions but only 4.4% received specific step-by-step return to activity. This study emphasizes the need for improved cognitive rest recommendations. Providers may benefit from support tools specific to cognitive rest and return to school recommendations.

Knowledge Transfer

The Fourth International Conference on Concussion in Sport held in Zurich in November of 2012 identified Knowledge Transfer (KT) as an important component of concussion education. Knowledge transfer is "the exchange, synthesis, and ethically sound application of knowledge within a complex system of interactions among researchers and users to accelerate the capture of the benefits of research" (Providenza et al., 2013). The Conference recommended implementing a KT model as one possible way for organizations to assess knowledge gaps and then "identify, develop and evaluate education strategies" (McCroy et al., 2013, p. e66). Based on the outcomes of this research, health organizations can work to make changes to practice. The Conference recommends identifying the needs and learning style of the intended audience as well as evaluating the changes as a means of improving knowledge of concussions (McCroy et al., 2013). According to Provvidenza et al. (2013), their literature review of improving

knowledge transfer revealed that physicians were mostly likely to change their practice through educational outreach and interactive education sessions. They found that education outreach was an effective method for influencing physician behavior. Interactive education sessions were also an effective means of knowledge transfer as it allowed the participant to apply their current knowledge. Methods that were less likely to effect change in practice include printed education materials and didactic lectures. Audit and feedback methods had variable effectiveness and moderate impact on changing practice (Provvidenza et al., 2013).

Provider Educational Programs

While multiple health institutions offer concussion educational modules on concussion with (CME) credits, very little research was published detailing the effectiveness of these programs and modules on improving practice and improving health outcomes in youth athletes. The CDC offers a free online course for providers called Heads Up. A similar program is available and directed toward coaches. A study on the effectiveness of the program for coaches demonstrated positive findings in the pursuit of better educating coaching staff on concussions. After reviewing the materials, coaches were able to recognize and respond to sports-related concussions; 50% of coaches reported they learned something new about concussion, 60% of coaches viewed concussion as a more serious injury, and 68% of coaches went on to provide education to others about concussion after reviewing the materials (Covassin, Elbin, & Sarmiento, 2012,).

Little research has been published proving the effectiveness of the online provider version of training. One study evaluated the effectiveness of mailing the CDC's Heads Up toolkit on provider concussion knowledge (Chrisman, Schiff, & Rivara, 2011). According to the study, no differences were found between the intervention and control group regarding general

concussion knowledge (Chrisman, Schiff, & Rivara, 2011). The study did find that providers who received and reviewed the toolkit were "significantly less likely to recommend next day return-to-play" following a concussion (Chrisman et al., 2011, p. 1031). It is unclear how many providers are aware of the existence of the toolkit or how often it is used (Kaye, Gallagher, Callahan, & Nance, 2010). Additional studies are needed to validate the effectiveness of concussion education programs at improving provider knowledge of concussion assessment and management.

Theoretical Framework

The theoretical underpinnings of this practice improvement project came from two sources, the Diffusion of Innovation theory and the Iowa Model of Evidenced-based Practice (APPENDIX A). Together, these two models created a means for understanding the process of adopting and sharing a new clinical practice as well as providing a stepwise pathway for implementation of the innovation. The purpose of this practice improvement project was to develop, implement, and evaluate an education program on concussion management for PCPs. The Diffusion of Innovation Theory offers an excellent explanation of the barriers and facilitators to implementing changing in primary care practice (Sanson-Fisher, 2004).

Iowa Model of Evidenced-Based Practice

The Iowa model provided a framework that guided the implementation of the practice improvement project. This model provided an appropriate approach for implementing, conducting, and evaluating the use of an education program in improving provider practice of sports related concussions. The Iowa Model of Evidenced-Based Care offers providers a process to help facilitate the diffusion of concussion care innovation into primary care practice. Tilter and colleagues developed The Iowa Model of Evidenced-Based Practice in 1994 to guide

practitioners in using evidence to improve health care outcomes (Rycroft-Malone & Buchnall, 2010). The model begins by examining knowledge- focused triggers or problem-focused triggers that lead practitioners to question a current health care practice and whether research may improve health outcomes (Rycroft-Malone & Buchnall, 2010). If the problem is a priority for an organization, a team is assembled and a literature review is conducted (Titler et al., 2001). If there is sufficient research, a pilot change of practice is conducted . The change isevaluated for improvement in health outcomes and, if so, it is implemented into full practice and continually evaluated over time (Titler et al., 2001).

Problem Focused Trigger

Inadequate training and inappropriate management of concussion by health care providers was the problem focused trigger. Many states require athletes suspected of having a concussion to seek evaluation by a health care provider prior to returning to activity. However, providers may lack sufficient experience, education, and support tools to properly assess and manage concussions. Providers may benefit from additional training to supplement their practice in managing concussion in young athletes.

Organization Priority and Support

The CDC and Fourth International Conference on Concussion identified knowledge transfer and provider competence in diagnosing and managing concussions as a priority for health care institutions. In 2011, the Center for Disease Control (CDC) released a training video for providers on concussions as well as other support documents to aid appropriate management of concussions. The CDC is also actively involved in educating coaches, parents, and health care providers about the dangers of concussion, identifying concussions, and managing concussion. Further educational efforts for providers would increase knowledge transfer to primary care

practice. The provider education module has the support of the Center for Rural Health at the University of North Dakota School of Medicine and Health Services. This organization is currently overseeing a grant from the North Dakota Department of Human Services to support services within the state for survivors of traumatic brain injury and their families. North Dakota Brain Injury Network (NDBIN) was established with this grant to support individuals with brain injury, offer referral services, coordinate peer support, and offer education outreach.

Team Assembly

The next step in Iowa Model of EBP was to assemble a team of individuals. Six individuals comprised the team: a doctorate of nursing practice graduate (DNP) student, two family nurse practitioner (FNP) graduate school faculty with an interest in the subject, a physician with experience as a concussion specialist at the Sports Medicine clinic, a licensed social worker with the Center of Rural Health, and a graduate school appointed faculty member with a background in athletic training. The role of the DNP student, also referred to as the co-investigator, entailed development of practice improvement project plan, conduction of literature review, collaboration with committee members, implementation of project, evaluation of project, and if applicable dissemination of project findings. The role of the FNP graduate school faculty included advising and instructing the co-investigator in the development and implementation of the practice improvement. The role of the concussion specialist was be to serve as a resource and oversee development of the practice intervention. The licensed social worker from Center for Rural Health served as a resource for the DNP student. The role of the graduate appointed faculty included assisting the in the development of the vignette evaluation rubric and grading of vignette responses.

Research and Related Literature

A review of current literature and evidence based guidelines was gathered as documented above under the heading Review of Literature. The literature review illustrated the clear need for an education program and support tools for health care providers about prescribing activity restrictions, cognitive rest, and return-to-pay decision making. While most providers voiced interest in online modalities as a means of educational improvement, these programs have shown little impact in change to practice. Educational outreach and interactive educational sessions were the most effective in changing provider practice. Given the amount of research supporting the need for concussion education for providers, the project improvement was warranted.

Pilot Change in Practice

Following the Iowa Model the next step was to pilot a change in practice. The process involved selecting outcomes to be achieved. The desired outcomes include:

1. Expand provider knowledge of current practice guidelines for managing concussions.
2. Improve provider confidence in assessment and management of concussion.
3. Improve provider access to decision-making tools and patient information for concussion management.

The proposed change in practice was to deliver an educational program to PCPs, particularly those rural communities, as a means of enhancing provider knowledge and improving provider practice. This occurred by examining the evidenced-based guidelines and developing an educational program. The program was developed with the assistance of a concussion specialist at the Sanford Sports Medicine clinic and supervisory committee. The program covered topics such as concussion diagnosis, management, return-to-play decisions, and indications for referral. As part of the education program, providers viewed vignettes about a young athletes presenting

to a clinic following a concussion and participated in creating a treatment plan that included cognitive rest, physical activity restrictions, indication for referral, and a graduated return-to-play program. Providers were also informed of resources available to them that may help assess and guide treatment for young athletes with concussion.

Evaluate Process and Outcomes

The educational program was evaluated in several ways. Providers evaluated the program effectiveness at meeting objectives of expanding provider knowledge and improving provider confidence in managing concussions. Evaluation of the program was also determined by comparing improvements noted between the pre and posttest vignette treatment decisions. The final step in piloting a change in practice was to modify the practice guideline based on evaluation of the project. Based on the evaluations and outcomes of the program, modifications were made as appropriate. The final step of the Iowa Model is to disseminate results. Following the completion of the practice improvement project, the co-investigator will submit for publication to the Journal of Adolescent Health and annual DNP poster session at NDSU.

Diffusion of Innovation

The other theoretical framework useful in evaluating the potential for a change to practice is the Diffusion of Innovation Theory. E.M. Roger first published his theory of Diffusion of Innovation in 1963, the fifth and last edition published in 2003 (Stacks & Salwen, 2009). Diffusion is a communication process through which an innovation is distributed among members of a social system (Stacks & Salwen, 2009). Diffusion requires methods of delivery both in mass media and through interpersonal communication. Innovation is a clinical practice change perceived as new by an individual or other unit for adoption (Sanson-Fisher, 2004). In this circumstance, the innovation to be shared is module made to educate providers on

assessment and management of concussion in the primary care setting. The Diffusion of Innovation Theory explains why some innovations are adopted more quickly and easily than others. Roger's identifies five elements that help determine whether an idea or clinical practice will be adopted or diffused: relative advantage, complexity, compatibility, trialability, and observability (Sanson-Fisher, 2004).

Relative Advantage

Within this practice improvement project, relative advantage refers to the degree to which the proposed change in practice is perceived to be better than the current manner of practice (Sanson-Fisher, 2004). Relative advantage is comprised of many factors. PCPs may be reluctant to change their practice if they find no fault in in their current practice. On the other hand, providers may recognize that their current practice is substandard, perhaps lacking in the areas of cognitive rest or return-to-play protocol recommendations, and seek to include those into their practice. Recent media attention may also bolster the relative advantage. Viewing media about young athletes dying from second impact syndrome or the long term neurological consequences surfacing in former NFL players may motivate providers to examine their current practice strive to stay up to date. As premature return-to-play places athletes at risk for potentially deadly consequences, providers may consider it an advantage to pursue a change in practice that improve athlete health outcomes and avoid a possible malpractice lawsuit. Providers may recognize that their current practice standards is substandard, perhaps lacking in the areas of cognitive rest recommendations or a return-to-play protocol. Time to complete the proposed change is also a consideration. The time to complete a full concussion assessment and explain management may lessen the relative advantage. The number of studies and expert support for

improved concussion management assist providers to see the relative advantage of practice changes as compared to current practice.

Compatibility

Compatibility refers to the way an innovation fits with the PCPs existing values, past experiences, and the provider's needs (Sanson-Fisher, 2004). Providers that have been following and modifying their practices to match evidence-based research may be more receptive to changes in how they practice concussion management. Providers that are uncomfortable managing concussions or feel they would benefit from more education may be more likely to implement new practice guidelines. It may also be agreeable for rural providers to manage concussions closer to home that requiring athletes to travel great distances to seek care from specialist.

Complexity

Complexity refers to how difficult an innovation is to understand and use (Sanson-Fisher, 2004). Assessment and management recommendation are easy to understand and implement. Available support tools and patient handouts assist in reducing the complexity. Complexity may arise should providers find resistance or noncompliance from the concussed young athlete who dislikes the physical and cognitive restriction imposed. Providers may also find resistance from parents, coaches, and school officials when young athletes are kept from class, practice, and big games.

Trialability

Trialability refers to the degree that a change in practice can be attempted or modified (Sanson-Fisher, 2004). The ability to use a certain medical intervention may limit its use in practice. Provider support tools such as the SCAT3 or concussion toolkit from the CDC

areaccessed easily online free of charge. They help guide and simplify the concussion assessment and management process. Equipping providers with knowledge and printable support tools will give this innovation more trialability.

Observability

Observability refers to the degree in which the results of the change in practice are visible to others (Sanson-Fisher, 2004). If expert and respect health care providers advocate and demonstrate the superiority of a practice changes, more providers are likely to follow that change. Concerning concussion, both the CDC and the International Consensus on Concussion in Sport advocate for improved means of assessing and managing concussions in athletes. Mainstream media has also increased the observability of the importance of proper concussion management.

Project Objectives

1. Assess current provider practice with regards to concussion assessment and management.
2. Expand provider knowledge of current practice guidelines for managing concussions.
3. Improve provider confidence in assessment and management of concussion.
4. Improve provider access to decision-making tools and patient information for concussion management.

CHAPTER 3: METHODOLOGY

Project Improvement Project Design

The practice improvement project began with the development of an education program using evidenced-based guidelines and under the supervision of the Sanford Sports Medicine Clinic, Center for Rural Health, and project advisory committee. Following the completion of the online module, the program was submitted to the American Association of Nurse Practitioners (AANP) and granted 1.0 credit of continuing education (APPENDIX J). Informational Technology (IT) Services of North Dakota State University (NDSU) assisted in the creation of the educational program into a video voice over PowerPoint Presentation. Three video vignettes were designed and acted out by teenagers to replicate a young athlete with a concussion injury presenting to his or her primary care provider for evaluation. The vignettes were created using video recording and editing equipment from the IT Services of NSDSU. For convenience, acquaintances of the program leader were recruited to act out the vignettes. In the first vignette scenario, a young athlete sustained a recent concussion and was symptomatic at the time of their appointment. In the second scenario, a young athlete sustained a concussion four weeks ago, she but continues to have some symptoms primarily with cognitive functioning and sleep. In the third scenario, the young athlete sustained a recent concussion but had been symptom free for several days. The survey questions, vignette questions, vignette videos, and voice over PowerPoint Presentation were hosted on the Qualtrics website. After viewing each vignette, providers responded to several question regarding treatment recommendations and ability to return-to-play. Responses were evaluated individually and score cumulatively using a rubric (APPENDIX H). Each question was awarded zero-three points dependent on the question and the response provided. Questions were worth one, two, or three total points. Participants

received full points when they met all criteria listed within the rubric. The pretest and posttest cumulative scores were compared to gauge changes in provider knowledge and understanding of treatment recommendations in concussion. Details of the vignettes and questions asked are available in APPENDIX G.

Adjustments

During the course of the development of the education program, several adjustments to the original proposed project were made. Initially the program was designed to be delivered via three methods: an online module, in clinic presentation with primary care providers, and as a side presentation at the North Dakota Nurse Practitioner Association Pharmacology Conference in September 2014. At the time of the conference, pending Sanford approval for the project and AANP CE approval, it was decided to forgo the conference and direct efforts towards in clinic presentations and the online module. Several Sanford clinic coordinators were contacted about the possibility of setting up an in clinic presentation; however, due to the difficulties of arranging provider schedules for a common time to meet and lack of provider interest, the decision was made to conduct the educational program solely through the online module. Another change in the formatting of the education program was to eliminate the two-week wait period between completing the online module and receiving the post module test. The purpose of the two-week wait period between the module and posttest was to demonstrate that providers retained the information presented and to offer a better indication of whether providers would make changes to their practice. Without the two-week wait period, the program was altered to allow for a continuous pretest, module, and posttest. Eliminating the two-week wait period between evaluations also improved the ability to distribute the survey. In order to distribute the survey with the two-week wait period, a sign in needed to be developed for the pretest and posttest to

link and compare changes between pre and posttest scores and treatment recommendations. To do so limited distribution, as provider emails and contact information were required ahead of time to create a unique link and sign-in for the provider. Once the two-week wait period was eliminated, a universal link could be created and sent to providers. Using the universal link also made it possible for the module to be advertised on the Other Online CE Opportunities webpage on the AANP website.

Protection of Human Subjects

In accordance with the NDSU graduate program and in an effort to reduce risk to participants, both Sanford Health and North Dakota State University Institutional Review Board (IRB) approvals were sought prior to the start of the practice improvement project. The PIP posed no more than minimal risks to participants and was granted exempt status through the North Dakota State University IRB #PH15009 (APPENDIX B). Sanford IRB approval was also sought. The Sanford IRB deemed the project a Practice Improvement Project and therefore did not meet the definition or regulatory requirements for human subject research (APPENDIX C). Prior to beginning the module, providers were directed to a webpage detailing the informed consent information (APPENDIX E). Potential risks and benefits of the PIP were listed. Participants were informed that by clicking the "next button" they were implying their consent to participate in the PIP. After clicking the next button, they proceeded onto the survey and pretest vignette questions. At the conclusion of the module, providers were asked to supply their name, as they desired it to read on their AANP CE certificate. Providers were informed their name would not be linked to the results of the survey.

Sample

The study included 15 providers that identified themselves as Nurse Practitioners, Physician Assistants, Medical Doctors, or Nurse Practitioner Students. The initial population sought to participate in the PIP was PCPs practicing in rural Sanford clinics within 100 miles of Fargo, ND. Due to the apparent need for provider education in urban areas as well as rural areas, the module was also offered to providers in Sanford clinics in the Fargo/Moorhead (FM) area. A list of local Sanford primary care providers was obtained through a contact at the Sanford Sports Medicine Clinic. Providers in the FM area were emailed with the link to the survey and encouraged to participate by completing the online program, (APPENDIX D). The Sanford Vice President that oversees the rural Sanford clinics participated in the distribution of the concussion program to rural Sanford providers. She contacted the physician chairs of the clinics and encouraged them to distribute the link to the module to their colleagues. The module was also listed on the AANP website under the link Other Online CE Activities. Due to the general inaccessibility of the module on the AANP website, it is unlikely many respondents participated from this venue.

Data Collection

In the first portion of the module, providers answered demographic survey questions and questions regarding their experience with treating concussions (APPENDIX F). Providers then viewed and answered questions pertaining to three vignettes (APPENDIX G). The vignettes detailed the experiences of three young athletes with concussions: a symptomatic athlete with a recent concussion, a symptomatic athlete with an old concussion, and an athlete with a recent concussion but asymptomatic. After viewing each vignette, providers where prompted to make treatment decisions for each athlete. The providers then viewed the educational program.

Following the program, providers viewed each vignettes once more and were prompted to make treatment recommendations. Provider responses to the vignettes were graded using a rubric (APPENDIX H) to evaluate the appropriateness of the recommendations such as physical rest, cognitive rest, return-to-play, return-to-learning, and appropriate referrals. At the conclusion of the module, providers responded to a series of questions about the effectiveness of the module and self-perceived changes in provider knowledge or confidence by participating in the project (APPENDIX I).

Fifteen providers completed the module. However, in three instances providers completed the pretest survey and pretest vignette questions but neglected to complete the same posttest vignette questions in the posttest portion, specifically questions requiring a free text response pertaining to treatment recommendations or return-to-play decisions. All other posttest survey questions such as effectiveness of the program and the self-perceived change in concussion knowledge were completed. Only the posttest vignette responses were neglected. Due to the already small sample number, it was decided to include the providers with missing posttest vignette responses into the results. In order to account for the missing posttest responses, the pretest answers were used in place of the missing posttest answers. In some instances, these three providers were removed from the results, such as when determining the average increase in cumulative points scored on the posttest.

Support for such a method of data collection and analysis comes from the statistical concept of "intention-to-treat (ITT) analysis" (Gupta, 2011). Missing data and noncompliance are not unique to this practice improvement or other forms of research. ITT allows for the last measured data, in this circumstance the pretest vignette responses, to be used as the final product or the posttest responses. Most commonly, researchers use ITT in medication trials where

noncompliance and dropout can be expected in both the trial process and in clinical practice (Gupta, 2011). Provider noncompliance with practice changes or interventions, such as information presented within a continuing education module, is also likely to occur within practice improvements as it is within clinical practice.

CHAPTER 4: RESULTS

Demographics Data of Sample

Of the 15 providers that participated in the module, two identified themselves as medical doctors (MD), one as a physician assistant, eight as nurse practitioners, and four as nurse practitioner students. Participants also indicated how many years they had been in practice. At the time of the survey, seven of the participants had worked for 0-5 years (47%), three had worked for six to ten years (20%), three had work for 11-19 years (20%), and two had worked for more than 20 years (13%). Of the fourteen participants that identified their practice area, four stated their practice was in a rural location and ten state their practice in an urban location. Due to the likelihood of providers working in both primary care and acute care setting, participants were asked to indicate the percentage of time they worked in primary care and other specialty areas, the total of which needed to add up to 100%. A majority of respondents worked primary care (63.7% of the time), 14.3 percent of the time in pediatrics, 7.3 percent of the time in a hospital setting, 1.3% of the time in emergency care, 1.3 percent of the time in orthopedics, and 12% in 'Other'. Table 1 illustrates the first set of demographic data gathered

Table 1. Sample Demographics

Question	Number of Respondents	Percentage
Profession		
MD	2	13%
NP	8	53%
PA	1	7%
NP Student	4	27%
Years in practice		
0-5	7	47%
6-10	3	20%
11-19	3	20%
.20 or more	2	13%
Practice Area		
Rural	4	29%
Urban	10	71%

Concussion Experience

Providers were then asked about their previous experience and education with concussion management. In the past year, eight providers (53%) diagnosed or treated a patient under that age of 19 for a concussion in the last year. Seven providers (47%) indicated they did not participate in care or diagnose a patient under the age of 19 for concussion in the past year. Seven providers (47%) indicated they had treated one to five patients under 19 with concussion. One respondent (7%) had diagnosed or treated between six and eleven young athletes for concussion in the past year. No provider indicated seeing 12 or more young athletes for concussion care. Regarding concussion training, 53% of the participants stated that concussion training was covered in their MD, NP, or PA preparation, while 47% stated they did not receive concussion education in their training. Twenty-seven percent of participants indicated they completed concussion training outside of their regular MD, NP, or PA preparation. Two of those four participants, attended a conference where concussion management was covered. One

participant went through the Sanford Concussion Clinic; and one participant completed the CDC's Heads Up for Providers training module. Seventy-three percent participants did not cover concussion outside of their MD, PA, or NP preparation. Table 2 lists these findings.

Table 2. Concussion Experience and Training

Question	Response	Percentage
Approximately how many patients under the age of 19 did you diagnose or treat for concussion?		
0	7	47%
1-5	7	47%
6-11	1	7%
12+	0	0%
In your medical, NP, PA training did you cover concussion?		
Yes	8	53%
No	7	47%
Have you ever completed any training outside of your medical, NP, PA preparation specific to concussion?		
Yes	4	27%
No	11	73%

Data were compared to discover whether providers that did not receive formal concussion training in their MD, NP, PA preparation, completed any outside training. When looking at the cross tabulation chart, one can gather that five providers (33%) received no training in their MD, NP, and PA preparation and neither have they completed any training outside of their initial preparation specific to concussion. Table 3 demonstrates the breakdown of the data.

Table 3. Concussion Training: Initial Preparation Training Versus Outside Training

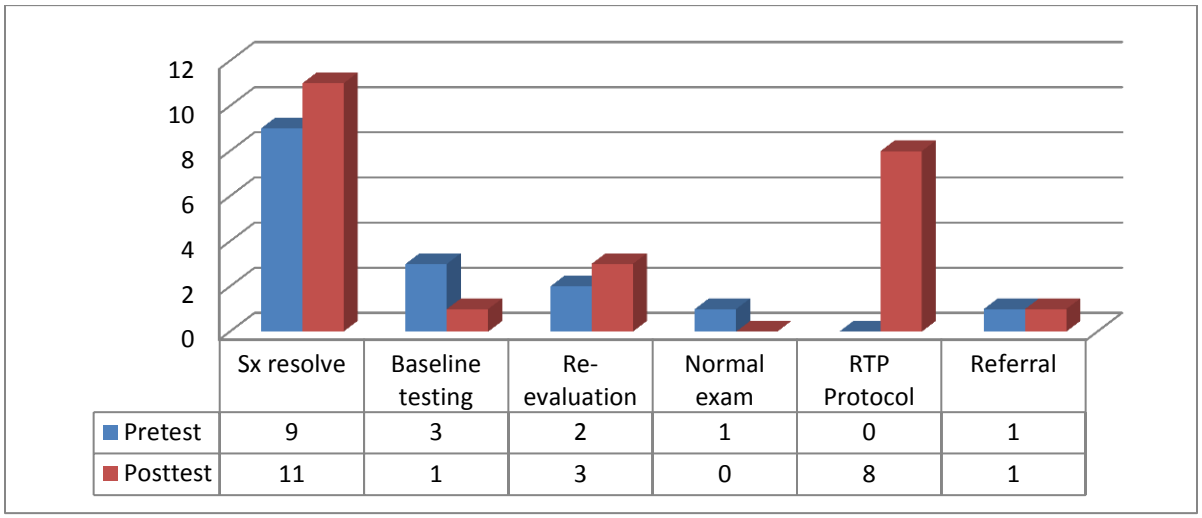
		In your MD, NP, PA training, did you cover concussion?		
		Yes	No	Total
Did you complete any training outside your MD, NP, PA training specific to concussion?	Yes	2	2	4
	No	6	5	11
	Total	8	7	15

Vignette 1

Based on the information given in Vignette 1, all providers indicated they would diagnose Johnny with a concussion. In similar fashion, all providers also indicated they would not allow Johnny to return to practice today. When asked when Johnny might return-to-play, responses varied. Prior to the education module, nine providers (60%) made mention that Johnny would be allowed to return-to-play once asymptomatic, or after his headache and nausea resolved. Three providers (20%) indicated he could return once his impact or other baselines testing were back to normal. Two providers (13%) indicated they would re-evaluate Johnny before making a return-to-play decision. No provider (0%) made any mention of a graduated return-to-play or return-to-play protocol. One provider (7%) indicated they would defer a return-to-play decision to a concussion specialist. Some providers listed more than one requirement before allowing Johnny to return to practice.

Following the education module, eleven providers (73%) would allow Johnny to return-to-play once asymptomatic. One provider (7%) would allow return-to-play after returning to baseline testing level or baseline Impact score. Three providers would like to re-evaluate Johnny (20%). No provider (0%) made mention of returning to a normal exam prior to return-to-play.

Eight providers (53%) recommended that Johnny follow a return-to-play protocol once asymptomatic. Again, one provider recommended Johnny be referred to a concussion specialist to make a return-to-play decision (7%). Figure 1 demonstrates the overall change in recommendation type comparing both pre and posttest results.



	Sx resolve	Baseline testing	Re-evaluation	Normal exam	RTP Protocol	Referral
Pretest	9	3	2	1	0	1
Posttest	11	1	3	0	8	1

Figure 1. When would you allows Johnny to return-to-play?: Pre and Posttest Results

In response to the question on specific treatment recommendations and discharge instructions they would give, results varied. On the pretest portion of the exam, 12 providers (80%) included some aspect of physical rest as part of their recommendations. Examples of physical rest recommendations given on the survey included rest, physical rest, limit activity, no practice. Eight providers (53%) included recommendations for cognitive resting. Examples of cognitive rest given included no screen time, limit activities that involve concentration, limit reading, limit cognitive activity, limit reading, limit TV use, and limit cell phone. Five (33%) providers made mention of recommendations pertaining specifically to accommodations to be made at school such as limiting homework time, absence from school, return home from school if concussive symptoms return, and working with educators to extend time permitted to complete assignments. In the pretest, three providers recommended the use of NSAIDS and two

recommended Tylenol. In the posttest, zero providers recommended NSAIDS and eleven recommended Tylenol. Figure 2, compares the changes between types of recommendations given.

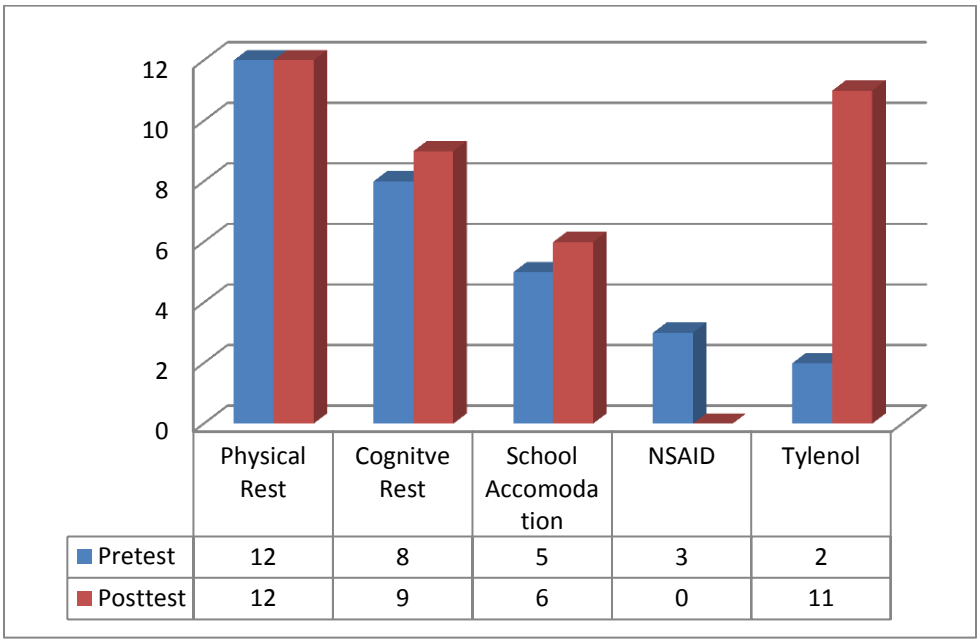
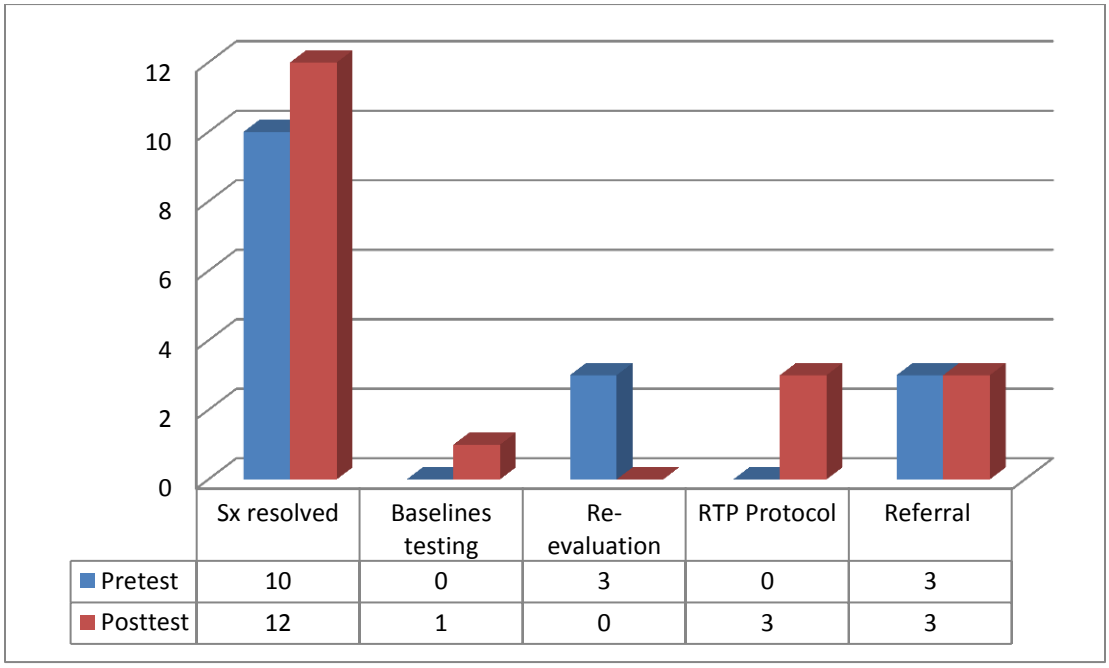


Figure 2. Recommendations, instructions for Johnny

Vignette 2

Following the information given in vignette 2, the athlete with a four week history of concussion symptoms, all providers (n=15) indicated they would not allow Alyssa to return today. Results varied for when they would allow her to return-to-play. Ten providers (67%) indicated after her symptoms resolve, no provider (0%) mentioned the use of baseline testing to assist in determine readiness to return, three stated they would like to re-evaluate her once more in clinic before determining, and three (20%) would like to defer to a specialty provider to determine. Following the module 12 (80%) providers mentioned requiring resolution of her symptoms before allowing her to return to practice, one provider (7%) recommended use of baseline testing such as Impact to assist in determining readiness, three providers (20%)

recommend using a RTP protocol once asymptomatic, three (20%) decided they would defer to a specialist to determine her ability to return to practice. Figure 3 illustrates these results.



	Sx resolved	Baselines testing	Re-evaluation	RTP Protocol	Referral
Pretest	10	0	3	0	3
Posttest	12	1	0	3	3

Figure 3. When would you allow Alyssa to return to play?: Pre and Posttest Results

Providers were also asked what specific treatment recommendations and discharge instructions they would give Alyssa (Instructions, medications, restrictions etc.). Eleven (73%) of the providers made mention of continuing physical rest recommendations, nine (60%) made mention of cognitive rest recommendations, and seven (47%) made a recommendations for at school accommodations. Following the module, 11 (73%) providers recommending physical rest, 10 (67%) made cognitive rest recommendations, and eight (53%) making recommendations for at school accommodations. Figure 4 illustrates these results.

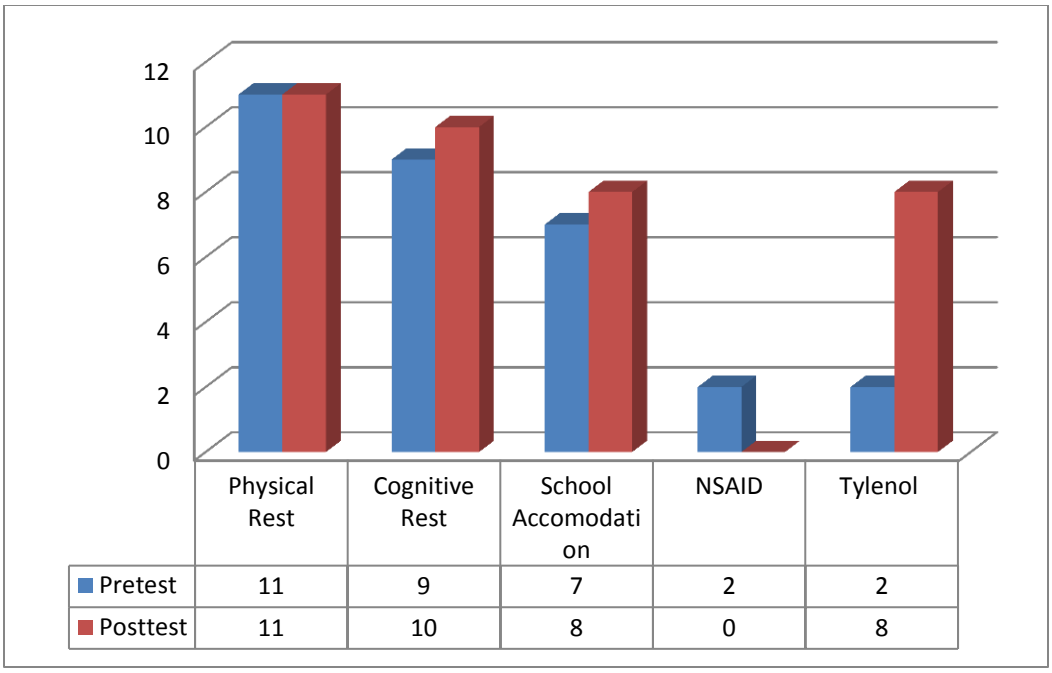


Figure 4. Recommendations, instructions for Alyssa: Pre and Posttest Results

Ten of the 15 providers (67%) indicated they would like to refer Alyssa. Some providers indicated more than one specialty when denoting where they would refer. Five providers (33%) chose not to refer at this time. Five referrals were made of concussion clinic/sports medicine and six referrals were made for neurology. Following the module, 13 provider recommended referral: seven providers recommended referral to concussion specialist/sports medicine, one recommended referral for neurology, and six recommended referral to neuropsychology. Two providers chose not to refer at this time. Figure 5 illustrates these results.

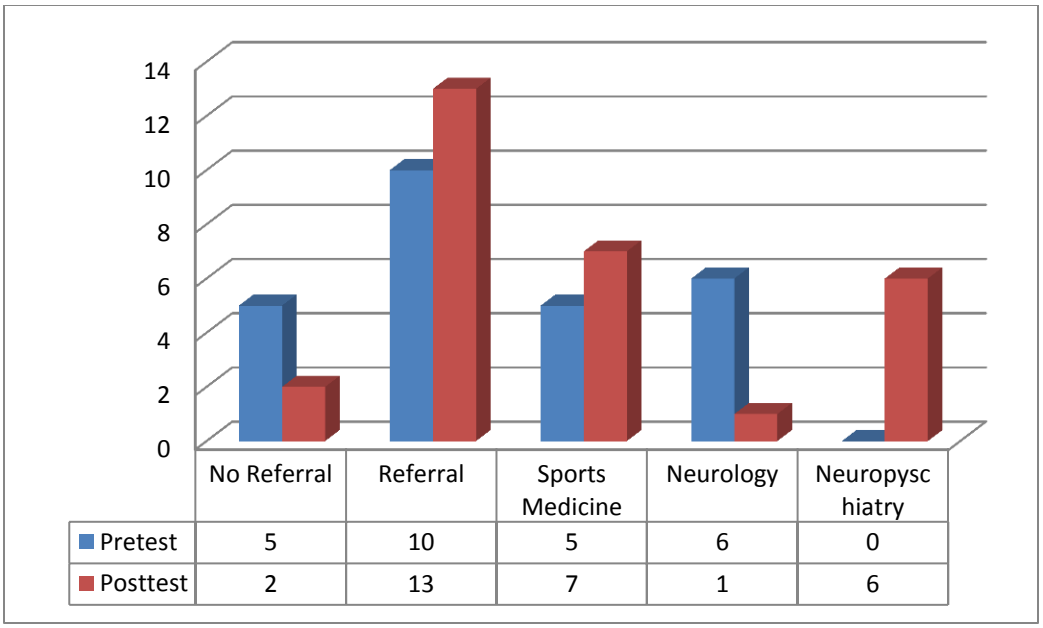


Figure 5. Referral for Alyssa: Pre and Posttest Results

Vignette 3

In response to information presented in vignette 3, the athlete with recent concussion and several asymptomatic days, all providers would allow return-to-play that day. While no provider explicitly used the terminology of "Return-to-play protocol", four providers (27%) made similar recommendations by instructing such things as doing light practice work initially, slow return to practice, and/or avoiding contact play at this time. Eleven providers indicated Noah could return-to-play without any instruction of limiting activity. In seven of these cases, providers did instruct that should signs and symptoms develop during practice, Noah should stop play and/or be evaluated. Four providers made mention of using a helmet. Following the educational module, nine of the 15 (60%) providers made mention of implementing a return-to-play protocol, six (40%) allowed play without mention of activity restrictions, four (27%) of those with instruction to stop if symptoms return. Two providers made mention of using a helmet following the module.

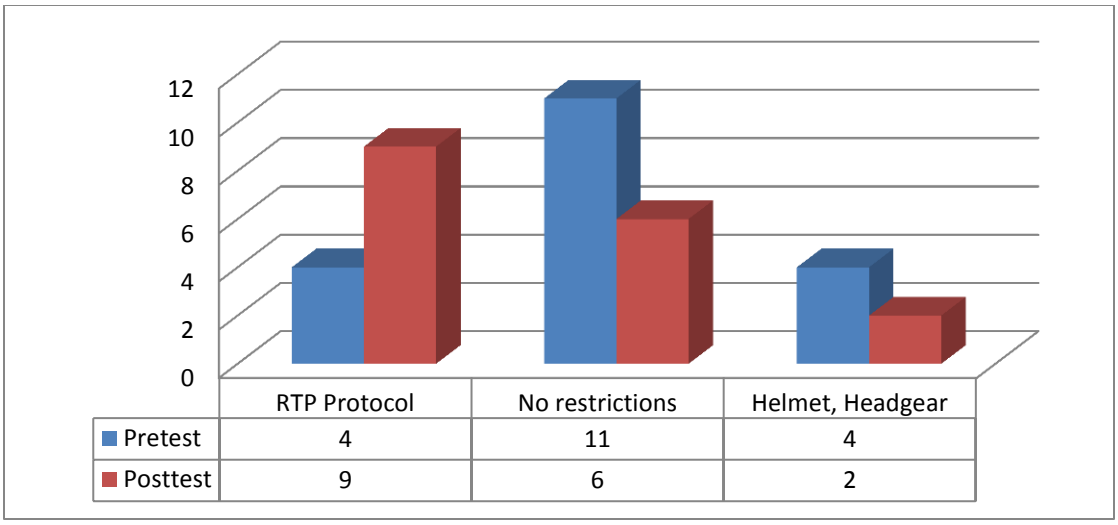


Figure 6. Return-to-play instructions for Noah: Pre and Posttest

Cumulative Vignette Score

Provider responses to the vignettes were graded using the rubric (APPENDIX H). The highest score possible was 24 points. The highest pretest score was 18 and the lowest score was eight. Following the module, the highest posttest score was 22 and the lowest was eight. The average score for participants (n=15) on the pretest was 13.7 points. The average score on the posttest was 16.4. The average change in points scored between the pre and posttest was +2.7 points or 11% higher than pretest scores. The smallest amount of change between pre and posttest score was 0 points (8-8). The highest change in score from pre to posttest was +9 points (10-19). No posttest score was noted to be lower than the pretest score. It may be noted on Figure 7 that participants 2, 9, and 11 did not complete the posttest vignette questions.

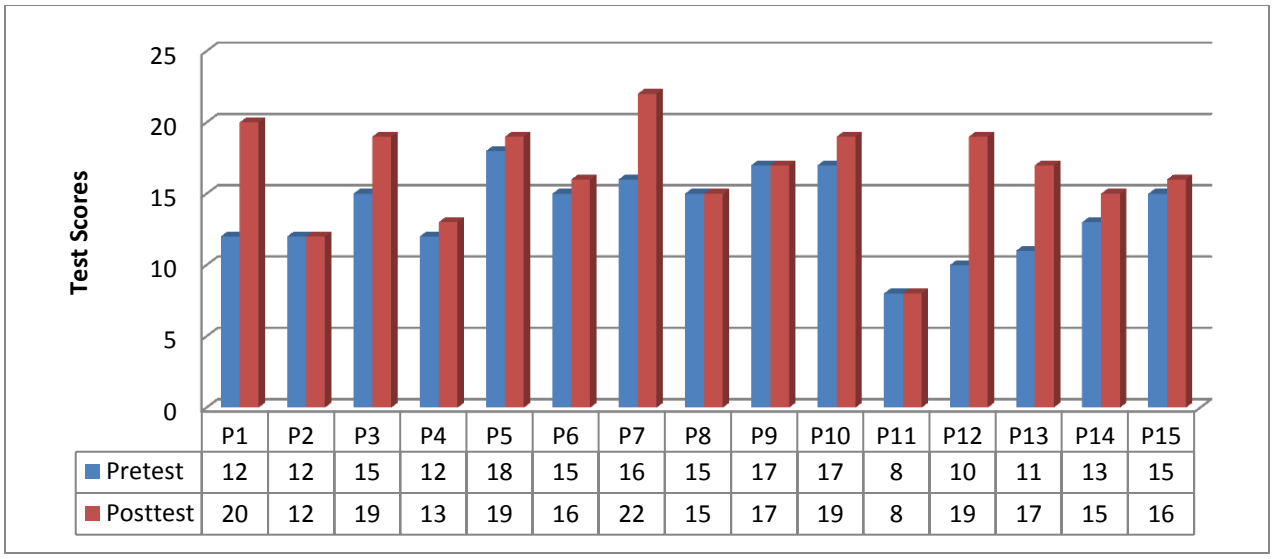


Figure 7. Pre and Posttest Score per Participant

To illustrate the amount of points each gained. Eight (53%) participants had zero to 1 point gain, two providers (17%) had a 2-3 point gain, one provider (8%) had a 4-5 point gain, 2 providers (17%) had a 6-7 point gain, and two providers (17%) has an 8-9 point gain. Figure 8 illustrates these statistics.

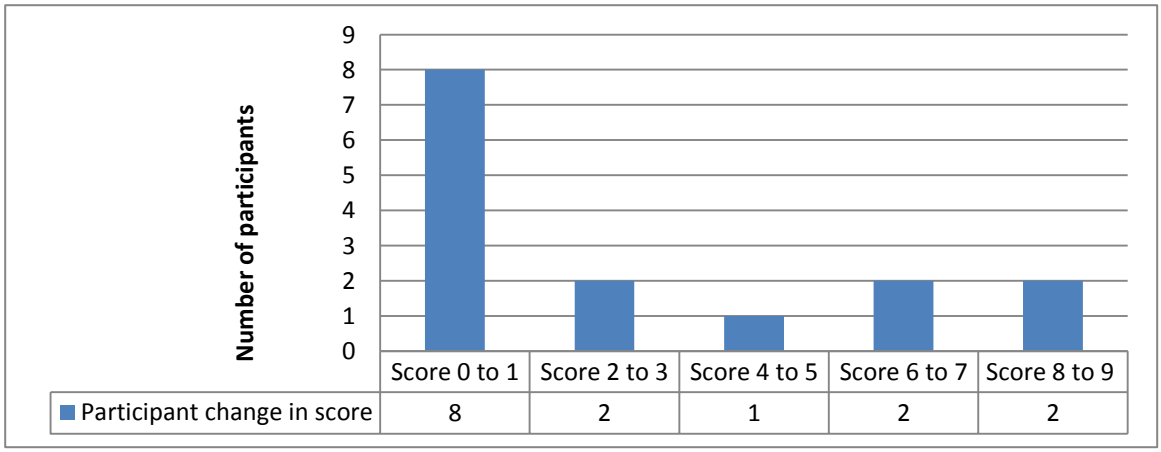


Figure 8. Participant Change in Score

Self-Perceived Learning

Following the vignettes, providers were also asked a series of questions about their perceived learning and improvements to concussion knowledge application and knowledge. Of

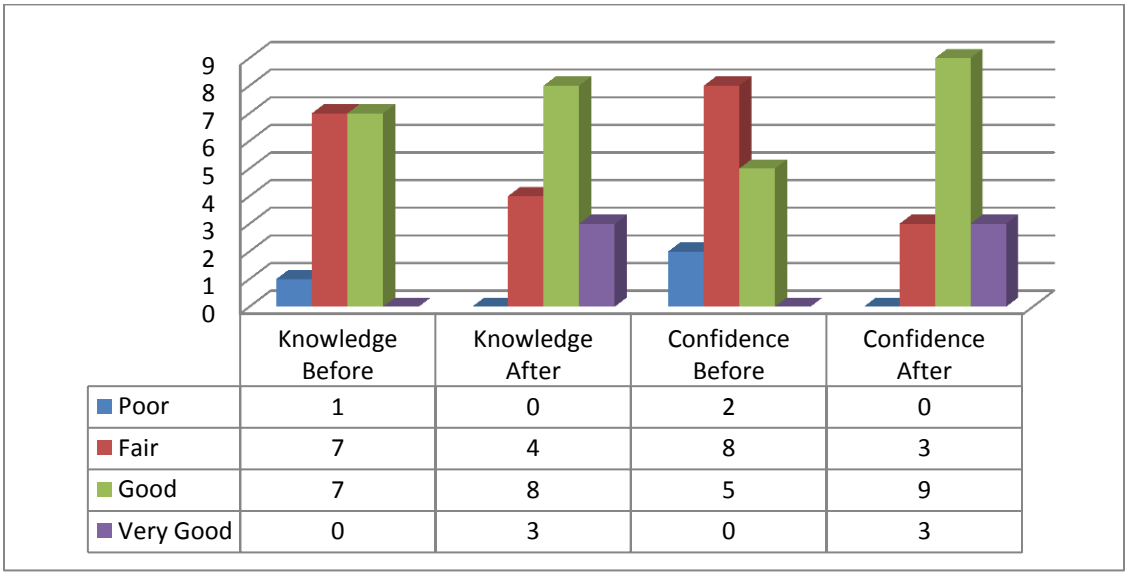
the 15 providers that responded to the question "Following the educational module will you make any changes to your practice?" All providers (n=15, 100%) stated that "yes" they would make changes to their practice. No providers indicated, "No I am already practicing within these guidelines" or "No I am content with my current practice standards."

Providers also responded to the question "After completing this activity I will be able to achieve the following objectives." All providers (n=15) indicated either "strongly agree" (53%) or "agree" (47%) that following the module, they understood the cause of concussion. All providers indicated that they either "strongly agree" (53%) or "agree" (47%) with the statement that following the module they were able to identify signs and symptoms of concussion. To the question, "after completing the module, I will be able to identify appropriate treatment recommendations for concussion" seven providers (47%) indicated they strongly agree, (47%) providers indicated they agree, and one (7%) provider indicated they "disagree." To the question, following the module," I will be able to identify indications for referral", six providers (40%) indicated, "strongly agree" eight providers (53%) indicated, "agree" and one provider (7%) indicated "disagree". Table 4 illustrates these results.

Table 4. After Completing this Module, I Will be Able to Achieve the Following objectives

Question	Strongly Agree	Agree	Disagree	Strongly Disagree
Understand cause of concussion	8 (53%)	7 (47%)	0	0
Identify signs and symptoms of concussion	8 (53%)	7 (47%)	0	0
Identify appropriate treatment recommendations for concussion	7 (47%)	7 (47%)	1 (7%)	0
Identify indications for referral	6 (40%)	8 (53%)	1 (7%)	0

Providers were asked to self-evaluate their knowledge on their application and practice of concussion management before and after the education. Before the program, one provider (7%) indicated poor. Seven providers (47%) indicated fair and seven providers (47%) indicated good. Following the program there was a general increase in the number of providers indicating fair, good, and very good responses. No provider indicated a poor level of knowledge following the module. Four (27%) indicated fair, eight (53%) indicated good, and three (20%) indicated very good. Prior to the module two providers (13%) indicated poor confidence in concussion management in young athletes, eight (53%) indicated fair, five (67%) indicated good, and no provider (0%) selected very good. Following the module, no provider selected a poor confidence level in managing concussion, three (20%) indicated fair, nine (60%) indicated good, and three (20%) indicated very good. The following figure illustrates the changes between knowledge and confidence levels in managing concussions.



	Knowledge Before	Knowledge After	Confidence Before	Confidence After
Poor	1	0	2	0
Fair	7	4	8	3
Good	7	8	5	9
Very Good	0	3	0	3

Figure 9. Knowledge and Confidence Before/After Module

CHAPTER 5: DISCUSSION

The purpose of this practice improvement project was to evaluate current provider practice and improve provider practice and confidence about diagnosing and treating young athletes with concussion. Data were analyzed and compared to the project objectives to evaluate and assess changes in practice. Based on these assumptions, recommendations can be made to improve provider practice on a larger scale.

Objective 1: Assess Current Provider Practice

The first project objective was to assess current provider practice on concussion assessment and management. The objective was analyzed through several pre and post module questions. The first of which is that only 53% of providers surveys had diagnosed or treated a patient under that age of 19 for a concussion in the last year. This figure changes slightly to 64% of practicing providers if excluding the four NP students whose limited practice exposure might affect this figure. This figure is lower than anticipated given the findings of other studies, such as the Lebrun et al., (2013) which reported 94.5% of North/South Dakota physicians diagnose or treat concussion in their practice. The difference may be a result specifying treating young athletes less than 19 years of age. A concussion specialist with the Sanford Sports Medicine Clinic offered her interpretation of the result. She stated that providers in Fargo, more so than any other community she has practiced, are highly encouraged to send their athletes diagnosed with concussions to the concussion specialist within the Sports Medicine Clinic. As a result, there may be fewer providers diagnosing and managing concussion in Fargo as compared to other communities. She states she often sees young athletes with basic uncomplicated concussions that could have been managed in primary care. This figure could also illustrate why one third of providers have neither obtained training preparation nor sought outside training

courses. If 47% of providers have not treated a single young athlete in the past year for concussion, there may be little impetus to seek out additional training and would direct their CE needs towards conditions they treat more regularly. Despite the lack of formal training, it is still possible that providers were able to self-educate themselves with journals and other published literature regarding treating concussion in young athletes. Providers may have been self-motivated to pursue additional information on concussion due to recent media coverage of the dangers of premature return-to-play and repeat concussion injuries. This survey did not inquire whether providers used a certain guideline to aid their decision- making.

Another interesting statistic of note is that only 53% of the participants stated their MD, NP, or PA preparation covered concussion training. With more responsibility placed on providers these days to recognize and treat concussion in young athletes, more MD, NP, and PA programs will focus more on implementing concussion training. With all the media and legislative attention on recognizing concussion and following appropriate return-to-play protocols, providers need to be accountable receive concussion training either in class or seek additional training and information.

Analyzing provider responses to the vignettes provided some assumptions about current provider practices. To assess what type of recommendations were being offered, provider responses were divided into categories based on the type of recommendation they made: physical rest, cognitive rest, at school accommodations. A high percentage of providers (80%) listed physical rest in their instructions and recommendations for concussion treatment. In the first vignette, nearly half of provider (53%) included cognitive rest in their treatment recommendations with one-third of providers specifically mentioning at school accommodations. These figures increase slightly with the second vignette to 60% recommending a cognitive rest,

and 47% recommending an at school accommodation. This increase is likely due to the young athlete's report of cognitive difficulties in school. Other studies that evaluated provider recommendations of cognitive rest found varying number of providers that recommend cognitive rest. Arbogast et al. (2013) found that 62% of providers advised cognitive rest as an important part of concussion management and Lebrun et al. who found that 28.4% of American providers recommended cognitive rest (2013). More efforts should be made to enhance provider awareness about the importance of cognitive rest, particularly in the school setting.

The second vignette detailed information about young athlete that sustained a concussion several weeks ago and had persistent symptoms. One of the key features examined in this vignette is whether providers would recognize the need for this young athlete to be referred to a specialist and whether that referral was a correct one. According to current guidelines, athletes with persistent concussive symptoms warrant referral to a specialty provider. The second vignette, the athlete with a concussion symptoms persisting four weeks following her injury, assessed this provider current practice. Given the longevity of her symptoms, current guidelines indicate referral. Of the 15 providers surveyed, two-thirds recommended referral to either sports medicine or neurology. While these are both appropriate places to refer, given the cognitive difficulties of the young athlete in the second vignette, a referral to neuropsychiatry would also be indicated. One-third of providers did not refer the young athlete at all.

The third vignette was beneficial in revealing provider's current practice of return-to-play recommendations. Given that the young athlete has been asymptomatic for several days, guidelines state return-to-practice would be appropriate following a graduated return-to-play protocol. All providers stated they would allow this athlete to return to practice today, and only four (27%) made mention that he was not to participate at full capacity. While no provider used

the phrase "return-to-play protocol." Eleven providers allowed return-to-play with no activity restriction and/or poor instructions. Seven of 11 providers that allowed RTP without mention of activity restriction, did note that the athlete was to stop play and/or be evaluated if symptoms returned. There appears to be lack of provider knowledge about the use and importance of graduated RTP protocols.

Objective 2: Expand Provider Knowledge of Current Practice Guidelines

Expansion of provider knowledge was evident in some areas more than other areas. Little change in provider knowledge was observed base on the increase in number of providers making recommendations pertaining to physical rest, cognitive rest, and at school accommodations in vignette 1 or vignette 2. In most instances, the number of providers making a recommendations for physical, cognitive, and at school accommodation increased by one provider after the educational module. In vignette 1, eight out of fifteen listed a recommendation or instruction for cognitive rest. In the posttest, nine out of fifteen providers listed an instruction for cognitive rest.

While the overall number of providers that made recommendations for physical rest, cognitive rest, and at school accommodations was largely unchanged, some individual participant responses were largely improved. For example, on the pretest one participant listed "limit screen time and homework" for cognitive rest recommendations. Following the module, the participant listed "limit brain stimuli, avoid prolonged concentration and noise exposure, may leave class to rest in nurse's office if symptoms, have accommodations at school arranged with teachers for decreased homework, and limit class time if needed." The response following the module offers a much recommendations for managing concussion in young athletes specifically with accommodations that can be made at school to ease return to learning. Another example of

improve provider responses includes a provider that recommended “no physical activity” on the pretest. On the posttest, the provider better explained physical rest as “rest, no physical activity that raise heart rate, part time school, and no extracurricular activities”. Better explaining physical rest recommendations is important. Young athletes need to know that when their provider tells them they need to rest this includes no heart rate raising activities, no exercise, no practice, and no gym.

In the first vignette, only five providers (33%) made mention of recommendation specific to school or homework accommodations on the pretest. Again, the increase noted with the posttest was very small, with only one additional provider (40%) recommending an at school accommodation. Discerning whether providers that listed “cognitive rest” also implied this would also carry on in to schoolwork is difficult. More provider outreach may yet to need to ensure that providers are aware of the potential stressors that the school setting has on the concussed brain.

The most notable change in provider practice was the recommendation for utilizing a return-to-play protocol. This was first illustrated in the first vignette, the athlete with recent concussion and active symptoms. When providers were asked when Johnny might return to practice, responses varied from resolution of symptoms, return to baseline testing, and re-evaluation in clinic. No provider made mention of a following a return-to-play protocol prior to restarting practice. Following the module, the number of providers recommending a return-to-play protocol before resuming play increased to eight (53%). A similar change was noted with the third vignette, the athlete with a recent concussion but no symptoms for several days is requesting to return to practice. Current guidelines recommend that when resuming play, all athletes with a suspected concussion follow a graduated return-to-play protocol. All providers

indicated they would allow Noah to return-to-play that day. Nearly three-fourths of providers (73%) failed to include return-to-play protocol like instruction to the athlete, potentially placing him at risk for further injury or delayed recovery. Prior to the module, no provider specifically used the words "return-to-play protocol". Four providers did make RTP-like recommendations with instructions including slow return to activity, no contact play, and/or conditioning only. Following the module, nine providers made mention of following a RTP protocol. The overall increase in the number of providers recommending a graduated RTP protocol is encouraging.

Overall progress in provider practice recommendations was also evident when a cumulative score was created of provider responses to all the vignettes. Some provider scores improved more than others. The average change in score from pre to posttest was +2.7 points or 11% higher than pretest scores.

Another potential area that provider practice may have been improved was in the area of referral for an athlete with chronic concussive symptoms. This was evaluated in the second vignette with athlete with significant cognitive symptoms following her concussion injury four weeks ago. Due to the chronic nature of Alyssa's symptoms, current guidelines recommend that she be referred to a specialty provider. Due to the chronicity of her headaches, a neurology consult would be appropriate. Due to the chronicity of her symptoms, a sports medicine/concussion specialist would be appropriate. More importantly, as most of Alyssa's difficulties are with school, the more important recommendation should be made to neuropsychiatry for evaluation. Providers were evaluated on their ability to correctly identify indications for referral and make an appropriate referral decisions. During the pretest, ten providers chose to refer and five did not choose to refer at the time. Referrals were made for either sports medicine/concussion specialist or neurology. No provider listed neuropsychiatry

for referral. Following the module, more providers (12) chose to refer and two did not. The most significant change noted is that six providers chose to refer to neuropsychiatry in the posttest. This is encouraging that more providers were able to identify neuropsychiatry as an appropriate for an athlete with significant cognitive learning difficulties.

Another interesting observation in vignette 1 is the change in NSAIDS and Tylenol. In the pretest, three of the 15 providers recommended the use of NSAIDs for pain. This is generally considered contraindicated in acute concussion cases due to the possible risk of bleeding. Two providers recommended the use of Tylenol for treatment of symptoms, which is appropriate. Following the concussion module, no provider recommended the use of an NSAID for treatment. Contrastingly, 11 providers recommend using Tylenol. The leap in the number of provider recommending Tylenol (from n=2 to n=11) is interesting. Why more change from pre to posttest was noted in this area than others such as cognitive rest is unclear.

Objective 3: Improve Provider Confidence

One of the goals of the PIP was that providers would express increased feelings of confidence in diagnosing and managing concussion in young athletes after completing the module. Based on their self-evaluations, gains were noted in provider confidence in diagnosing and treating concussion. As illustrated previously by Figure 9. A shift is noticeable with more providers indicating a higher level of confidence with diagnosing and treating concussions following the educational module indicating the objective was met.

Objective 4: Improve Provider Access to Decision Making Tools

This objective was not fully met. The original design of the program called for meeting with providers in the clinic setting to deliver the education program and providing providers with a resources or binder of helpful documents. This was not accomplished due to the lack of

interest in clinic provider education. During the module, providers were presented with a slide detailing different resource that may be accessed including clinic resources, modules, and return-to-play protocols. This area could have been better addressed by first asking providers about their access and use of such materials in practice and if they found them useful. Allowing providers to download resources from the module if desired would have also been beneficial, however, this was not possible with the survey website that was utilized.

Limitations

The biggest limitation to the study was the small number of participants. Technical difficulties with the survey site may have been part of the result. A one participant informed the co-investigator that she was unable to access the second portion of the survey. Whether this was a result of providers unintentionally closing the survey window instead of proceeding to the next page is unknown. Thirty-two individuals started the module but stopped at various points throughout the pretest and/or did not complete any part of the posttest. No additional incidences of difficulties with the survey were reported, but they may have occurred. Low participation may also be a result of soliciting providers through their work email. Providers may have lacked the time to be able to commit to a module that takes one hour to complete while at work. Providers may also have lacked interested in the subject. According to the study by Lebrun et al. (2012) a majority of providers indicated a desire for additional education on concussion, and Continuing Medical Education (CME) courses and CME online modules were the preferred manner of education delivery for continuing education. Despite this suggestion, there appeared to be little interest in a continuing education module that was offered to providers. Formulating the project online through the AANP may have improved participation. On the AANP CE website, providers who were actively seeking a continuing education opportunity are likely more

willing participate in the module compared to soliciting participation from providers that perhaps lacked the time or desire to complete the module.

The Other Online CE Opportunity webpage likely offered little additional access for providers seeking concussion CE modules. The module was not easy to locate via this venue. Providers could not search for this module as they could for an AANP CE Opportunity. Instead, providers had to access the CE Opportunity webpage, click on the Other Online CE Opportunity link, and then scroll down a long list of CE modules to find this module. As such, it is unlikely any providers accessed this module from this venue. A suggestion to make the module more visible and garner more participation would be to reformat the vignette and survey questions to allow for use through the AANP CE Opportunity webpage.

Another limitation was the survey format. Providers were asked several questions that required them to answer in a free text format. Some provider answers where difficult to grade and subject to bias by the grader. Vague answers such as "avoid stimulating activities" were difficult to differentiate as it was unclear whether to mark this as a physical rest recommendation or cognitive rest recommendation. The survey questions and text responses may also have been a poor indicator of provider knowledge and measure change in provider knowledge. This method of evaluating provider knowledge was believed to offer the truest assessment of provider knowledge as some "select the correct response" questions have the possibly to lead the provider to the correct response whether they actually knew the correct response or not. It may have been beneficial to ask such questions as "How often do you recommend physical rest to athletes you diagnoses with concussion?" or "On a scale of one to ten, how important is cognitive rest in recovering from a concussion?" Use of such questions over the free text responses may have led the provider to some degree, but they would also have been easier to score. The survey format

and rubric may also have failed to demonstrate provider learning in some areas. Providers were given three points for a response that included physical rest, cognitive rest, and at school accommodation recommendations. The quality of the responses was not taken into account. A provider that listed "physical rest" as a recommendation received the same score as a provider that listed "no activities that raise heart rate, no gym class, no exercising, no extracurricular activity." Several providers were noted to have much improve treatment recommendation responses, however, the rubric did not account for this improvement.

Provider complacency may also be a limitation. The Qualtrics survey program allows the co-investigator to see how long each participant took to complete the module. Based on the time the providers took to complete the module, some providers likely did not view the module to its entirety. This may account for the lower than anticipated changes to practice recommendations. The video presentation of the module itself takes approximately 30 minutes to view not including the time need to answer the pre and post survey questions. Some providers had completion times of 17 or 24 minutes. A majority of providers completed the module in 50-60 minutes. It can be assumed that providers that did not completely view the module are less likely to have change noted between their pre and posttest responses possibly skewing the results. Alternatively, some providers may have been confident enough in their concussion knowledge that they did not seek the information in the module and/or only sought the CE credit.

Including the providers that did not complete the posttest vignette questions may be another limitation affecting project results. As pretest responses were used in place of missing posttest information, no change in provider score could occur thereby lowering the average posttest score and the average change in points earned on the posttest. Using the scores of participants (n=12) that completed all of the pre and posttest. The average posttest score equaled

17.5 (n=12) compared to 16.4 (n=15). The average change in points score between pre and posttest was +3.4 points (n=12) compared to +2.7 (n=15). To correct providers from skipping these questions in the future, configuring the survey to prevent the provider from continuing onto the next page until all questions are completed may suffice.

Future Practice Improvement Project

Providers offered several suggestions for improvements that could be made to the educational program. One provider requested additional information about appropriate indications for referral. Another requested information that would help them differentiate between post concussive syndrome and concussion. Several providers made suggestions for a speed button. Other providers were unable to enlarge the screen and had difficulty viewing the module. Two providers stated that the module was boring. Attempts could be made to speed up the program and eliminate superfluous information. Another provider remarked that the acting for the vignettes was on the "economical side" attempts could be made to utilize better actors and directors.

One potential for a practice improvement project is provider access and use of concussion guidelines and support tools. Support tools and information are readily accessible online such as the SCAT3 and CDC concussion toolkit. Assessing primary care provider awareness of such support tools and their utilization in practice may be worth exploring.

Implications in Practice

One insight gained from the practice improvement project is that many providers are not practicing current concussion management. This is most notable with the lack of awareness of the need for graduated RTP protocol for athletes returning to sport. Nearly three fourths of providers (73%) would allow an athlete to return-to-play without any return-to-play protocol like

instruction, placing young athletes at risk for further injury and/or delayed healing. Another area of concussion management that needs improvement is provider recommendations for cognitive rest and school accommodations. Even following the educational module, one-third of providers failed to include cognitive rest in their treatment plan potentially delaying healing. Another area of concussion management that requires improvement is appropriate referrals. In the pretest, one third of providers failed to refer an athlete with persistent symptoms to an indicated specialty provider. One might also infer that some providers are not willing to take the time to learn about concussion, even when such free programs are delivered right to their email inbox or available free online. If CE modules are not the preferred method of learning for providers, then attempts should be made present this pertinent information to providers through other venues. Given that one third of providers have not completed any formal concussion training, NP programs would benefit from including concussion education in their programs. Clinic administrators and health systems may need to encourage, require, or host training on concussion to improve appropriate concussion management. Accessing free and quality modules for concussion management in primary care are not difficult to find. Advertising and recommending such programs will be only so effective. If provider resistance to staying up to date with concussion management continues to continue, pursuing state legislation may be worthwhile. As in the case with Massachusetts, mandating a state department approved concussion course may be necessary to ensure providers follow current concussion guidelines recommendation to protect young athletes, avert preventable re-injury, and facilitate healing from concussion.

Conclusion

Young athletes are at higher risk for concussion and prolonged concussion symptoms. They require appropriate diagnosis, instruction, and surveillance to promote healing and prevent

the dangers of inappropriate and premature return-to-play. Physical rest, cognitive rest, return-to-learning at school accommodations, graduated return-to-play protocol, and appropriate referral as indicated are all part of concussion management for the young athlete. Despite the amount of literature advocating the use of these instructions, many providers fail to include these recommendations in their treatment plan. The educational program Concussion in Young Athletes: A Module for Primary Care Providers is once such way providers can improve their practice and confidence in treating young athlete with concussion. After viewing the module, provider responses revealed improved practice recommendations particularly in regards including a return-to-play protocol as part of their treatment plan. Opportunities that are more educational geared towards primary care providers should be advertised and offered to improve provider practice throughout the community in young athletes with concussion.

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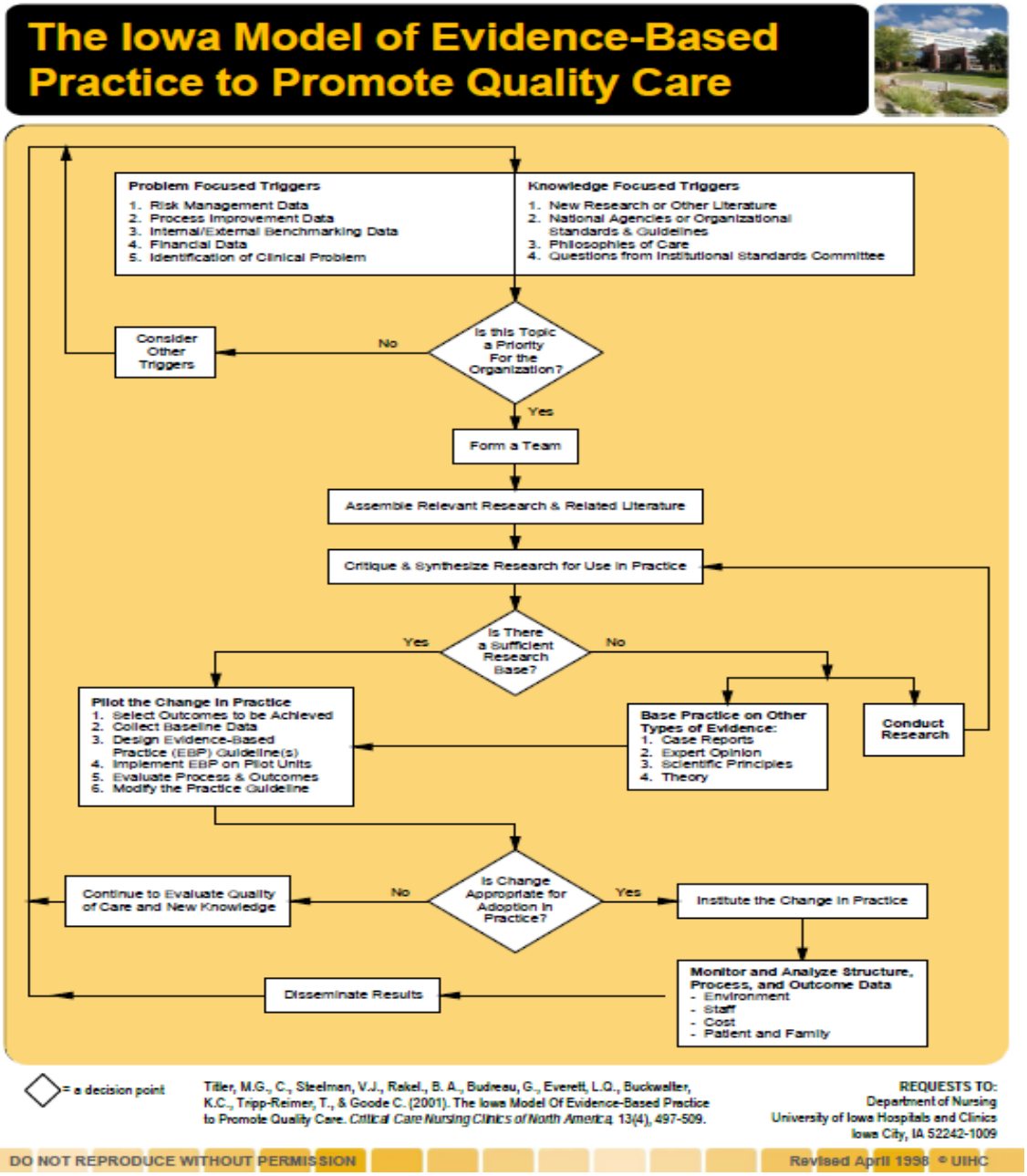
APPENDIX A: IOWA MODEL OF EVIDENCE BASED CARE



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APPENDIX B: NDSU IRB APPROVAL LETTER

NDSU NORTH DAKOTA STATE UNIVERSITY

July 18, 2014

Dr. Dean Gross
Nursing
Sudro Hall

Re: IRB Certification of Exempt Human Subjects Research:
Protocol #PH15009, "Concussion Assessment and Management in Young Athletes: A Provider Education Program"

Co-investigator(s) and research team: Christa Kleinjan, Shannon David

Certification Date: 7/18/14 Expiration Date: 7/17/17
Study site(s): varied
Sponsor: n/a

The above referenced human subjects research project has been certified as exempt (category # 2) in accordance with federal regulations (Code of Federal Regulations, Title 45, Part 46, Protection of Human Subjects). This determination is based on the protocol submitted 7/15/14 and revised consent document (received 7/17/14).

Please also note the following:
☐ If you wish to continue the research after the expiration, submit a request for recertification several weeks prior to the expiration.
☐ The study must be conducted as described in the approved protocol. Changes to this protocol must be approved prior to initiating, unless the changes are necessary to eliminate an immediate hazard to subjects.
☐ Notify the IRB promptly of any adverse events, complaints, or unanticipated problems involving risks to subjects or others related to this project.
☐ Report any significant new findings that may affect the risks and benefits to the participants and the IRB.

Research records may be subject to a random or directed audit at any time to verify compliance with IRB standard operating procedures.

Thank you for your cooperation with NDSU IRB procedures. Best wishes for a successful study.
Sincerely,

Kristy Shirley

Kristy Shirley, CIP, Research Compliance Administrator

For more information regarding IRB Office submissions and guidelines, please consult www.ndsu.edu/irb. This Institution has an approved FederalWide Assurance with the Department of Health and Human Services: FWA00002439.

INSTITUTIONAL REVIEW BOARD
NDSU Dept 4000 | PO Box 6050 | Fargo ND 58108-6050 | 701.231.8995 | Fax 701.231.8098 | ndsu.edu/irb

Shipping address: Research 1, 1735 NDSU Research Park Drive, Fargo ND 58102

APPENDIX C: SANFORD IRB LETTER

SANFORD HEALTH

October 3, 2014

PI: Dean Gross, Ph.D., FNP-C
Project: 03-14-083 Concussion Assessment and Management in Young Athletes: A Provider Education Program

The study submission for the proposal referenced above has been reviewed via the procedures the Sanford Health Institutional Review Board.

The activities described in your application are intended to contribute to quality improvement / assessment. Based on these findings, the project proposal does not meet the definition or regulatory requirements for human subject research. If in the future, you decide to collect information with the intent to develop or contribute to generalizable knowledge, you will be required to submit an application to the IRB for prospective review.

Please maintain a copy of this letter in your study file for documentation that your study does not meet the regulatory requirements for human subject's research.

Sincerely,

Deb Langstraat, CIP
Director-Sanford IRB

Sanford Health Human Research Protection Program, Route #5033 • 1305 W. 18th Street • Sioux Falls SD 57117-5039 • P 605-312-6430

APPENDIX D: PROVIDER INVITATION EMAIL

Dear health care provider,

Want to know more about managing concussions in primary care practice? **Here is your chance!**

Did You Know?
40% of high school athletes are returned to play prematurely?

- Signs and symptoms of concussion may not be present for **several hours or days** following injury?
- Children and adolescents are at an **increased risk for concussion** incidence, severity, and prolonged recovery times?
- Inappropriate management of concussion can lead to potentially **severe and long lasting complications**?
- Following an initial concussion, athletes are **3-6 times** more likely to suffer a concussion compared to an athlete that has not suffered a concussion

I am a primary care sports medicine provider in Fargo assisting Christa Kleinjan who is a nurse practitioner student at NDSU. For her dissertation project, she has been collaborating with Sanford Orthopedic and Sports Medicine Clinic to create an online provider education program "Concussion in Young Athletes: A Module for Primary Care Providers" about assessing and managing concussions in young athletes. Our program has recently received AANP approval for 1.0 credit of continuing education for NPs. The survey and module take approximately 1 - 1.5 hours to complete and focuses on recognizing concussions, treatment recommendations, return-to-play protocols, and making appropriate referrals. Please use the following link to access the survey and module. If you have any trouble accessing the module, please contact Christa at christa.kleinjan@ndsu.edu.
We hope you find this module useful in your practice!

Sincerely,
Robyn Knutson-Bueling and Christa Kleinjan

Robyn Knutson-Bueling MD, CAQ, MS
robyn.knutson-bueling@sanfordhealth.org

Christa Kleinjan DNP-student, BSN, RN
christa.kleinjan@ndsu.edu

APPENDIX E: INFORMED CONSENT

NDSU North Dakota State University

Department of Nursing
Campus Address
NDSU Dept. 2670
PO Box 6050
Fargo, ND 58108-6050
701.231.7395

Title of Research Study: Concussion Assessment and Management in Young Athletes

Dear Healthcare Provider:

My name is Christa Kleinjan. I am a graduate student in the Department of Nursing at North Dakota State University, and I am conducting a practice improvement project to improve assessment and management of young athletes with concussion that are treated within the primary care setting. This program was created in conjunction with Dr. Robyn Knutson-Beuling of the Sanford Sports Medicine Clinic. It is our hope that by participating in the concussion educational program, healthcare providers will be better prepared to manage concussions in the primary care setting.

Because you are healthcare provider, you are invited to take part in this practice improvement project. Your participation is entirely your choice, and you may change your mind or quit participating at any time, with no penalty to you.

If you choose to participate in this practice improvement project you will be asked to view and respond to three preprogram vignettes and participate in an educational program about concussion management in youth athletes. Two weeks following the educational program, you will receive an email with a link to a website to view and respond to three post program vignettes. You will also complete a short survey that includes questions about demographics, previous experience with concussion treatment, and the educational program. The time estimated for your participation in the preprogram vignettes, educational program, and postprogram vignettes is approximately one hour and fifteen minutes

It is not possible to identify all potential risks in research procedures, but we have taken reasonable safeguards to minimize any known risks. There are no foreseeable risks with this practice improvement project.

By taking part in this practice improvement project you may benefit by gaining advancement of knowledge in concussion management and treatment in young athletes. However, you may not get any benefit from being in this study.

We will keep private all research records that identify you. Your information will be combined with information from other people taking part in the study, we will write about the combined information that we have gathered. You will not be identified in these written materials. We may publish the results of the study; however, we will keep your name and other identifying information private.

If you have any questions about this project, please contact me at 320-493-7511 or christa.kleinjan@ndsu.edu, or contact my advisor Dr. Dean Gross at 701-231-8355 or dean.gross@ndsu.edu.

You have rights as a research participant. If you have questions about your rights or complaints about this research, you may talk to the researcher or contact the NDSU Human Research Protection Program at 701.231.8908, toll-free at 1-855-800-6717, by email at ndsu.irb@ndsu.edu, or by mail at: NDSU HRPP Office, NDSU Dept. 4000, P.O. Box 6050, Fargo, ND 58108-6050.

Thank you for your taking part in this research. If you wish to receive a copy of the results, please contact me or my advisor.

Sincerely,

Christa Kleinjan RN, BSN, DNP-Student

APPENDIX F: PRETEST SURVEY

1. Indicate your profession
    a. MD
    b. NP
    c. PA
    d. Other – Please List
2. How many years have you practiced?
    a. 0-5
    b. 6-10
    c. 11-19
    d. 20 or more
3. Describe the area you practice most of the time
    a. Frontier
    b. Rural
    c. Urban
4. What percentage is the setting in which you practice? (Total must sum to 100)
    a. Primary Care
    b. Emergency Department
    c. Pediatrics
    d. Orthopedics
    e. Specialty Area – Please describe
5. Approximately how many patient under the age of 19 did you diagnose or treat for concussion in the past year (either first visit of follow up)
    a. 0
    b. 1-5
    c. 6-11
    d. 12 or more
6. In your Medical, NP, or PA training, did you cover concussions?
    a. Yes
    b. No
7. Have you ever completed any training outside of your Medical, NP, or PA preparation specific to concussion? (CME, CEU, other?)
    a. Yes – Please list
    b. No

APPENDIX G: VIGNETTES

Vignette 1

Johnny is a fifteen year old football player. During football practice yesterday afternoon, he was running drills when he took a hard tackle. While he initially felt fine, within fifteen minutes he developed a headache and nausea. His coach pulled him out of practice and had his mother take him home. He presents to the clinic today with complaints of headache, limited memory of events before and after the collision, and nausea. He reports feeling slow and complains of sensitivity to light and sound. His mother states that he appears more spaced out and forgetful than normal. Johnny questions whether he might be allowed to return to football practice this afternoon. His physical exam is normal, except for difficulty with balance testing.

1. Based on the information given, would you diagnose Johnny with a concussion?
    a. Yes
    b. No
2. Would you allow Johnny to return to Practice today?
    a. Yes
    b. No

3. What specific treatment recommendations and discharge instructions would you give Johnny? (Instructions, medication, restrictions etc.) Please list.

a. .

4. Are there any referrals you would like to make at this time?
    a. Yes – List where you would like to refer
    b. No

Vignette 2

Alyssa is a seventeen year old basketball player. Four weeks ago she was playing basketball when she collided with another player. Initially she complained of headache, nausea, and feeling foggy. She also has limited memory of events after the collision. She taken that evening to the clinic and diagnosed with a concussion. She was sent home with instructions of no physical activity for one week and to follow up with her primary care provider. Now four weeks later, her mother bring her into the clinic today to Alyssa can resume basketball practice. She denies nausea, vomiting, difficulty with balance. She continues to have mild intermittent headaches that are relieved with Tylenol. Normally a straight A student, Alyssa has been struggling in school and has received failing grades on her last few quizzes and exams. She has been struggling to learn and remember new information. Her mother states that she has been more moody than normal these past few weeks and has been sleeping an average of 14 hours per day. On exam no deficits were noted.

1. Would you allow Alyssa to return to practice today?

a. Yes
b. No

2. What specific treatment recommendations and discharge instructions would you give Alyssa? (Instructions, medication, restrictions etc.) Please list.
    a. .
3. Are there any referrals you would like to make at this time?
    a. Yes – List where you would like to refer
    b. No

Vignette 3

Noah is a thirteen year old baseball player. One week ago he collided with a catcher during a play at home plate. After the collision he developed a moderate headache, dizziness, nausea and felt "out of it". He was seen in the ER and given instructions to rest and follow up with his primary care provider in one week. He presents to the clinic today for re-evaluation. He states that over the first few days his concussion symptoms gradually improved and he has been symptoms free for the past three days. He denies nausea, vomiting, dizziness, headache, difficulty concentrating, or loss of balance. He is back to full days at school and denies any

difficulty with cognitive tasks. On exam, his physical exam was normal and no balance deficits were noted.

1. Would you allow Noah to return to practice today?
    a. Yes
    b. No – Pease list when you would allow him to return to practice?
2. Any recommendations you would like to make about returning to play?
    a. Please list
3. Any referrals you would like to make at this time?

APPENDIX H: VIGNETTE GRADING RUBRIC

Grading Rubric for Provider Vignette Responses

Vignette 1

Questions	0	1	2	3
Based on the information given, would you diagnose the student with a concussion?	Provider fails to diagnose student with concussion	Provider appropriately diagnoses student with a concussion		
Would you allow the student to return to practice today?	Provider fails to recognize persistent symptoms related to concussion and/or allows student to return-to-play	Provider correctly identifies persistent symptoms related to concussion and recommends no return-to-play today.		
When would you allow the student to return-to-play?	Provider allows student to return-to-play while symptomatic	Provider allows student to return-to-play after meeting 1 criteria	Provider allows student to return-to-play after meeting 2 criteria	Provider correctly identifies the need to refrain from play until all criteria met - symptoms resolve, graduated return-to-play and/or after additional follow up.

What treatment recommendations and discharge instructions would you make for the student (instructions, medications, restrictions etc.)	Provider fails to list any correct treatment recommendations	Provider correctly lists 1 instructions regarding to physical rest, cognitive, rest, at school accommodation, or return-to-play protocol	Provider correctly lists 2 instructions regarding physical rest, cognitive rest, at school accommodation, or return-to-play protocol	Provider includes instruction pertaining to 3-4 realms of concussion management – physical rest, cognitive rest, at school accommodation and graduated return-to-play protocol
Are there any referrals you would like to make at this time?	Provider makes improper referral for concussion management	Provider requests referral to appropriate source	Provider does not refer or refers to sports medicine clinic	

Vignette 2

Question	0	1	2	3
Would you allow the student to return to practice today?	Provider fails to recognize persistent symptoms related to concussion and/or allows student to return-to-play	Provider correctly identifies persistent symptoms related to concussion and recommends no return-to-play today.		
If, no when would you allow the student to return to practice?	Provider allows student to return-to-play while symptomatic	Provider allows student to return-to-play after meeting some but not all return-to-play criteria		Provider correctly identifies the need to refrain from practice until symptoms resolve and/or after additional follow up.
What treatment recommendations and discharge instructions would you make for the student (instructions, medications, restrictions etc.)	Provider fails to list any treatment recommendations	Provider correctly lists 1 instructions regarding to physical rest, medication, cognitive, rest, at school accommodation, or return-to-play protocol	Provider correctly lists 2-3 instructions regarding physical rest, medication, cognitive rest, at school accommodation, or return-to-play protocol	Provider correctly lists 4 instructions physical rest, medication, cognitive rest, at school accommodation and return-to-play protocol
Are there any referrals you would like to make at this time?	Provider fails to recognize need for referral	Provider makes referral that's not wrong but not right either	Provider makes appropriate referral to neuropsych, neurology, sports medicine	

Vignette 3

Question	0	1	2
Do you allow this student to return to practice today? Are there any recommendations you would like to make about resuming practice?	Provider fails to list any recommendations about resuming practice	Makes some appropriate recommendations without mention of GRTP	Provider recommends gradual return-to-play
Any referrals you would like to make at this time?	Inappropriate referral	Does not refer	
Would you allow Noah to return to practice today – what recommendations would you make about resuming practice	Prevents return-to-play Or allows return-to-play without mention of RTP protocol	Allows return-to-play with some appropriate recommendations but without mention of RTP protocol	Provider allows return-to-play with RTP protocol

APPENDIX I: POSTTEST SURVEY

1. After participating in the education module, will you many any changes to your practice?
    a. Yes
    b. No, I am already practicing within these recommendations
    c. No, I am content with my current practice standards
2. My knowledge on the application and practice of concussion management before the education program?
    a. Poor
    b. Fair
    c. Good
    d. Very Good
3. The level of my confidence in the practice of concussion management before the educational program?
    a. Poor
    b. Fair
    c. Good
    d. Very Good
4. My knowledge on the application and practice of concussion management after the education program?
    a. Poor
    b. Fair
    c. Good
    d. Very Good
5. The level of my confidence in the practice of concussion management after the educational program?
    a. Poor
    b. Fair
    c. Good
    d. Very Good
6. Would you make any improvements to the education program? Please list

7. After completing this activity, I will be able to achieve the following objectives

	Strongly Agree	Agree	Disagree	Strongly Disagree
Understand the potential causes of concussion				
Identify the signs and symptoms of concussion				
Identify the appropriate treatment recommendations for concussion				
Identify indications for referral				

8. The teaching methods used were appropriate to the objectives
    a. Strongly agree
    b. Agree
    c. Somewhat disagree
    d. Strongly disagree
9. The methods used were appropriate to the objectives
    a. Strongly agree
    b. Agree
    c. Somewhat disagree
    d. Strongly disagree
10. The speaker demonstrated expertise and effectiveness in the topic
    a. Strongly agree
    b. Agree
    c. Somewhat disagree
    d. Strongly disagree
11. The individual objectives/content topics were cohesive with one another
    a. Strongly agree
    b. Agree
    c. Somewhat disagree
    d. Strongly disagree
12. The content was balanced (free of commercial bias)?
    a. Strongly agree
    b. Agree
    c. Somewhat disagree
    d. Strongly disagree

13. Speaker fully disclosed any conflict of interest and discussion of off-usage of mediations and/or medical devices at the beginning of, or during the presentation
    a. Strongly agree
    b. Agree
    c. Somewhat disagree
    d. Strongly disagree
14. The environment was conducive to learning?
    a. Strongly agree
    b. Agree
    c. Somewhat disagree
    d. Strongly disagree
15. I would recommend this program to my colleagues
    a. Strongly agree
    b. Agree
    c. Somewhat disagree
    d. Strongly disagree
16. What if any recommendations would you like to share for future improvements of this program? Please List
17. Was the level of content for NPs
    a. Too basic?
    b. Just Right?
    c. Too Advanced?

APPENDIX J: AANP CERTIFICATION

AANP | American Association of NURSE PRACTITIONERS™

The Voice of the Nurse Practitioner®

October 20, 2014

Christa Kleinjan
DNP Dissertation
4259 9th Avenue Circle S Apt #303
Fargo, ND 58103

Dear Christa,

The continuing education activity *Concussion in Young Athletes: a Provider Education Module* is approved for continuing education by the American Association of Nurse Practitioners.

All sessions included in this application are approved as submitted. Use the following statement in your literature to indicate the maximum credit one person can obtain upon completion of this activity.

"This program is approved for 1.0 contact hour(s) of continuing education by the American Association of Nurse Practitioners. Program ID 1410463. This program was planned in accordance with AANP CE Standards and Policies and AANP Commercial Support Standards."

ID number 1410463 has been assigned to this application. Please refer to this number with all communication pertaining to this application including the required post-program reports. This program has been approved for 2 years (through November 30, 2016), provided no changes are made. Attendance sheets and evaluation summaries are due in this office one month after the program's initial presentation (no later than December 14, 2014).

Thank you,

Stormy Causey

Stormy Causey
CE Coordinator

Administration: PO Box 12846 • Austin, TX 78711 • 512-442-4262 • Email: admin@aanp.org • Website: www.aanp.org
Office of Health Policy: 215 Reinekers Lane, Suite 325 • Alexandria, VA 22314 • 703-740-2529 • Email: federalpolicy@aanp.org

APPENDIX K: EXECUTIVE SUMMARY

Background

Concussions are a common occurrence in young athletes (Center for Disease Control and Prevention [CDC], 2011; Noble & Hesdorffer, 2013), comprising nearly 15% of all sport-related injuries in high school athletes (Meehan III, D'Hemecourt, Collins, & Comstock, 2011). The potential consequences of improperly managed concussions can have serious short and long-term effects. Death, permanent brain injury, delayed recovery, and persistent late-life effects are possible consequences of improper concussion management (Lebrun et al., 2013). The risk of adverse health outcomes increases when a person incurs multiple concussion or repetitive head injuries, particularly when a second concussion follows shortly after the primary concussion or head injury (Lebrun et al., 2013). As such, it is necessary that providers properly assess and manage patients suspected of having a concussion. Despite the well-documented and disseminated dangers, premature return-to-play (RTP) is a frequent occurrence. According to the study by Yard and Comstock (2009) premature return-to-play occurred in as many as 40% of high school athletes. In recent years, concussion in youth sports has gained considerable attention in the media, healthcare, and state legislation. While many state governments and health care institutions focus on the need to educate coaches, parents, and athletes on concussion and the risks of premature return-to-play, it appears not enough attention is directed at ensuring primary care providers (PCP) receive proper training and are following current recommendations for assessing and managing concussions in young athletes. Primary care providers, particularly those in rural settings that often lack access to specialists or athletic trainers, are often the sole provider to diagnose, manage, and make return-to-play decisions (Zonfrillo et al., 2012).

Project Summary

Based on the need for enhanced awareness of concussion assessment and management in young athletes, a provider education module was created under the supervision of the Sanford Sports Medicine Clinic and practice improvement project supervisory committee. The module covered topics such as pathophysiology of concussion, assessment techniques, treatment recommendations, and referral indications. The module also included three video vignettes about young athletes presenting to their primary care provider following a concussion injury. Providers were then instructed to provide their treatment recommendations for the athletes in the scenarios. Provider responses were evaluated for appropriate recommendations of physical rest, cognitive rest, at school accommodations, graduated return-to-play, and appropriate referral. Provider responses were also cumulatively scored using rubric. The vignette were used prior to and following the program to assess for change and/or improvements in practice recommendations. Providers were also given the opportunity to rate their level of knowledge and confidence with managing concussion in young athletes prior to and following the module.

Results

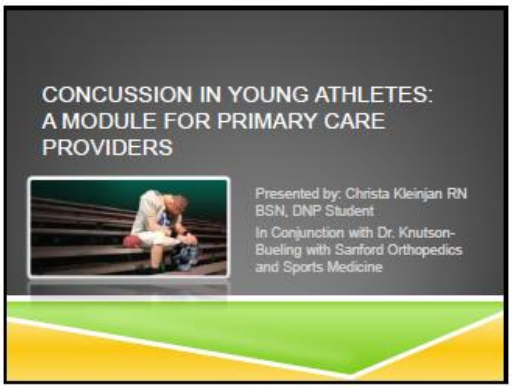
Data were collected for six weeks with 15 providers participating. Sixty-four percent of practicing providers diagnosed or treated a young athlete in the past year. Only 53% percent of providers covered concussion in their MD, NP, or PA preparation. One third of providers indicated they neither received concussion training during their MD, NP, or PA preparation nor completed training outside of their preparation. While little change was observed in the overall number of providers recommending physical rest, cognitive rest, and at school accommodations, notable improvements were made in the number of providers recommending return-to-play protocols and appropriate referrals for athletes with prolonged concussive symptoms. Seventy-

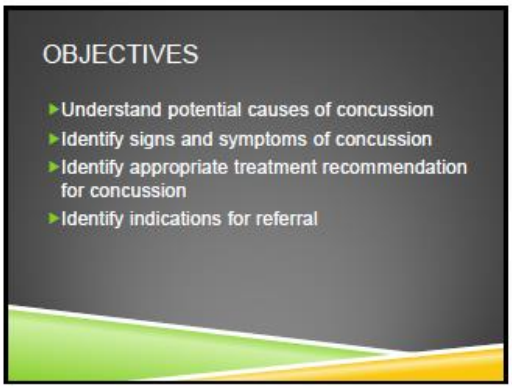
three percent neglected to include a return-to-play protocol in their recommendations for resuming sport. This was reduced to 40% following the module. In the pretest, one third of providers failed to refer an athlete with persistent concussive symptoms to a specialty provider. Comparing the cumulative pre and posttest scores, following the module providers scored an average of +2.7 points higher on the posttest. Improvements in score ranged of from zero to nine points. A general increase in self-perceived knowledge and confidence levels in managing concussion was noted following the concussion. After completing the module, all providers (n=15, 100%) reported planning to make changes to their practice after viewing the module.

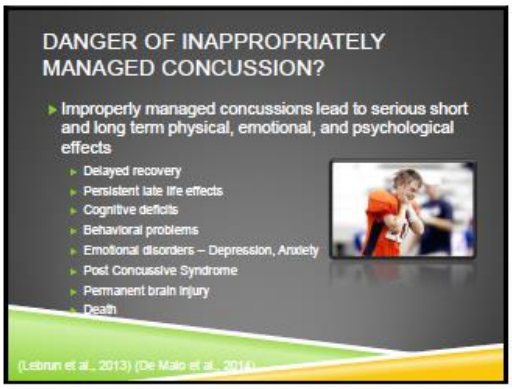
Recommendations

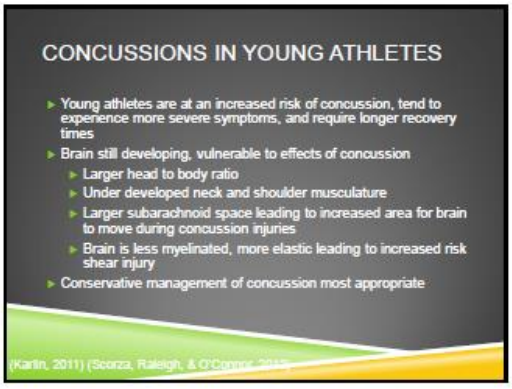
After viewing the module, provider responses revealed improved practice recommendations particularly in regards including a return-to-play protocol as part of their treatment plan. As demonstrated by the low participation in the practice improvement project, it may be advisable that health care systems require concussion training in providers that treat young athletes or other methods of concussion training be offered. It may also be advisable that other states follow suit of Massachusetts and require providers to complete a mandatory concussion education program. Additional educational opportunities geared towards primary care providers should be advertised, offered, and possibly required to improve practice of managing concussions in young athletes.

APPENDIX L: MODULE POWERPOINT SLIDES









DEFINITION

Concussion is a **brain injury** and is defined as a complex pathophysiological process affecting the brain, induced by biomechanical forces.

4th International Conference on Concussion in Sport, Zurich 2012

(McCroy et al., 2013)

DEFINITION

- 1. Caused either by a direct blow to the head, face, neck or elsewhere on the body with an "impulsive" force transmitted to the head.

(McCroy et al., 2013)

DEFINITION

- 2. Results in the rapid onset of short-lived impairment of neurologic function that resolves spontaneously. Signs/symptoms may manifest minutes or even hours after injury

(McCroy et al., 2013)

DEFINITION

- 3. 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 structural neuroimaging studies.

(McCroy et al., 2013)

DEFINITION

- 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.
  - Loss of consciousness NOT required for diagnosis
  - Only 1 in 10 concussions results in loss of consciousness

(McCroy et al., 2013)

SOME THINGS A CONCUSSION IS NOT

- Concussion is NOT
  - Brain contusion
  - Brain bleeding
  - Brain swelling
- Concussion IS
  - A brain injury
  - Functional injury rather than structural injury

(McCroy et al., 2013)

WHAT HAPPENS TO THE BRAIN DURING A CONCUSSION?

- Exact process not fully understood
- Rotation acceleration of brain causes shear strain of the underlying neural elements causing a sequence of events often called the neurometablic cascade
  - Neuronal depolarization
  - Local lactic acid accumulation
  - Decreased cerebral flow/ mismatch of cerebral glucose supply and demand

(Halstead & Walter, 2010) (McCrory et al., 2013)

SECOND IMPACT SYNDROME

- Possible deadly consequence of premature return to play
- Occurs when a second concussion is sustained prior to the complete healing of the first
- Theory suggests the brain is sensitive to extremes in blood pressure caused by loss of cerebrovascular autoregulation
- Second concussion triggers catecholamine surge
- Vascular congestion, cerebral edema, increased intracranial pressure, coma, death
- Fortunately rare occurrence, incidence unknown

(De Los Angeles Whyte, Benton, & Whyte, 2014) (McCrory et al., 2013)

SIGNS AND SYMPTOMS

- Physical
- Cognitive
- Emotional
- Sleep Disturbance

(Herring et al., 2011)

PHYSICAL

- Headache
- Nausea
- Vomiting
- Balance deficit
- Dizziness
- Visual disturbances
  - Blurry vision
- Fatigue
- Sensitivity to light
- Sensitivity to sound

(Herring et al., 2011)

COGNITIVE

- Loss of consciousness
- Disorientation
- Feeling dazed
- Feeling foggy
- Feeling slowed down
- Difficulty concentrating
- Inability to learn new material
- Difficulty remembering
- Confusion
- Amnesia
- Delayed responses
- Slurred speech

(Herring et al., 2011)

EMOTIONAL

- Irritability
- Sadness
- More emotional
- Nervousness
- Anxiety
- Depression

(Herring et al., 2011)

SLEEP DISTURBANCE

- Drowsiness
- Sleeping less than usual
- Excessive sleep
- Trouble falling or staying asleep

(Herring et al., 2011)

RECOVERY FROM CONCUSSION

- Majority of symptoms resolve within 7-10 day period but may persist for a month or longer
- Recovery time thought to be longer in children and adolescents
- Physical activity and cognitive strain may exacerbate and prolong symptoms of concussion

(Halstead et al., 2013)(McCroy et al., 2013)

HISTORY AND EXAM

HISTORY

- Mechanism of injury
- Loss of consciousness
- Amnesia (before or after event)
- Initial and current symptoms
- Medications
- Risk factor for protracted recovery
  - History of previous concussion or head injury
- Anxiety/Depression, other psychiatric disorder
- History of migraine
- Sleep disorder

(Sanford Orthopedics Sports Medicine, 2012)

PHYSICAL EXAM

- Neck
  - Muscle strain, ligamentous strain, boney injury
  - Cervical spine injury – immobilization, imaging
- Neurological Exam
  - Mental Status
  - Cognitive Functioning
  - Gait
  - Balance
  - Cranial nerve, sensory, motor findings typically normal in concussed athlete

(Sanford Orthopedics Sports Medicine, 2012)

PHYSICAL EXAM

- Immediate Memory
  - 5 word recall
- Delayed recall
  - 5 word recall
- Motor and Balance
  - Fine movement of hands
  - Finger to nose
  - Gait
  - Tandem walk
  - Rhomberg
  - Advanced balancing testing

(Sanford Orthopedics Sports Medicine, 2012)

PHYSICAL EXAM

- Concentration
  - Listen and recite string of words backwards
  - Recite months backwards
- Pupil/Eye exam
  - Hemorrhages
  - Reactivity, size, shape of pupils
  - Abnormal tracking, nystagmus

(Sanford Orthopedics Sports Medicine, 2012)

ROLE OF IMAGING IN CONCUSSION

- Concussions do not show on advanced imaging – x-ray, CT scan or MRI
- No need to order unless red flag suggestive of spinal or intracranial injury
  - Altered mental status
  - Concern for intracranial process
  - Abnormal neurological exam
  - Evidence or strong suspicion of skull fracture

(McCroy et al., 2013)

IS THIS MORE THAN A CONCUSSION?

- Red Flags
  - Headache that worsens
  - Looks drowsy or can't be awakened
  - Repeated vomiting
  - Slurred speech
  - Can't recognize people or places
  - Increasing confusion or irritability
  - Weakness or numbness in arms or legs
  - Unusual behavior change
  - Any loss of consciousness greater than 30 seconds
  - Abnormal eye evaluation

(Sanford Orthopedics Sports Medicine, 2012)

TREATMENT PLAN

- Physical Rest
- Cognitive Rest
- Graduated Return to Play

MEDICATIONS

- Symptom management
  - Headache – acetaminophen (Tylenol)
    - Avoid ibuprofen (Motrin) , naproxen (Aleve),
  - Sleep disturbance – diphenhydramine (Benadryl)
  - Nausea – Ondansetron (Zofran)

PHYSICAL REST

- No physical exertion
- Normal activities of daily living allowed
- Avoid activities that increase heart rate
- No exercising
- No athletics
- No gym class

(Sanford Orthopedics Sports Medicine, 2012)

COGNITIVE REST

- Limit school
  - No school
  - Part time attendance
    - No gym, choir, band, woodshop, non essential classes
  - No extra-curricular and afterschool activities
- Limit reading, homework
- Limit screen time
  - Limit computer, television, video games
- Avoid loud noise, bright lights

(Sanford Orthopedics Sports Medicine, 2012)

COGNITIVE REST

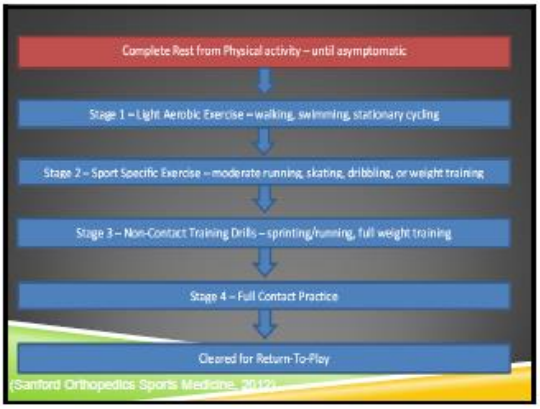
- At school accommodations
  - Allow student to wear sunglasses in class
  - Allow student to go to nurse's office if symptoms increase
  - Allow student to go home if symptoms do not subside
  - Limit homework load – shorter assignments, alternative assignments
  - Allow extra time for projects and testing
  - Allow for note taker or pre-printed notes
  - Allow student to audiotape classes

(Sanford Orthopedics Sports Medicine, 2012)

GRADUATED RETURN TO PLAY

- **No same day return to play**
- Prior to beginning graduated return to play student must
  - Make successful return to school
  - Symptom free and off all medications
  - Normal physical examination
  - Back to baseline balance and cognitive measures

(Sanford Orthopedics Sports Medicine, 2012)



(Sanford Orthopedics Sports Medicine, 2012)

GRADUATED RETURN TO PLAY

- **Minimum** of 24 hours between each stage
  - longer periods with recurrent or severe cases
- At each stage must be **asymptomatic**
  - no return or concussive symptoms prior to progressing to the next stage
- If symptomatic during the course of the protocol
  - Reevaluation athlete before restarting the protocol
- When the athlete resumes the protocol, they should begin again at stage 1
- Take advantage of athletic trainers to aid and guide RTP

(Sanford Orthopedics Sports Medicine, 2012)

WHEN TO REFER TO CONCUSSION SPECIALIST

- No overall improvement of symptoms after 10-14 days
- Symptoms persisting over one month
- Athlete with history of multiple concussions occurring with progressively less force or greater cognitive dysfunction
- Considering need to disqualify athlete from play
- Uncertain of how to manage symptoms
- Uncertain of how to manage graduated return to play

(Sanford Orthopedics Sports Medicine, 2012)

OTHER REFERRALS

- Neurosurgery
  - Treatment of patient with injury that may require surgical treatment
  - Expanding brain bleed, progressive loss of consciousness
  - Edema of brain
  - Concern for associated brain injury
  - Skull fracture
  - Cerebrospinal fluid leak from ear or nose
- Neuropsychology
  - Difficulty returning to school or play due to cognitive functioning issues after 4 weeks
  - Continual problems with stress or mood
  - Pre-existing condition – ADHD, depression, anxiety

(Sanford Orthopedics Sports Medicine, 2012)

OTHER REFERRALS

- Neurology
  - History of seizures
  - Chronic headache (>4 weeks)
  - Persistent neurological deficits, balance issues
- Physiatry/Physical therapy
  - Acute physical and cognitive symptoms
  - Ongoing vestibular issues – dizziness, balance, sensitivity to light/sound
  - Suspect headache or other symptoms to be related to whiplash injury or other musculoskeletal injury

(Sanford Orthopedics Sports Medicine, 2012)

504 PLAN

- For student with significant concussion symptoms or symptoms lasting longer than a few months consider
  - Document that requires school to offer reasonable accommodations for student with temporary or permanent disability
  - Requires legal documentation by health care provider (such as a doctors notes)
  - May be implemented or discontinued easily
  - May prove beneficial in future should student continue to have chronic issues with cognitive functions and require further resources
  - May consider referral to neuropsychologist to aide in 504 Plan process

(CDC, 2011)

IEP

- Individualized Education Plan
- Requires school to make accommodations and services available to student with disability
- Requires legal documentation by health care provider
- Requires referral to neuropsychologist for Mutli-Factored Evaluation (MFE) to determine disability and its impact on young athletes educational program

(CDC, 2011)

FREQUENTLY ASKED QUESTIONS

AFTER HOW MANY CONCUSSIONS BEFORE YOU NEED TO DISQUALIFY AN ATHLETE FROM SPORT?

- No magic number
- Discussion for provider and athlete – whether risk of concussion is worth benefit of continued play in sport
- If considering need to disqualify an athlete from sport, consider referral to concussion specialist

SHOULD ATHLETE WITH CONCUSSION BE AWAKENED EVERY 1-2 HOURS FOR SIGNS OF DECREASING LEVEL OF CONSCIOUSNESS?

- **No**
  - Outdated practice
  - Promoting sleep is good for brain recovery

WHERE DOES NEUROCOGNTIVE COMPUTERIZED TESTING FIT INTO CONCUSSION MANAGEMENT?

- Role not fully established
- Used as method to assess degree of cognitive impairment
- Used to monitor progression
- More commonly used in athletes with baseline testing
- NOT mandatory for managing patients with concussion
- NOT a substitute for initial or subsequent clinical evaluation of patient with a concussion

(McCroy et al., 2013)

WHAT IS THE BEST METHOD OF GRADING A CONCUSSION

- Outdated practice of grading concussion (1,2,3) primarily based on loss of consciousness
- Evidence shows the LOC does not predict clinical course or long term cognitive impairment
- Do not consider using

(McCroy et al., 2013)

CAN CONCUSSION HEADGEAR OR MOUTH GUARD PREVENT CONCUSSION?

- No significant evidence to support the effectiveness of headgear or mouth guards in preventing concussion injury
- Headgear and helmets
  - biomechanical evidence of the reduction of impact forces to the brain
  - not translated into observed differences in rate or severity of concussion
- Mouth guards
  - effective in preventing dental and oro-facial injury
  - no evidence that standard or fitted mouth guards decrease the rate or severity of concussions in athletes

(Daneshvar et al., 2013)

WANT TO KNOW MORE?

- North Dakota Brain Injury Network
  - Information, referral service, peer support
  - http://ruralhealth.und.edu/projects/brain-injury-network
- Brain Injury Alliance for MN
  - http://www.braininjurymn.org
- CDC/NFL– Heads Up for Clinicians
  - Providers Concussion Training Module, continuing education credit available
  - Concussion Toolkit – Facts for Physicians Booklet, Acute Concussion Evaluation
  - http://www.cdc.gov/concussion/HeadsUp/physicians_tool_kit.html
- Children's Healthcare of Atlanta
  - Concussion Toolkit – Resources, algorithms, protocols
  - Graduated Return to Play specific to sport
  - http://www.choa.org/Children's-Hospital-Services/Concussion
- Sanford Health
  - Concussion Toolkit – Return to play protocol, cognitive rest accommodations
  - http://www.sanfordhealth.org/Medical-Services/Concussion
- Sports Concussion Assessment Tool 3
  - http://bjsm.bmj.com/content/47/5/259.full.pdf

THANKS FOR WATCHING!

A link to the post test and evaluation will be delivered to your email address in two weeks. Following this you will receive your continuing education certificate for your participation.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