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## Concussions: education for coaches and safe return to play for athletes

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CONCUSSIONS: EDUCATION FOR COACHES AND SAFE  
RETURN TO PLAY FOR ATHLETES

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University of Northern Iowa  
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## Concussions: Education for Coaches and Safe Return to Play for Athletes

### **Introduction**

Head injuries can occur due to a variety of reasons, including falls, auto accidents, and contact sports. In 2010 the Center for Disease Control reported that 2.5 million traumatic brain injuries occurred in the United States. Any injury the body sustains requires that a person take the appropriate steps to have the most successful outcome. Appropriate action with an injury is not just limited to recovery, but being aware of the potential injury and acting accordingly. This is even more important when the injury is sustained by the brain. A situation in which brain injuries are becoming a larger issue is in contact sports. In order for athletes to have the best outcome from head injuries it is important for coaches to be educated on concussions. Coaches need to be able to identify when a concussion could have occurred, then act accordingly. This thesis will show what types of online training programs are available for coaches and what is necessary for coaches to know when dealing with these injuries. It will also show the best course of action to take for an athlete to return to play and return to school and learning safely.

### **Literature Review**

Many children participate in sports while growing up. Sports are a great way to keep children active as they mature. As children get older and sports become more competitive, injuries become more prevalent. An injury that should be taken very seriously is traumatic brain injury (TBI), or more commonly referred to as concussions. Head injuries do not have the obvious physical symptoms that many other injuries do. This can affect the identification and treatment of the injury. Head injuries can occur from many different accidents, but for the purpose of this study I will be focusing on concussions as a result of contact youth sports. I will be discussing several different topics revolving around concussions in youth sports. In order to look more closely at concussions, it is important to understand what a concussion is and the signs and symptoms presented if an athlete sustains a concussion. Coaches are a major part of concussion recognition, so I will also look into training options for coaches. After an

athlete has sustained the injury they need to return to play and school, or cognitive function, safely. I will also discuss the guidelines put forth by the State of Iowa for monitoring concussions in sports as well as protective equipment available and its ability to protect against concussions.

### **Concussions Defined**

Concussions fall under the category of mild traumatic brain injuries (mTBI). According to Sady, Vaughan, and Gioia (2011), "mild traumatic brain injury is defined as a direct or indirect force to the head that results in immediate, short-lived, neurological impairment (e.g., amnesia, loss of consciousness, confusion) that resolves spontaneously, typically followed by physical, cognitive, emotional symptoms and sleep disturbance" (p.2). TBIs typically result from a blow to the head (Mayo Clinic Staff, 2011). This can easily occur during contact sports. Injuries can happen during practices, but more often mTBIs occur during the actual competitions. Brain damage occurs from a blow to the head; the impact forces the head forward, the skull then stops but the brain keeps moving, causing a collision. Then the head rebounds back, once again the skull stops and the brain keeps moving, hitting the back of the skull as well. This is called coup contrecoup. A specific type of brain injury that can occur in contact sports, such as football, is a diffuse axonal injury (DAI). DAI can result from rotational movement of the skull and brain at an accelerated speed (Sahler & Greenwald, 2012). This speed causes lesions in the axons. The axons are the part of a cell that relay messages out to the rest of the body. This is important to know when developing protective equipment for athletes. The brain cells at the point of impact or rotation are damaged and result in the athlete experiencing various signs and symptoms. According to the Mayo Clinic, effects of a mild traumatic brain injury include confusion and disorientation. If there is a loss of consciousness it only lasts a few seconds to a few minutes. The person may experience headaches, loss of balance, dizziness, nausea, vomiting, sensitivity to light or sounds and fatigue. After the injury they can also experience issues with memory and concentration, difficulty sleeping or sleeping more than usual, or mood swings. Sensory problems such as blurred vision, ringing in ears, and bad taste

in mouth can also occur. It is recommended that a person should see a doctor following any suspected brain injury.

Concussion or mTBI resulting from sports are not uncommon, but can be difficult to diagnose. The symptoms that were previously listed can change and appear over time, hours or days after the injury occurred (Sahler & Greenwald, 2012). A diagnosis takes many tests and can be difficult for a doctor to find. The education that is available for coaches should not teach them to diagnose (Glang, Koester, Vondy Beaver, Clay, & McLaughlin, 2010). These programs should educate coaches on symptoms and risk factors so they can identify potential concussions. The mentality for athletes and coaches can be to “play through the pain”. When it comes to head injuries especially, this should not be the case. The benefits of being cautious and sitting athletes out for a game will far outweigh the risk of allowing athletes to continue competing with head injuries.

### **Education for Coaches**

Traumatic brain injuries are not uncommon in sports, according to Glang et al. (2010), “approximately 1.6-3.8 million sports and recreation-related traumatic brain injuries occur in the United States each year” (p. 1). There is not always a doctor or trainer at these events, which is why it is important for coaches to be educated on concussions. Powell noted that, “it is the responsibility of the sponsors of these programs to provide an environment that minimizes the risk of injury” (2001, p. 307). Whatever the body is that is sponsoring a group, such as a school, it is their responsibility to be sure that the coaches know the precautions necessary to minimize the likelihood of an injury to occur. Along with this, it is also their responsibility to educate the coaches on how to spot a brain injury and what precautions to take when one has potentially occurred. This is important because, “Early identification and management minimizes the risk of a negative outcome and maximizes the probability of the players returning to competition without an increased risk of reinjury” (Powell, 2001, p. 310). Coaches know their players and will be the first to notice any changes in their play. They are also the first line of

defense in protecting athletes from further injury once a concussion is suspected. Injuries in sports are inevitable, so knowing what to do when one happens is just as important as steps taken to prevent injury. There is currently online concussion training available for coaches. The Center for Disease Control offers a toolkit for schools called, "Heads Up to Schools: Know your concussion ABCs" (Sady, Vaughan, & Gioia, 2011, p. 7). Another training option is ACTIVE: Athletic Concussion Training using Interactive Video Education. This is designed for coaches of 10-18 year olds to be educated on concussion prevention and management (Glang et al., 2010, p. 2). Both of these programs are readily available online, free of charge.

Increased knowledge about concussions is important, as is caring for brain injuries once one is identified. Proper steps should be taken for the athlete to be able to return to play safely. Educated coaches are the key to an athlete's success in the event of a concussion. Taking precautions and knowing warning signs will ensure the best outcome for each athlete. Identifying concussions is a challenging issue facing medical professionals due to the variety of symptoms that may or may not be present (Powell, 2001). The symptoms associated with mild TBI could be symptoms of other injuries and vary from athlete to athlete. If it is hard for medical professionals to diagnose concussions, it is not expected that coaches should know for sure whether or not there is significant damage when athletes collide. This is why education is important, so coaches know risks and warning signs and not to take any chances with head injuries. Coaches should also know the implications of an athlete reinjuring themselves before they have fully healed, and know to listen to doctors for when the athlete is cleared to play again. When a player is returning to play it is important that they are not expected to practice or compete at 100% right away. Before it is safe for the athlete to return to their sport, it is imperative that they gradually work their way up to physical activity after a period of rest. One study showed that athletes had the best scores on neurocognitive testing when they participated in moderate activity while recovering (Giza & DiFiori, 2011). This is important because the body and brain need to be exercised

while recovering, but an athlete must be aware of what they are capable of for the best recovery. They must work from rest back up to normal practice and competition.

### **Cognitive Recovery**

When recovering from concussions it is obviously important that athletes do not return to play too soon. Along with their athletics, it is also important that these students make the proper adjustments when taking a break from cognitive activities including school. Areas that are affected by concussion include cognition, recall, vision, balance, and motor function, specifically reaction time (Schmies, 2014). All of these abilities necessary to be successful in school. These seemed to be a topic that is often glazed over. Many studies state that both the physical and cognitive workload should be considered during recovery. According to Harmon et al. (2012) “there are no standardized guidelines for returning the athlete to school” (p. 9). They went on to explain that recovery will depend on each athlete’s symptoms and stress levels. Sady et al. (2011) gave the most detail for returning to cognitive activities. Cognitive recovery should be approached in a gradual and stepwise manner similar to physical return to play guidelines. A gradual return is important so that cognitive demands are kept below the symptom threshold (do not cause increase or return of symptoms) and lowered stress of the athlete as they do not become overwhelmed with school (Sady et al., 2011). It is also important to remember that recovery will vary based on the individual, some will recover rapidly and others’ recovery will be more prolonged.

Utilizing baseline testing can be a way to ensure that the student is recovering cognitively and that the steps are progressing at an appropriate rate. Baseline testing helps to quantify signs of concussion. “Baseline testing can include neurological, cognitive, and balance assessments in a non-injured state to assess how far an individual may deviate from baseline performance in a concussed state” (Schmies, 2014, p. 7). As an athlete’s symptoms are being monitored, baseline testing shows if there is regression or progression of cognitive skills. Athletes should be withheld from contact sports

until they have returned to their academic baseline (Harmon et al., 2012), taking out some of the guess work from clearing athletes with TBI. A study by Echlin et al. of hockey players found that, “athletes tend to recover from perceived symptoms and their neurocognitive performance normalizes within 3-10 days” (2010, p.3). Utilizing a baseline test helps to pinpoint when that performance normalizes.

Certain considerations should be made when an athlete is returning to school or any other cognitive activities. The athlete should begin by taking time for cognitive rest. This means avoiding activities involving concentration, memory, attention, and mental focus (Schmies, 2014). This includes limiting screen time and giving the brain the time it needs to begin the healing process. The timing and rate of return to school should be monitored on an individual basis (Sady et al., 2011). It is also important that there is communication between the athlete’s school and medical professionals so everyone is aware of what the athlete can handle and how quickly or slowly they are progressing. It difficult, but vital to find, “a balance between what is too much for the student and how to progress them to a fully active day” (Schmies, 2014, p. 6). An athlete may also experience cognitive fatigue or problems with new learning (Sady et al., 2012), which should be considered in the accommodations made at school.

Sahler and Greenwald (2012) gave suggestions for adjusting during the school day, “reduced number of work assignments, more time to complete class work and tests, breaking down complex tasks into simple steps, and providing a distraction free area for work” (p. 5). It may also be helpful for the student to only attend for part of the day and work their way up to full days back at school. The more severe the concussion, the longer of a process cognitive recovery will take. Communication between the student, parents, teachers, and coaches will result in the best recovery plan for the student-athlete.

Not only is it important to monitor an athlete’s return to sports, it is also important that the athlete is not expected to do more school work than their brain is ready for. The amount of time it takes for a person to recover from a concussion depends on the severity of the injury (Sady et al., 2011, p. 3).



The best predictor of outcome is the length of the impaired state of consciousness after the collision and the duration of post-traumatic amnesia, if these are present (Russell, 1993). Severity of a concussion includes the type of symptoms present and the athlete's sensitivity to physical and cognitive exertion.

If an athlete sustains another head injury before the first one has fully healed, the risks of major complications and permanent damage are much greater. According to Giza and DiFori (2011), this is known as second impact syndrome (SIS), "a second brain injury that occurs before the symptoms of a prior injury have resolved, resulting in catastrophic cerebral edema and neurologic collapse" (p. 48). This is important for coaches to know so they do not take chances with head injuries in competition. Putting an athlete back in play after a head injury can have major consequences. This should be something coaches are educated about in training programs.

### **State Guidelines**

It is clear that head injuries that occur during sports need to be handled correctly for the safety of the athletes that sustain them. One body that can regulate this is state governments. I became aware of this because of my younger siblings who currently participate in high school sports. Iowa's Concussion Management Protocol was published by the Iowa High School Athletic Association (IHSAA) and Iowa Girls High School Athletic Union (IGHSAU). This protocol is consistent with the Heads Up four step action plan. However, it does have more specific guidelines. The first action that is required in this section of the Iowa Code is that a parent or guardian shall sign and return an information sheet to the school prior to the student's participation. Student athletes and their parents receive a handout called, "Heads Up: Concussion in High School Sports." This fact sheet defines concussion for parents, states their role to keep their child out of play until they are cleared by a licensed healthcare provider, and lists the signs and symptoms of concussions. The fact sheet also provides a list of signs often reported by students and signs observed by parents. Tips for helping the child prevent concussions are also included. There is also

a section for students. It states that students should tell coaches and parents if they think they have a concussion, get a medical check-up, and give yourself time to heal.

Another specific the Iowa code states, "No student should return to play/ competition or practice on the same day of a concussion." The code does state that returning to play should follow a stepwise protocol, this could be provided in the various training programs for coaches. Education of officials and coaches is mandated by this code, and states that the IHSA and IGSAU will provide a variety of educational materials related to concussions and brain injuries. This document also goes through specific steps to take when a student is removed from play for an injury, deciding whether or not a concussion is sustained, and returning to participation.

The state protocol also included a return to participation plan. The program outlined is very detailed. Before it lists the steps the protocol states the student should be asymptomatic at rest and with exertion as well as have written clearance from a licensed healthcare provider. It is also stated that progression to return should be determined on a case-by-case basis. The state outlined seven steps to returning to participation. First the athlete should complete physical and cognitive rest. The second step is return to school full-time or normal cognitive daily activities. Cognitive recovery is often overlooked in the discussion on concussions, so I am glad the state included it in their protocols. The third step is low impact, light aerobic exercise. Step four allows basic exercise, at step five the student can increase to non-contact, sport specific training drills. Step six allows full contact practice or training after gaining medical clearance. Finally, the seventh step is normal competition in a contest. This protocol requires at least 24 hours for each step. If any concussion symptoms return during any step the student should stop activity and see a licensed healthcare provider. It is also important to recognize that this is Iowa Code, so schools and coaches are being held responsible for the safety of their athletes. This is why concussion education programs are important and should be useful for the coaches who participate. I will also use

these guidelines to guide my analysis of the training programs. If they do not agree with state guidelines, they would not be an adequate source for coaches.

### **Protective Equipment**

A major way sports programs try to prevent or reduce the risk of concussions is by the use of protective equipment. An issue that is often talked about is concussions in football. Football helmet technology has evolved over the years and continues to improve. Over time a governing body has been established to regulate protective equipment in sports. The National Operating Committee on Standards for Athletic Equipment (NOCSAE) was established in 1969 (Bachynski & Goldberg, 2014). The need for this committee arose from the number of injuries in both football and hockey, some of which were fatal. The NOCSAE published the first safety standards on football helmets in 1973. Ever since then helmet companies and scientists alike have been working to improve helmet technology to protect against mTBI. It is important to remember that a helmet is only going to reduce the risk of concussions. Chuck Huggins, CEO of Xenith, a company that has recently patented a new design for football helmets even admits, "there is no such thing as a concussion-proof helmet" (Smith, 2014). One of the problems facing helmet manufacturers according to Sahler and Greenwald (2012) is that hard helmets protect against bony head trauma, such as skull fractures, but do not reduce the risk of brain injury. This is a very important function of a helmet, however there are other forces that need to be considered as well. It is vital that there is a continued search to find a solution to protect against both linear and rotational acceleration (Foster, 2013). Rotational forces are those that would result in a diffuse axonal injury (DAI). Sahler and Greenwald did a review on TBI in sports and discussed the use of helmets in contact sports. They found that "Helmets are primarily designed to reduce linear accelerative/ decelerative forces, not the rotational forces which cause the DAI and in fact may increase rotation forces experienced" (2012, p. 7). Most hits in football occur when an athlete is unbalanced, and likely resulting with impact at a

sideways angle creating in these multidimensional forces that move the brain. Companies are starting to find ways to protect the brain from these types of injuries.

One reason helmets may be lacking in their protection is the testing they are put through. The NOCSAE uses a vertical drop test. This test uses the helmet in question on a test dummy's head. A heavy metal arm is held five feet above the helmet and dropped. An accelerometer inside the head measures the linear acceleration transmitted during the impact. This has been the standard over the last forty years, since 1975. The problem with this is that if the correlation between linear and rotational acceleration is weak the current helmets only protect against linear acceleration (Foster, 2013). Unfortunately, most hits during competition do not come straight on like this test demonstrates, so more research is needed in this area.

One of the technologies being developed to protect against rotational acceleration as well as linear is being developed by Riddell, a leader in the helmet industry. They developed a system called Concussion Reducing Technology (CRT) in 2002 (Foster, 2013). The helmet they developed, the 560, had extra padding to the side and front impact areas that would attenuate energy upon impact. The problem with this is that it still does not offer extra protection from the rotating forces, but their claim is that the padding reduces linear forces and, "reducing linear forces will reduce the rotational forces" (Foster, 2013, p. 9). This claim may be true, but the correlation between the two forces is still unclear. This leaves much room for improvement.

A company from Sweden is working on a different approach. Their new approach is possible because they also have a new way of testing their helmets. The test consists of dropping the helmet onto a sled that moves horizontally. By changing the angle and height of the drop and speed of the sled, they can more accurately recreate the rotational acceleration present in sports collisions (Foster, 2013). Peter Halladin is a biomechanical engineer leading the development of a system called Multidirectional Impact Protection System (MIPS). Their developments are promising in the area of protection from

rotational acceleration because it “permits sliding to occur between the helmet and the head” (Piazza, 2014, p. 348). Foster (2013) explains it further, “the plastic layer sits snugly on a player’s head beneath the padding. By allowing the head to float during an impact, MIPS can eliminate some of the rotational force before it makes its way to the brain” (p. 10). When they compared two identical helmets, except the second one had the MIPS layer they found a 55% reduction in rotational acceleration. This is very promising for the development of helmets and the safety of athletes.

More recently Xenith, who was mentioned earlier, has developed similar technology that is becoming more widely available in the United States. Xenith is led by a former Harvard quarterback, Vin Ferrara, who also has an M.D. and M.B.A. Xenith’s helmet designs uses air cells as shock absorbers to minimize sudden movements during an impact (Lambert, 2010). Standard football helmets are lined with dense padding. Xenith’s design, however, includes “air cells that collapse and vent air to dissipate the energy of impact” (Lambert, 2010). This works similar to a car’s air bag design. Allowing the head to move more gradually upon impact will lessen the injury the brain may sustain. Xenith’s helmets are currently being worn by 100 NFL players as well as multiple college programs. A majority of their helmets (90%) are distributed to high school and youth leagues (Smith, 2014). Xenith shows that there is improvement in the helmet industry and it will only keep getting better.

Understanding that a concussion is an injury to the brain demonstrates the importance of knowledge on concussions surrounding youth sports. The consequences of responding to this kind of injury incorrectly could be much more devastating than other injuries. There is currently no protective equipment that will prevent concussions. In order to help protect athletes, State guidelines have been established. Because of this it is important the coaches are effectively trained to recognize and respond to concussions. Education programs are vital to the safety of athletes because there needs to be a reliable option that educates coaches fully on concussions in sports.

### **Research Question**

What types of education programs are available for coaches? What do they teach about prevention and recovery of concussions?

### **Methodology**

Head injuries can have major implications if they are not addressed appropriately from the beginning. This is why it is imperative that coaches are educated on concussions. I completed three online training programs in order to discover how coaches are being educated. I completed the ACTIVE program and the Heads Up program from the CDC that was mentioned in the literature review. I also completed a program through the National Federation of State High School Associations. All three programs I used were offered online and did not require any payment in order to complete them. I found some background information on each as well as broke down the components they each had in educating coaches on concussions.

It is important for coaches to be properly trained to recognize and respond to injuries that their athletes may sustain. It is exceptionally important with head injuries, including concussions. In the Glang et al. (2010) study on the ACTIVE training program they had a focus group of youth coaches to find what coaches expected from a training program. They concluded that training should:

“(a) stress the seriousness of concussion, especially in young people, (b) teach coaches that they can’t be too conservative in removing a child from play and that the ramifications for concussion in youth are long term, (c) teach coaches to recognize, not diagnose concussion, and (d) use brief video segments and professional athletes to communicate brief messages” (p. 4).

All of these are important components of a training program and I will compare the programs using these criteria. Each of these components are important to a training program. For example, if coaches are not able to recognize a concussion they will be able to make the right call when removing athletes from play. If all parts are not done well, the education program will not have fully done its job in preparing the coach to keep their athletes safe.

## Results

### ACTive

The first online training I took was ACTive: Athletic Concussion Training using Interactive Video Education. This training took about 20 minutes. I thought it was well organized. I also liked how they used videos, questions, and had resources so it was slightly interactive. For the short amount of time it took I thought it was very informative and useful for coaches. It also provided a lot of useful, printable resources. This program also pointed out important statistics. One statistic that stuck out was that only 1 out of every 10 concussions results in the person losing consciousness for any period of time. It also highlighted that concussions can occur in any sport at any age. Even though people most often associate concussions with football it is important for coaches to be looking for signs of concussions no matter what sport they are coaching. The program also stressed the importance of caring for a concussion in order to avoid a second injury. It mainly focused on the steps that should be taken for an athlete to return to play. They did mention that depending on the severity a medical professional may recommend that the athlete stay home from school for a few days as well.

ACTive was developed by the Oregon Center for Applied Science, Inc. (ORCAS), a healthcare technology company. They developed ACTive from recommendations from the National Athletic Trainers' Association and the International Conference on Concussion in Sport (Glang et al., 2010). They used the Health Belief Model to design the conceptual framework. This suggests that, "individuals will be more likely to take action if they perceive greater risk, if the danger seems serious" (Glang et al., 2010, p. 3). In order to develop the content and design the developers used focus groups and interviews with various professionals. They consulted physicians, neuropsychologists, public health professionals and certified athletic trainers who represented different athletic and community contexts. They had viewpoints from all types of professionals that would work with an athlete that has sustained a concussion. They also used many different professionals to deliver the message about concussions. The

information in the videos was presented by a sports medicine physician, a former NFL quarterback, a professional high school coach, and a volunteer youth coach. ACTive used many shorter videos to present the information as well as provided many resource documents. My overall impression of the ACTive training program was positive. Of the three programs I used, this was the easiest. It also only took 20 minutes, but I felt that it delivered the information the best as well.

### **Heads Up**

The second online training program I used was from the Center for Disease Control and Prevention. This course is called “Heads Up: Concussion in Youth Sports.” This program uses five sections to educate its viewers on concussions: concussion basics, recognizing a concussion, responding to concussions, getting back in the game, and concussion prevention. The CDC first published this program 10 years ago and it has been available online since 2010. Since then, an average of 25,000 to 35,000 individuals complete the training each month (“Heads Up in 10 Years”). This was set up similar to the ACTive program. There were multiple videos that presented the information. There were fewer videos in this program, but they were longer than the first program. The videos were narrated by a former Harvard football player and WWE wrestler who had to retire at age 24 due to concussions. Dr. Robert Cantu, a professor of neurosurgery at Boston University School of Medicine, also appeared in the videos. The information seemed very similar to the ACTive program. However the videos were less engaging, maybe because the acting was exceptionally overdone, and the quizzes in each section seemed lengthier than necessary. Overall, the information presented was adequate but was not presented in the best way. The videos in this program could be paused, but you could not navigate within the videos. This was troublesome because if a coach was watching these videos and wanted to repeat a certain bit of information, because it was very helpful or they had missed something, this would not be possible.

### **NFHS**



The final online concussion training program I completed was from the National Federation of State High School Associations (NFHS). This organization was founded in 1920 and develops education-based interscholastic sports and activities that help students succeed in their lives. They also work to build awareness and support to raise participation standards, including establishing consistent rules for competition. Keeping athletes safe and protecting them from concussion obviously fit under this mission. One thing this website does that the others did not was create a username. This allowed for a user to track what courses you have taken and go back and review the material. Not all courses from this organization were free, but the concussion course was. The content of this video once again echoed what was presented in the first two programs. At the end of this course they also ask the trainee to evaluate this course. This is good because this likely means that they work to improve the program and keep it up to date. This course was closer to thirty minutes in length, similar to the CDC. It also presented the information with videos followed by short quizzes. The videos were narrated by Dr. Mick Koester, who chaired the Sports Medicine Advisory Committee for the NFHS. NFHS partnered with the CDC Heads Up program to develop their own program, as a result these two programs were very comparable. It was a very easy program to use. I could navigate within the program's different sections and videos. There were the transcripts for each video section right below the videos. This ensured all information was accessible to anyone taking the program.

### **Course Comparisons**

Each of these courses presented very similar information. I divided the information into these main categories: concussion basics, recognizing a concussion, responding to concussions, returning to play, and prevention. Understanding each of these topics is vital to responding to head injuries during competition. The information in these categories would be necessary for any concussion training program to include in order for coaches to be prepared to respond to head injuries.

The first information that every video presented was basic knowledge on concussions. All three videos discussed what happens physiologically when a concussion is sustained. In all videos a doctor presented this information, this makes sense because it is the medical side of what happens in this injury. All three programs defined concussions as an injury to the brain that can occur from a jolt to the body, not just the head. ACTIVE pointed out the important statistic that 9 out of every 10 concussions, the athlete does not lose consciousness. Both ACTIVE and the CDC programs also revealed that kids are more vulnerable to these injuries, especially to second impact syndrome (SIS). The CDC and NFHS pointed out that concussions are serious injuries even though there may not be physical evidence such as bleeding or bruising. This is even true to the fact that concussions do not show up on CAT scans or MRIs. Finally, the ACTIVE program presented statistics that the other two did not provide. These statistics were presented in a matching game. This made the numbers of prevalence more memorable. It was good to see that even though football had the highest percentage; concussions are still prevalent in many other sports, both boys and girls. As you can see, these three programs had very similar information regarding basic concussion knowledge. ACTIVE provided extra information that helped to emphasize the importance of concussion education.

The second category of information I analyzed was “recognizing a concussion”. All three programs were consistent stating that there is no single indicator that an athlete has suffered a concussion. It is important to be aware of signs that can be observed by coaches and parents as well as symptoms that can be reported by athletes. The CDC program stressed the importance of observing athletes who were suspected to have a concussion because sometimes symptoms appear or worsen an hour or more after the original injury. The video used in the ACTIVE program for this section was presented by a long-time high school football coach. He stressed the importance of a coach knowing their players so they notice any changes that could be a result of a concussion. He even showed a clip of one of his games where a player was involved in a typical tackle during a high school game, and later

collapsed on the side lines. The coaches and trainers were aware of signs and symptoms of concussions and got him the medical attention he needed immediately. The athlete had a long road to recovery, but ultimately was able to recover thanks to the knowledge of preparedness of the coaching staff. I think this personal story drove home the seriousness of coaches' knowledge on concussions. The NFHS training program also had personal stories from athletes, it was not in the required videos, but was available in the resource section of the program. All programs presented the signs and symptoms in lists. For the CDC program you had to click through the lists in order to move on through the training. They also provided a printable clipboard reference sheet for coaches to keep with them. ACTive provided flashcards with pictures as an interactive way to present symptoms. An important phrase that was addressed when responding to concussions was, "when in doubt, sit them out." This was stated directly in all three programs. It makes it clear that concussions are injuries that should not be taken lightly. An aspect that was unique to ACTive was that they presented actual scenarios that would happen to athletes during a game or practice and the trainee had to respond whether or not they should be removed from play. It was a very good way to put what the videos were teaching to the test. The NFHS program highlighted best when to seek medical attention. They went through severe symptoms that would require a medical professional immediately.

The next area of concussions that was addressed by these training programs was "responding to concussions". The ACTive program integrated recognizing and responding to concussions very well. They did the best applying the recognition to response with the scenarios I mentioned previously. The CDC and NFHS programs recommended the Heads Up four step action plan as a guide to responding to concussions. The first step is to remove the athlete from play, recalling that "when in doubt, sit them out." The second step is to have the athlete examined by a medical professional. Even if coaches are trained to recognize a concussion it is important that a certified athletic trainer or medical professional do an assessment to determine whether or not a concussion has occurred and if so how severe is the

injury. Third, the coach must inform the athlete's parents or guardians about the suspected concussion and give them information and signs and symptoms they should be aware of. Finally, fourth, keep the athlete out of play until they are cleared by a healthcare professional. In order for the athlete to avoid further, or worsening their injury they should be recovered fully before entering back into competitive play. Both the CDC and NFHS programs highlighted the dangers of continuing to play with a concussion. The scenario presented in the video in the CDC program emphasized the importance of all these steps being followed up on, not just from a report from the athlete. If an athlete returns to activity too soon they are at risk of a second concussion, this injury could be sustained without a second impact.

The last step for an athlete that has sustained a concussion is for the athlete to return to play. All three programs stressed the importance that the athlete takes time to rest, physically and cognitively. The cognitive side can often be forgotten because it is an athletic injury, however due to the fact that the brain is injured it is important it rests as well. Remembering that different athletes will heal at different rates was also stressed throughout all programs. A recommendation that was made in the in ACTIVE program was to complete baseline testing for athletes. This would mean that athletes would complete cognitive tests before the season. If they were to sustain a concussion, they would repeat these tests. They would then have normative data specific to that athlete to best decide when the athlete can return to play as far as their cognitive recovery was concerned. The coach in the video said he was worried this would cause players to stay out longer, but in fact allowed them to return sooner since it took a lot of guessing out of returning to play. The CDC and NFHS programs presented five gradual steps for athletes returning to play after a concussion. These steps should be started once all other symptoms have ceased, and should be stopped if symptoms returned. The first step to returning to physical activity is to begin with light aerobic exercise, this could be 5-10 minutes on a bike or light jog. Secondly, the athlete can add activities that increase their heart rate and incorporate limited body or head movement. NFHS specifies that this step should not include equipment, including helmets. Next,

they can increase to heavy, non-contact physical activity. The fourth step is to reintegrate into full contact practice. Fifth and finally, the athlete can return into normal play. According to NFHS, this process could take as little as one week, but only one step can be done in a day. NFHS also provided specific return to play guidelines for all of the states that have mandated it.

The final topic that these three programs discussed was prevention of concussions. The NFHS program emphasized that we cannot eliminate the risk of concussion while participating in sports, but we can take steps to reduce the risk. ACTIVE focuses on education. The more coaches, athletes, and parents know about concussion, the better the outcome if a concussion occurs. The CDC points out the importance of parent education because they are the ones with the athlete after the practice or game. They would notice any delayed symptoms that present themselves later that night or over the weekend. Other steps that can be taken to minimize the risk of concussions is properly fitted equipment, good technique, and good officiating. It is also key to remember to sit the athlete out if there is any sign that they have suffered a concussion until they can be cleared by a healthcare professional. Even though concussions cannot be eliminated, these programs give suggestions for ways to decrease the risk that concussions pose to athletes.

These three training programs presented a plethora of great information about concussions. Although the set-up varied as well as the presentation of the information, they all presented the information necessary for a coach to become more aware of concussions. As well as how to recognize and proceed if a concussion is suspected.

### **Criteria for successful training programs**

Now I would like to refer back to the criteria listed originally for a training program. I have rated each program on these criteria in the table at the end of this section. Each program will be rated on a scale from 1-5. A 5 would be that program meets the criteria fully and a 1 being not at all. The first criterion was that a program must stress the seriousness of concussion, especially in young people.

ACTIVE received the highest score because they provided statistics that made concussions relevant in all sports. ACTIVE also had components such as a good definition and highlighting concussions as lacking in physical evidence of injury that the other programs also had. The CDC program was slightly better than NFHS because they added more stress of the seriousness in concussions for children. Through the videos and introduction of Second Impact Syndrome they had more emphasis on the importance of coaches being aware of their athletes.

The second criterion is to teach coaches that they cannot be too conservative in removing a child from play and they the ramifications for the concussion in youth are long term. An important point that all three videos made in regards to this criteria is, "when in doubt, sit them out." This is a great phrase to remind coaches that concussions are not something to be taken lightly. The ACTIVE program gave actual scenarios as an assessment at the end of this section, this gave coaches the opportunity to make the call to sit a player out in a very real situation, but before it involved real athletes. This application of the information was what set ACTIVE apart from the other two. The way the CDC and NFHS presented this information was equal. They both presented the information about removing an athlete from play. However, they did not include any real stories or application for this information.

Thirdly, the programs must teach coaches to recognize, not diagnose concussion. The ACTIVE program did the best educating coaches on recognizing a concussion. Just as they did with removing an athlete from play they provided real scenarios in their training. The CDC and NFHS did a better job specifically stating that it was not a coach's job to diagnose a concussion and medical professionals should always be seen if a concussion is suspected. I gave them each the same score because they were all lacking in something in this category.

The fourth criterion said that the programs should use brief video segments and professional athletes to communicate messages. As I have mentioned, ACTIVE presented the most effective information in many brief videos. As a user this made it much easier to pay attention to and retain the

information that was presented. They also used many different professionals to educate coaches. The CDC program was the worst because they used the longest video segments. Not only was this more difficult to attend to, but also not being able to navigate within the long videos made it more difficult to catch information that may have been missed. NFHS was in between the other two in this category. They used professionals as well. The videos were longer than ACTIVE's but were easier to navigate within. Although NFHS only used one professional in their videos, the briefer segments allowed the messages to be communicated more effectively.

Finally, I scored each program on how well it followed state guidelines. It turns out that all three programs were in compliance with Iowa's guidelines. This was important to examine because it would be a major issue if the laws differed from the training programs.

|        | Seriousness of concussion | Removing child from play | Coaches recognize concussion | Brief video segments | Compliance with state guidelines |
|--------|---------------------------|--------------------------|------------------------------|----------------------|----------------------------------|
| ACTIVE | 5                         | 5                        | 3                            | 5                    | 5                                |
| CDC    | 4                         | 3                        | 3                            | 1                    | 5                                |
| NFHS   | 3                         | 3                        | 3                            | 3                    | 5                                |

### Discussion

Now that I have outlined and compared the three different training programs I will discuss why I think ACTIVE is the best option for educating coaches. To begin, ACTIVE was set up in a way that kept me interested. There were many short videos in each section. One thing I found really helpful was that you could navigate within these videos. If you wanted to listen to a specific part again, you go back to re-watch that section. This was something that was very frustrating about the CDC videos. You could pause them, but you could not navigate backwards, you would have to watch the entire section again. There was also something interactive between most videos. These interactive sections including matching concussion statistics to the appropriate sport, deciding what to do in real scenarios, as well as multiple

choice questions about the information that was presented. At the end of each section there was a video that was usually thirty seconds to a minute long that recapped the whole section as well. This repetition really helps to commit the key points to memory.

ACTIVE's use of more videos that were shorter made it easier to pay attention to. The CDC and NFHS programs only took five or ten more minutes to complete, but the use of longer videos made it feel very long. The CDC videos showed more scenarios. I did not find most of these effective because they were portrayed in a way that was unrealistic and over the top. One of the scenarios included a soccer player that was involved in a collision. The player protested coming out of the game and said she was fine. This would normally be a completely plausible situation. The CDC video, however, used an athlete that seemed to be about seven years old. The athlete's response just did not seem to match up to their age. I do not think this was the time and place for overdone videos. However, this is a serious topic and coaches' time is valuable and should be used effectively.

Each of these programs also used quizzes at points in their training. ACTIVE only used multiple choice questions at the end of the program when they tested the information all together. As I said before, the beginning of the program used more interactive types of questions. For the activities in each section they put the information into a real life situation. This allowed the coach taking the training to start applying this important information in a way that could easily happen while they are on the field. The CDC quizzes were mostly multiple choice. It seemed to be a straightforward regurgitation of the information. This did not give coaches an opportunity to apply what they had learned. Also, for the signs and symptoms they presented a large list and asked to pick three options that were correct signs and symptoms. After submitting your answer, you find all options were correct. This did not seem like a way to check a person's understanding of or retention of new information. The CDC program also would ask questions within their videos. It would show up on the screen, but the narrator did not read it. Then after a long wait, the answer would show up on the screen for an extended period of time, again it was



not read. This also seemed to be an ineffective way to test someone's understanding of information. The NFHS program did not have any quizzes or activities within their training program. They did have a post test at the end. This post-test was very similar to the one at the end of the CDC program. I think having quizzes or activities that allow the coach to use the information throughout the program are beneficial. I believe this leaves a coach better prepared to use this information in real situations.

ACTIVE was the best program for educating coaches on concussions for many reasons. They utilized the time for the training most effectively. This program allowed coaches to apply the information in real life situations and allowed them to apply the knowledge they were gaining throughout the program. The CDC and NFHS programs did not vary significantly in the information presented, but ACTIVE was more engaging and applicable to coaches.

One aspect I had expected from the videos was that they would have more information on prevention. After my research in helmets I realized that prevention is not entirely in the coaches' control. Even with good tackling technique in football, concussions cannot be eliminated. All programs did bring up second impact syndrome (SIS) and the importance of taking precautions to ensure the athlete heals fully before returning to play, and SIS does not occur. The prevention section of these programs was typically where they presented return to play strategies for athletes. Following a plan and returning to play slowly is a key component to prevent an athlete from SIS.

### **Conclusion**

As you can see there is a lot to consider when dealing with concussions. Concussions will never be eliminated from sports. The biggest way that concussions are trying to be avoided is through the use of protective equipment such as helmets. They are making strides in this technology, but there is still plenty to do in this area. Concussion education of those around these student athletes, such as parents and coaches, is very important for the best outcome if an injury is suspected. Coaches are especially important as they are around the athlete at every practice and competition. Coaches should be trained

on what a concussion is, how to recognize it, how to respond, and finally how to return that athlete to play and school in a safe and effective manner. From the three training programs I was able to complete it was best when videos were presented in shorter increments. It was also more beneficial when the quizzes allowed for the coach to apply the information learned, as opposed to repeating the information that was just presented. State laws also help to enforce that coaches are able to respond to injury. Iowa state law requires coach education as well as mandates return to play protocol for athletes. From recognizing the injury to returning an athlete to play, coaches play an integral part in the success of their student athletes.

Considerations for future research could include, including a larger group of people to participate in the education programs as well as rating them in the criteria I used. This would show any trends that were occurring as well as confirm or contradict the scores I came up with. I would also be curious to ask coaches in Iowa schools what training they receive on concussions. This could bring to light other types of training other than online videos. Also, I would want to know how often coaches are trained or review information on concussions. Another way I that would help to compare the effectiveness of each program would be to different groups of people take each training course and a post- test. Then have them retake the post-test after a period of time to see if there was a program that coaches retained information from better. Overall, there is a lot more research to be done in concussion education programs for coaches.

There are two main considerations that should be made for concussion education programs from the research I was able to complete. First, any program should prepare coaches to recognize and react to a possible concussion. If a coach cannot identify situations where a concussion can occur their athlete's safety is at risk. If they cannot recognize a potential concussion, they will not make the right call to sit an athlete out. Any other step a coach could take for their athlete to have success after a concussion is irrelevant if a coach is unable to recognize the potential for concussions during a

competition. A coach's ability to recognize a concussion is the first step to eliminating the severe consequences of unrecognized and untreated concussions.

Second, proper steps need to be taken for an athlete to return to play after a concussion. A very important part of this step is seeing a medical professional. Coaches are not trained in diagnosing or clearing an athlete for concussions. With the consult of a medical professional, taking an athlete through the proper steps of returning to play minimizes the risk of worsening or reinjuring the original concussion. This also applies to return to cognitive function. It is important that training programs mention that recovery is also important for brain function. An athlete should not be rushed back into play in order for them to have the best success. Initial recognition of the injury and safely recovering from the injury are important parts of the education programs because they will cause the most severe consequences if handled incorrectly. Head injuries cannot be prevented, but having properly educated coaches will give athletes the best opportunity for success when sustaining and recovering from these injuries.

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