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CONCUSSIONS AND THE MARKETING OF SPORTS EQUIPMENT

HEARING

BEFORE THE

COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION UNITED STATES SENATE

ONE HUNDRED TWELFTH CONGRESS

FIRST SESSION

OCTOBER 19, 2011

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ONE HUNDRED TWELFTH CONGRESS

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CONCUSSIONS AND THE MARKETING OF SPORTS EQUIPMENT

WEDNESDAY, OCTOBER 19, 2011

U.S. SENATE,
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION,
Washington, DC.

The Committee met, pursuant to notice, at 2:34 p.m., in room SR–253, Russell Senate Office Building, Hon. John D. Rockefeller IV, Chairman of the Committee, presiding.

OPENING STATEMENT OF HON. JOHN D. ROCKEFELLER IV, U.S. SENATOR FROM WEST VIRGINIA

The CHAIRMAN. This hearing will come to order, and it is going to be an absolutely wonderful hearing.

There are actually 14 Senators in front of you. You just can't see all of them. It is something that we are working on with NASA. We become invisible at proper moments.

I am very proud that you are here, and I am very proud of our two Senators over here. This one, although you would never know looking at him, is a football player and—or was, I guess I should say. Yes.

Senator BOOZMAN. Two stadiums ago.

The CHAIRMAN. There you go. So I am going to make an opening statement, and then I wish each of them would. We try to keep it brief because we want to have plenty of time for you to talk and for us to question.

I am so grateful for all of you being here, all of you. This is a massive subject. The story which I may tell about my son reveals that parents can't always be as effective as they would like to be. I haven't decided whether to do that or not, whether it is an invasion of his privacy. But you can advise me when you give your testimony.

So, anyway, every afternoon at the end of the school day, millions of our children head to playing fields, gymnasiums, or hockey rinks to participate in team sports. I should have said soccer fields, too. Playing sports doesn't just make our kids stronger and healthier. It also teaches them important values. They learn about hard work, about leadership, about living with pain and going through it, about working together for a common goal.

The camaraderie that comes out of sports units is wonderful to see. It is real, and it lasts forever. Most of our young athletes will not end up playing sports at the collegiate or professional level, but we hope they will all carry the positive lessons they have learned on the playing fields with them throughout life, and they will.

So our hearing today is about the head injuries that tens of thousands of these athletes sustain every year while playing the sports they love. Many of us are reluctant to talk about the risks involved in playing sports because we know what a positive role that sports play in our communities.

On the other hand, the last thing we can do here is not talk about this problem of concussions and gear and all the rest of it. I mean, America has to have this conversation, and there will be many, many hearings on it, I know.

In fact, more of our children should be playing sports, not fewer. Too many kids are spending their afternoons in front of computer or televisions screens, instead of on the sports field. And that is said every day by everybody who is involved in healthcare. I am going to give you a couple of pathetic figures.

According to the latest data compiled by the Centers for Disease Control, only 17 percent of American high school students get an hour of daily physical activity, which is our current health guidelines. They say that, that you need to have that to stay healthy—only 17 percent. One-third of our children are now overweight or obese, which makes it more likely that they will suffer from chronic health conditions, such as heart disease or diabetes, things which will plague them for the rest of their lives as, indeed, what we will be talking about today could do to some.

But the risks involved in playing sports are also very, very real. And by now, we have all heard about the National Football League players who are struggling with serious mental and physical health problems because they sustained repeated mild traumatic brain injuries, which is what concussions are called, I guess, medically, during their playing years. And it is very, very sad.

I mean, I have seen a number of these players, people that I had worshipped growing up, in wheelchairs. Who was the guy that played—he was a cornerback for the Raiders? The greatest interceptor of all time, Woody—come on, give me——

No. No. Doesn't matter. Doesn't matter.

[Laughter.]

The CHAIRMAN. But I mean, it was awful. I was at an event with him, and he was seated in a wheelchair, and he couldn't even pull his head up. And I leaned down and whispered in his ear. I think I kissed him, too. I am not sure. But it was having seen from this to that and who knows, especially this was 8 years ago. Nobody was talking about it.

We now understand, however, that this is not an injury only NFL players can suffer. According to research conducted at the Nationwide Children's Hospital in Columbus, Ohio, more than 70,000 high school football players sustain concussions every single year.

And it is not just a football problem. One of our witnesses today, Alexis Ball, will talk about the concussions she suffered while playing soccer in high school and college. According to Nationwide Children's Hospital, more than 10,000 high school girl soccer players sustain concussions each year.

So what we are going to do is we are going to hear from Ms. Ball and our other witnesses today, who I should name. Dr. Jeffrey Kutcher. Jeffrey, you are not in my opening script. So I have to do this, and you forgive me. Associate Professor, Department of Neu-

rology, University of Michigan; Director, Michigan NeuroSport. And Dr. Ann McKee, Professor of Neurology and Pathology at Boston University and Director of Neuropathology Core, BU Alzheimer's Disease Center. I guess that is Boston University's. And Mr. Mike Oliver, who is Executive Director of the National Operating Committee on Standards for Athletic Equipment.

We welcome all of you, and I will just close right there and ask if the Chairman of the Subcommittee would wish to say something because he has been just terrific on this subject and also the Ranking Member.

Go ahead.

STATEMENT OF HON. JOHN BOOZMAN, U.S. SENATOR FROM ARKANSAS

Senator BOOZMAN. Well, thank you, Mr. Chairman, again for us holding this very important hearing this afternoon.

As a former player, it is certainly something that I am interested in. But also there are so many moms and dads and coaches and players all across the country that also are very interested and probably should be more interested than what they realize. And I think that is the great thing about having this hearing is to try and get that information out and really discuss a potential very serious problem. Not a potential very serious problem, a very serious problem, period.

Sports play a vital role in development of young men and women. They help build youth social relationships and learn to work as a team while keeping them physically active and healthy and having fun. According to the National High School Sports-Related Injury Surveillance Study, participation in high school sports has almost doubled in the last 30 years.

This is fantastic news, and I think it is important for us to highlight the benefits of playing sports. However, participation in athletics does carry with it significant risk of injury. Just last week, there was news of a tragic death of a 16-year-old high school football player who died after sustaining a head injury during a game.

It is important that everyone—coaches, parents, physicians, and the athletes themselves—understand those risks and be able to identify injuries when they occur. Concussions especially have the potential for severe injury, and multiple concussions can cause significant repercussions later in life, as we are going to hear about today.

Especially with many recent media reports of high-profile incidents in the NFL, we often associate football with concussions. As I am well aware and as Mr. Threet will mention in his testimony, concussions are a risk with playing football, but players in many sports run the risk of sustaining concussion, as we will hear from Ms. Ball in her story about playing soccer.

It is imperative for coaches and parents involved in all sports to be aware of the dangers associated with concussions, know how to recognize the signs and symptoms and what to do if a player suffers a concussion. I look forward to hearing from Dr. Kutcher and Dr. McKee about the research to further the knowledge that we have about concussions, but many questions remain as to the

causes and effects of concussions. I am very interested in hearing from the experts on what is known and where we can go from here.

As we will also discuss, there is a wide variety of athletic equipment on the market that claim to use concussion-reducing or concussion-preventing technology. Parents want to keep their children protected, but navigating the many products and claims in the marketplace, especially online, can be overwhelming. It can be easy to read that something offers the best maximum security protection and assume that their child will be safe from injury. That is simply not true.

Some products may offer better protection than others, but we need to explore what resources exist to help parents and coaches know what level of safety a product will actually provide. I also do not know how the average parent or coach can be confident that the equipment they purchase genuinely offers a greater safety benefit or if its advertisement contains misleading or deceptive claims. I hope our witnesses today will be able to help me answer this question.

Along with knowing the safety benefits and limitations of sports equipment, parents and coaches need to educate themselves on what to look for in the event that an athlete has a potential concussion. There are a number of different materials available for this purpose. Perhaps the most well-known education effort is the "Heads Up" initiative, led by the CDC in partnership with dozens of professional organizations and individuals.

Individual associations, like USA Football, also have their own education campaigns for coaches, how to teach proper execution of plays and tackles so athletes are in as little danger as possible. However, education campaigns must be effective in order to effect change. I am interested to learn if there is data that shows whether these efforts are reaching a wide enough audience and promoting awareness sufficiently.

Mr. Chairman, I know today's hearing will draw attention to this important safety issue. Parents, coaches, and athletes must have the resources available to them to understand the severity of concussions and how to react when one occurs. As I said earlier, the benefits from participating in sports are many, and I hope that the potential for injury does not prevent anyone from playing.

Mr. Chairman, again, I thank you for calling this very important hearing and look forward to hearing from our witnesses. I ask unanimous consent that a statement from the Sporting Goods Manufacturers Association and USA Football be in the record.

The CHAIRMAN. It is so done.

[The statement can be found in the Appendix.]

Senator BOOZMAN. And with that, I yield back.

The CHAIRMAN. I thank the Senator and call upon Senator Udall, who has been huge in putting together all of this.

STATEMENT OF HON. TOM UDALL, U.S. SENATOR FROM NEW MEXICO

Senator UDALL. Thank you, Chairman Rockefeller, and thank you for that nice comment.

And I very much appreciate you holding this hearing today. I would like to say a few words and ask that my full statement be

put in the record. And Mr. Chairman, I greatly appreciate your efforts to promote brain research and, as Chairman of this Subcommittee, your close attention to consumer protection issues.

Concussions used to be dismissed as simply "dings" or "bell-ringers." We know now that a concussion is a form of traumatic brain injury that should be taken seriously. According to a recent Centers for Disease Control report, emergency room visits for sports and recreation-related traumatic brain injuries increased by 60 percent among children and adolescents over the last decade.

The CDC attributes this rise to greater concussion awareness, which is a good thing. Now that athletes, coaches, and parents have a better understanding of concussions, some sports equipment makers appear to be taking advantage. There are a number of so-called "anti-concussion" and "concussion-reducing" devices on the market.

While we should encourage any innovation to protect young athletes, we need to make sure that advertisers play by the rules. Expert witnesses today can shed some light on "anti-concussion" claims used by some sports equipment manufacturers.

Although we now know more about the dangers of concussions, we shouldn't forget how important sports and physical activity is for children. The CDC estimates that only 18 percent of American high school students participate in at least 1 hour of physical activity a day. That is the amount recommended by the Department of Health and Human Services.

Among high school students in New Mexico, only 23 percent are getting it. This could lead to negative health consequences that last a lifetime. So we need to encourage kids to play sports, to exercise, and to be more physically active. Injury is always a risk, but the benefits far outweigh the dangers. And as we learn more about the dangers of concussions for young athletes, we can take steps to make sure that they are played more safely.

I want to thank all the witnesses for being here and testifying today. I especially want to recognize Ms. Alexis Ball, who traveled from Albuquerque to share her experience with sports concussions.

In reviewing Dr. McKee's testimony, I find it especially poignant that she discusses Dave Duerson, a former NFL player who tragically took his own life earlier this year. In 2007, he testified before this committee. According to news reports, Duerson informed his family that he wanted his brain to be studied. He hoped people could learn more about the effect of brain trauma so kids could play football more safely in the future.

In keeping with this sentiment, I hope that this hearing today will advance the goal of making sports safer for our children.

With that, Chairman Rockefeller, thank you very much, and thanks for being here and the Ranking Member for being here. Appreciate it.

The CHAIRMAN. That is a pretty powerful statement.

Senator UDALL. Thank you.

[The prepared statement of Senator Udall follows:]

PREPARED STATEMENT OF THE HON. TOM UDALL, U.S. SENATOR FROM NEW MEXICO

Concussions used to be dismissed as simply "dings" or "bell ringers." Today we know that a concussion is a form of traumatic brain injury that should be taken

seriously. For young people between 15 and 24 years old, playing sports is the second-leading cause of traumatic brain injury—second only to motor vehicle crashes.

According to a recent Centers for Disease Control and Prevention (CDC) report, *Nonfatal Traumatic Brain Injuries Related to Sports and Recreation Activities Among Persons Aged ≤19 Years—United States, 2001–2009,* emergency room visits for sports and recreation-related traumatic brain injuries increased by 60 percent among children and adolescents over the last decade. The CDC attributes this rise to greater concussion awareness, which is actually a good thing.

Now that athletes, coaches, and parents have a better understanding of concussions, some sports equipment makers appear to be taking advantage of their new concerns about safety. There are a number of so-called "anti-concussion" and "concussion reducing" devices on the market—from helmets and headbands to mouth guards, and even dietary supplements. While we should encourage any innovation to protect young athletes, we need to make sure that advertisers play by the rules. Claims they make about the safety of their equipment should be truthful and not misleading. Expert witnesses today can shed light on some of these concussions-related claims, and I look forward to hearing their testimony.

Earlier this year, I asked the Federal Trade Commission (FTC) to investigate some of the safety claims used to sell football helmets. Given the seriousness of concussion risk and the potential for real injury to children, the FTC should have the ability to impose civil penalties, at the agency's discretion, for any violation of the FTC Act that involves the use of false injury prevention claims to sell children's sports gear.

I also introduced legislation. This bill, the *Children's Sports Athletic Equipment Safety Act,* would allow the FTC to impose civil penalties for using false injury prevention claims to sell any kind of children's sports equipment. Again, under my bill the use of this enforcement power would be at the agency's discretion. It would also require improvements to the current voluntary safety standard for football helmets. I am pleased to be working on this important legislation in a bipartisan manner with Representatives Bill Pascrell and Todd Russell Platts, the Co-Chairs of the Congressional Brain Injury Task Force. I also want to thank fellow Commerce Committee member Sen. Lautenberg for his support and co-sponsorship of the legislation.

I believe it is important to share with my Commerce committee colleagues some of the potentially misleading advertising that is used to market so-called "anti-concussion" and "concussion reducing" sports gear for children's use.

My January 4, 2011 letter to FTC Chairman Jon Leibowitz cited several troubling advertisements for youth football helmets in particular. For example, one troubling claim comes from Riddell, the leading helmet-maker in the country. Riddell continues to use a concussion reduction claim that appears to be deceptive, misleading, and unsubstantiated.

The CEO of Riddell, Dan Arment, told the House Committee on the Judiciary at a January 4, 2010 hearing on "Legal Issues Relating to Football Head Injuries" that:

> "We have independent, peer-reviewed, published research in the medical journal Neurosurgery, February of 2006, showing that the Revolution [helmet] reduces the risks of concussions by 31 percent when compared to traditional helmets. . . . Today, over one million high school, college, and professional players have made the switch from traditional helmets to the Revolution family of helmets." (See also "House Judiciary Committee hearing—Dan Arment opening statement." Video recording. Available at *http://www.youtube.com/watch?feature=player_embedded&v=v1gmwk2nqi4* accessed Oct. 19, 2011)

Riddell bases this claim on a single study of high school football players using brand new Riddell Revolution helmets compared with players wearing used and reconditioned helmets of unknown condition. Scientists who commented on the article cautioned against drawing broad conclusions from a single study that compared the performance of new helmets with used headgear of unknown condition and that examined just 136 high school players who experienced concussions.

Nevertheless, Riddell launched a media campaign featuring the claim from the 2006 study that, according to its "Riddell Revolution UPMC Media Campaign Highlights" video news release, created "over 60 million media impressions, nearly 150 television placements, over 100 newspaper clips, over 250 on-line placements, [and] 6 live sports radio interviews." (See *http://www.riddell.com/pressreleases_upmcstudy/,* accessed Jan. 6, 2011.)

Several helmet and sports safety experts have criticized Riddell's use of this concussion prevention claim to sell Revolution type helmets. In his 2007 book, *Head Games: Football's Concussion Crisis from the NFL to Youth Leagues,* Chris Nowinski notes that:

> "As it is well established that rotational forces have a major role in football concussions, and that football helmets do little to reduce those forces, we could skip the discussion of the benefits of the newest football helmets, the Riddell 'Revolution' and the Schutt 'DNA.' If they make any difference it all, it would be minor. But. . .. both these companies are spending a lot of money to get you to buy these newer and more expensive helmets. You deserve to know what's really going on."

In his book, Nowinski also quotes Dr. Robert Cantu, a board member of the National Operating Committee on Standards for Athletic Equipment (NOCSAE), who told him that:

> "The theory behind the [Riddell] 'Revolution' is that if you build a helmet that's a little bit bigger, especially in the temple area, and padded more thickly, then you'll reduce force more than you would if you had thinner padding and not so big an outer shell. That theory is good for blows that go right to the temple, but that's it."

NOCSAE's technical director, Dave Halstead, told the *New York Times* in an October 27, 2007 story titled "Studies for Competing Design Called Into Question" that ". . . the [Riddell] Revolution is a good helmet. . . . But I have problems with that particular [2006 *Neurosurgery*] study. The helmet is not shown to do what they say it does." In another October 21, 2010 *New York Times* article titled "As Injuries Rise, Scant Oversight of Helmet Safety," Halstead bluntly told reporter Alan Schwarz that ". . . I don't believe that 31 percent [reduction in concussion risk claim] for a Yankee minute." These public statements from one author of the 2006 study and other helmet safety experts call into question whether there is competent and reliable scientific evidence to substantiate Riddell's marketing claim.

Moreover, Riddell advertisements cited in my letter to the FTC do not disclose that the company provided a grant to underwrite the 2006 *Neurosurgery* study. Nor do they disclose that Riddell's vice president of research and development, Thad Ide, was one of the study authors. An official *Neurosurgery* commenter highlighted the authors' conflicts of interest and stated that the study's conclusions "should be interpreted accordingly." Nevertheless, this claim has been extensively used in Riddell marketing of high school and youth helmets.

Here is just one example taken from the website of Riddell's parent company, Easton Bell, that does not disclose Riddell's role in funding and writing the 2006 study:

> "An extensive long-term study by the University of Pittsburgh Medical Center was published in the February 2006 issue of Neurosurgery. The results were impressive: Players wearing the Riddell Revolution® football helmet were 31 percent less likely to suffer a concussion than athletes who wore traditional or standard football helmets. For athletes who had never suffered a previous concussion, wearing the Riddell Revolution® decreased their relative risk of concussion by 41 percent. . . .* * NEUROSURGERY, FEBRUARY 2006, VOL. 58, NO. 2" (See *http://www.eastonbellsports.com/brands/riddell,* accessed Oct. 19, 2011).

The same Easton Bell webpage includes an image of a Riddell Revolution Speed helmet with the claim that "[r]esearch shows a 31 percent reduction in the risk of concussion in players wearing Riddell Revolution helmets when compared to traditionally designed helmets.* *NEUROSURGERY, FEBRUARY 2006, VOL. 58, NO. 2." (See image at end of statement.)

Riddell also uses its reduced risk of concussion claim to sell youth helmets that were not actually tested in the 2006 study of high school football players. For example, Riddell's online store advertises the Riddell Revolution Youth football helmet with the claim that research shows a 31 percent reduction in the risk of concussion when wearing the Riddell Revolution helmet compared to traditional helmets. This webpage does not disclose that the youth helmet was not actually included in the published study:

> Based on the same technology that made the varsity Riddell Revolution® helmet possible—we offer in a Youth version—the Riddell Revolution® Youth. . . . After an extensive long-term study by the University of Pittsburgh Medical Center was published in the February 2006 issue of Neurosurgery. The results were impressive: research shows a 31 percent reduction in the risk of concussion in players wearing a Riddell Revolution football helmet when compared to traditional helmets.* * NEUROSURGERY, FEBRUARY 2006, VOL. 58, NO. 2" (See *https://shop.riddell.com/riddell/app/displayApp/%28cpgsize=20&layout=7.0-7_2_3_75_12_13_67_77_6_4_5&carea=0000000002&cpgnum=1%29/.do?rf=y,* viewed Oct. 17, 2011)

Since concussion risk may differ depending on the age group and skill level of players, the results of a single study of high school football players may not be valid for younger children, especially if they wear a different helmet not used in the study. That the youth helmet was not actually tested in the 2006 *Neurosurgery* study may be a significant omission in such marketing claims used by Riddell and other retailers to sell Revolution youth helmets.

As the official helmet of the National Football League (NFL), Riddell also highlights the use of its products "by the pros" when marketing helmets for high school and younger players. I am concerned by some of the product testimonial claims from one NFL head athletic trainer, Tim Bream of the Chicago Bears, who states in a Riddell Revolution Video News release titled "Riddell Revolution UPMC Media Campaign Highlights:"

> "We've had some players who have had ongoing problems with head injury, and we made the switch to the new protective headwear when it came out, at its inception. And these players have had no problems since then, or no repeated concussions."

Bream does not name the players who "had ongoing problems with head injury" before switching to Riddell Revolution helmets. However, the NFL Injury Report website and news articles discussing head injuries suffered by Chicago Bears players during the 2010 football season seem to contradict the claim that wearing the Riddell Revolution helmet prevents all repeated concussions. Three Chicago Bears players who are listed as having head injuries during the 2010 season seem to be wearing Riddell Revolution helmets in press photos. Even if this Riddell Revolution testimonial claim of "no repeated concussions" were true at the time the video was made, one can question whether those who buy the Riddell Revolution helmet for youth or high school players would see similar results of "no repeated concussions."

Riddell uses additional endorsements from this athletic trainer in a January 9, 2006 press release titled *Research Shows Riddell Revolution Football Helmet Provides Better Protection Against Concussions* (available at: *http://www.riddell.com/wp-content/uploads/2006_UPMC_Press_Release_web3.pdf,* accessed Oct. 19, 2011) and a 2006 Riddell brochure titled *Revolution Helmet Research Findings* (available at: *http://www.lohud.com/assets/pdf/BH1661391028.PDF,* accessed Oct. 19, 2011). In the brochure, Bream states that the "new data [from the 2006 *Neurosurgery* study] helps our players make an informed choice when deciding which helmet is best for them."

Coaches and athletic equipment managers for youth and high school teams with players who have suffered concussions might also be particularly susceptible to such injury prevention claims. The *Orlando Sentinel* newspaper's Varsity Sports blog reported on October 17 that one high school football coach and athletic trainer issued a fundraising appeal to buy 60 new Riddell helmets that are "the most-up-to-date . . . concerning concussion reduction technology" since he is concerned about team athletes with multiple concussions. He told the Varsity Sports blog that:

> "In the last three years, we have had eight concussions on the football team. . . . What brought us to this point is we have a player who has had a second concussion and of course there is [former South Sumter linebacker] Your highness Morgan [a junior] at Florida Atlantic University but he can't play because he has had three concussions in the last two years. We're afraid we are putting our kids at risk. There are recent studies that have shown multiple concussions can lead to a lifetime of medical problems. It's twice the price of the helmets we are wearing now and it's a lot of money to ask a small community to raise but truly, I'm not sure how you cannot afford to get these helmets." (Available at *http://blogs.orlandosentinel.com/sports_highschool_varsity/2011/10/17/south-sumter-raising-money-for-new-helmets/,* accessed Oct. 19, 2011.)

New Riddell helmets may be very good products. It may also be advisable for this team to replace its old helmets with new headgear. Yet there are still real dangers to overstating the ability of children's sports equipment to prevent brain injury, particularly to coaches and parents of young athletes who have already suffered multiple concussions.

Unfortunately, misleading "anti-concussion" claims appear in advertisements for more than just football helmets. There are other troubling examples of children's sports equipment sold with concussion prevention claims. Although there is evidence that wearing properly fitted mouth guards reduces the risk of dental injuries, Dr. William Meehan, director of the Sports Concussion Clinic at Children's Hospital Boston, writes in his 2011 book *Kids, Sports, and Concussion: A Guide for Coaches and Parents* that any "effects of [custom mandibular orthotics] and other mouth guards on concussions remains unknown."

Such uncertainty about the ability of mouth guards to prevent concussions does not keep some companies from using concussion reduction claims to market mouth guards for youth and high school athletes. The product packaging for the Brain Pad Lo Pro+ junior mouth guard, which is sold for athletes aged eleven years and under, prominently states that it "Reduces the Risk of CONCUSSIONS!" and "Creates this: BRAIN SAFETY SPACE!" On its Brain Pad Blog, the company highlights in a banner image the claim "BioMechanically Tested and Proven to Reduce Concussions Risk by 40 percent!" (*see: http://blog.brainpads.com/,* accessed Oct. 19, 2011).

In Brain Pad's online video advertisement titled *Head Trainer announces "Zero concussions with Brain Pad mouth guards!",* a head athletic trainer "at one of the top 5 private [high] schools in the country" who is "responsible for the well-being of 800 student athletes at the school" states that:

> "We've been using the Brain Pad since 1995. In all those years, whenever I go out on the field, especially if somebody has a potential of a concussion, I always check to see what type of mouth guard they're wearing. And I have never, ever seen anybody wearing the Brain Pad and having a concussion. . . . Since 1995, my experience with this mouth guard preventing concussions has been absolutely awesome." (see *http://www.youtube.com/user/brainpads#p/u/3/mtg1EF6LdVQ,* accessed Oct. 17, 2011.)

Similar to the Riddell Revolution helmet video described above, this testimonial claim of no concussions among student athletes wearing the Brain Pad mouth guard seems to imply that those who purchase the product will have similar results. This could lead to young athletes putting themselves at greater risk of head injury if they believe that they will never suffer a concussion while wearing the Brain Pad mouth guard.

Another company makes the "Tap Out Youth Mouthguard" for ages 5 to 11 years. The back of the product packaging states that the mouth guard has a "Concussion Defense System backed by a $30,000 Dental Warranty." Although this Tap Out mouth guard claim is not as prominent as the previously cited claims for the Brain Pad mouth guard, it is not clear how the product's "Concussion Defense System" actually protects children from sports-related head injury.

There are also sporting goods companies that sell protective headbands for soccer players with potentially misleading concussion prevention claims. Dr. Meehan notes in *Kids, Sports, and Concussion: A Guide for Coaches and Parents* that although many headbands advertise the ability to reduce the risk of concussion, there is little medical evidence to support this assertion.

The website for ForceField FF headband describes concussions as a problem in soccer and notes that their headband "can come between you and a head injury" (*see image at end of statement*). The company website states that:

> "Research on concussions in soccer has shown that soccer players have concussion rates similar to football and ice hockey. . . . The ForceField FF Headband will reduce the risk of head injury when exposed to any type of external force." (See *http://www.forcefieldheadbands.com/sportrelated.html* accessed Oct. 17, 2011)

Another webpage indicates that the result of wearing the ForceField headband is a "[s]ignificant reduction of the risk of head injuries when exposed to all types of impacts" (available at: *http://www.forcefieldheadbands.com/rationale.html,* accessed Oct. 17, 2011). The company also markets this headband specifically for use by young children (*see: http://www.forcefieldheadbands.com/children.html,* accessed Oct. 17, 2011).

Full90 Sports sells other "performance headguards" to protect against concussion in soccer. The company's online store claims the F90 Performance Headguard's "ForceBloc foam reduces impact force by up to 50 percent, meaning fewer concussions overall and a reduction of severity of injury." The company further states that an unnamed "recent study" found that "college players not wearing a Full90 Performance Headguard were 2.65 times more likely to receive a concussion than players that did." (See *http://www.full90.com/products/protect/club/* accessed Oct. 19, 2011).

Full 90 Sports' website also includes a product testimonial from a pro soccer player supported by a photo apparently taken moments after he collided with another player. Wearing Full90 headgear, the player looks at his opponent who, not wearing any headgear, appears injured on the ground. The quote accompanying the image is as follows:

> "We don't know exactly how much [the headgear] reduced the force of [the impact] but I just thank God . . . I was wearing that thing because I might not

> be here talking to you had I not worn it. (available at *http://www.full90.com/players/pro/* accessed Oct. 19, 2011. See also image enclosed at end of statement.)

Although this photo and testimonial statement may accurately convey the player's honest belief in the protective properties of Full90 headgear, it is questionable whether there is a reasonable basis to claim that such soccer headgear actually reduces the likelihood and severity of brain injury to any degree.

Such concussion prevention claims used in advertising for a variety of children's sports equipment are very concerning. Paying for a product that does not work as effectively as advertised is bad enough. It is far worse when a product sold for children's use might actually increase the risk of brain injury due to a false sense of security. Enacting the *Children's Sports Athletic Equipment Safety Act* would discourage companies from misleading coaches, parents, and young athletes.

Unfortunately, one even finds similar, potentially misleading concussion claims in marketing for dietary supplements for children's use. Newport Nutritionals sells Sports Brain Guard, a "[d]aily tri-delivery bioactive protection program" that "help[s] protect your brain from concussion injury" (see *http://www.sportsbrainguard.com/* accessed Oct. 19, 2011; See also *image at end of statement*). Elsewhere on the website, Sports Brain Guard claims to "maximize the brain's ability to heal and reduce inflammation." While this claim may be true, it is not clear that there is enough scientific evidence to date to substantiate that this dietary supplement actually protects the brain from concussion.

Moreover, the net impression of the product's advertising may improperly convey the message that athletes who are concussed or recovering from the lingering effects of concussion can safely "stay in the game" by taking Sports Brain Guard supplements. This "stay in the game" advertising slogan, which is used throughout the product's website, contrasts with the concussion safety and awareness efforts promoted by the CDC and various sports leagues. In fact, the CDC recommends that concussed athletes never return to sports activities "the day of the injury and until a health care professional, experienced in evaluating for concussion, says they are symptom-free and it's OK to return to play" (see *http://www.cdc.gov/concussion/what_to_do.html,* accessed Oct. 19, 2011).

Yet, despite all this, elsewhere on the site, Newport Nutritionals also prominently announced on the product's homepage that Sports Brain Guard is "Recommended by Dr. Joseph Maroon—Expert in head Injury treatment, Heindl Scholar in Neuroscience, [and] Team Neurosurgeon for the Pittsburg Steelers" (See Sports Brain Guard website from Feb 10, 2011. Internet Archive Wayback Machine. Available at *http://web.archive.org/web/20110210114509/http://sportsbrainguard.com/,* accessed Oct. 19, 2011). In a separate webpage highlighting his expert endorsement, Maroon states:

> "Over the past 30 years, as a practicing neurosurgeon, I have treated thousands of athletes with sports related concussions—players from the NFL, NHL, NBA, NCAA and all the way down to kids playing youth sports. . . . I have personally recommended [this] product, *Sports Brain Guard*, to athletes at all levels following concussions." (See *http://www.sportsbrainguard.com/maroonmsg.aspx,* accessed Oct. 19, 2011 and see also image at end of statement)

This kind of testimonial in support of the product from a doctor who has worked in the field of sports concussion is very concerning. It is seems to be intended to provided a level of consumer confidence in the efficacy of Sports Brain Guard supplements that does not appear to be justified by scientific data.

Also of great concern, the product website homepage includes a "Notice to Parents" about children and concussion risk that seems to indicate that this product is sold for use by young athletes (See *http://www.sportsbrainguard.com/,* accessed Oct. 19, 2011; see also image at end of statement). Given the intent seems to be to sell for use by young athletes, it is even more important that the product advertising claims are accurate and supported by scientific evidence.

There are undoubtedly more examples of "anti-concussion" and "concussion reducing" products marketed for children's use. The examples cited above, however, demonstrate that this is already a problem that could become even worse as awareness of sports concussion increases. As we continue to look for the best ways to tackle the problem of sports concussion, we should work to take false advertising out of the game. I hope that responsible sporting goods manufacturers and sports leagues—which are already working to improve concussion awareness among athletes, coaches and parents—will also join in this important effort.

In conclusion, I want to emphasize the very positive role of sports for individuals and our society. Although we now know more about the dangers of concussion, we

must not forget how important physical activity and sports are for children. The CDC estimates that only 18 percent of American high school students participate in at least one hour of physical activity a day. That is the amount recommended by the Department of Health and Human Services. Among high school students in New Mexico, only 23 percent are getting the recommended amount of physical activity. This could lead to negative health consequences that last a lifetime.

We know that physically-active youth have lower rates of body fat, better cardiorespiratory fitness, stronger muscles and bones. They also have less anxiety, stress, and depression. As highlighted in HSS's *Physical Activities Guidelines for Americans,* the bottom line is that the health benefits of physical activity far outweigh the risks of adverse events for almost everyone.

So we need to encourage kids to play sports, to exercise, and to be more physically active. As we learn more about the dangers of concussions for young athletes, we can take steps to make sure sports are played more safely.

Enclosures:

1. Image from Easton Bell website, available at *http://www.eastonbellsports.com/brands/riddell,* accessed Oct. 19, 2011.

2. Image and testimonial statement from "Riddell Revolution UPMC Media Campaign Highlights" video news release available at: *http://www.riddell.com/press releases_upmcstudy/,* accessed Jan. 6, 2011.

3. Image of product packaging (top front) for Brain Pad Lo Pro+ junior mouth guard.

4. Image of product packaging (back) for Brain Pad Lo Pro+ junior mouth guard.

5. Image from ForceField FF Headbands website, available at *http://www.force fieldheadbands.com,* accessed Oct. 19, 2011.

6. Image from ForceField FF Headbands website, available at *http://www.force fieldheadbands.com/children.html,* accessed Oct. 19, 2011.

7. Image and testimonial statement from Full90 Sports website, available at *http://www.full90.com/players/pro/,* accessed 10–19–11.

8. Image from Sports Brain Guard website, available at *http://www.sports brainguard.com/purchase.aspx,* accessed Oct. 19, 2011.

9. Image of Sports Brain Guard website, "Stay in the Game with Sports Brain Guard." available at *http://www.sportsbrainguard.com/maroonmsg.aspx,* accessed Oct. 19, 2011.

10. Image of Sports Brain Guard website and text excerpt, "Stay in the Game with Sports Brain Guard." available at *http://www.sportsbrainguard.com/maroon msg.aspx,* accessed Oct. 19, 2011.

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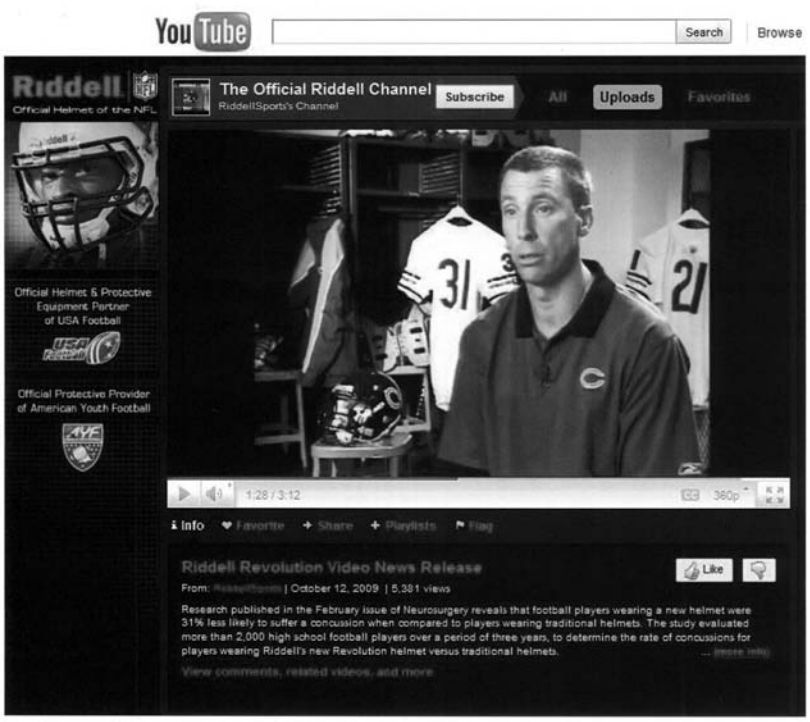
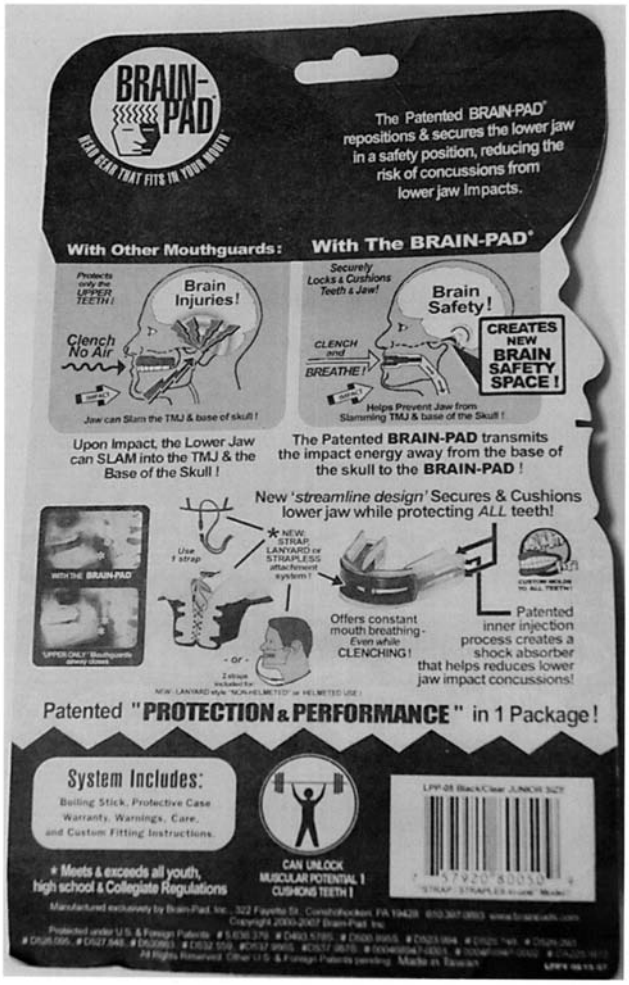


"We've had some players who have had ongoing problems with head injury, and we made the switch to the new [Riddell] protective headwear when it came out, at its inception. And these players have had no problems since then, or no repeated concussions."

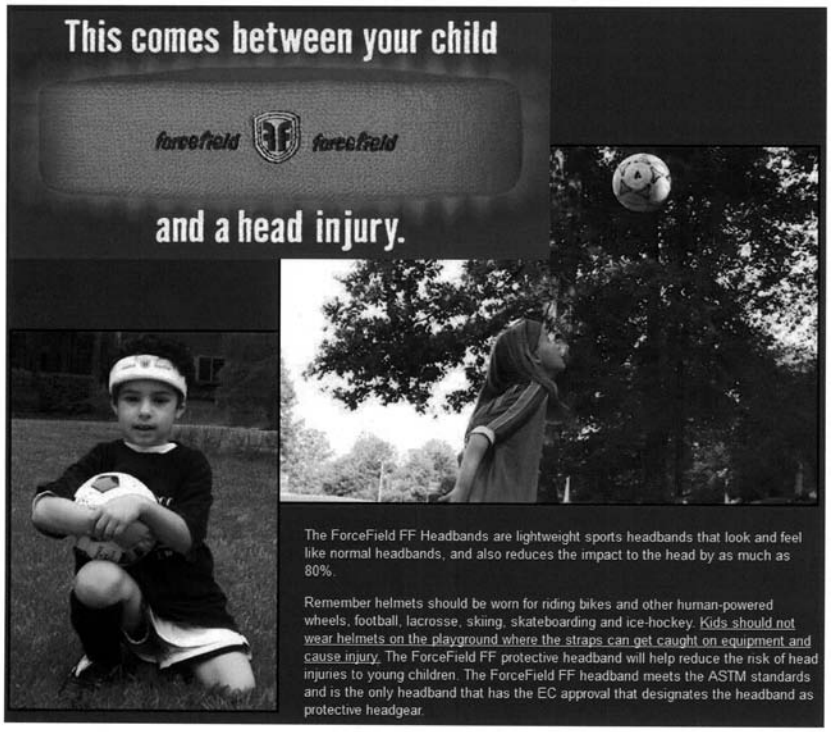
3. Image of product packaging (top front) for Brain Pad Lo Pro+ junior mouth guard. Image enhanced for presentation.

4. Image of product packaging (back) for Brain Pad Lo Pro+ junior mouth guard.



5. Image from ForceField FF Headbands website, available at: *http://www.forcefieldheadbands.com*, accessed Oct. 19, 2011.

6. Image from ForceField FF Headbands website, available at: *http://www.forcefieldheadbands.com/children.html*, accessed Oct. 19, 2011.



7. Image and testimonial statement from Full90 Sports website, available at *http://www.full90.com/players/pro/*, accessed 10-19-11.

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Stay in the Game with Sports Brain Guard - Sports...

Home | How SBG Works | Concussions Explained | Prevention and Treatment | Coaches Corner | BUY SBG

Neurosurgeon Dr. Joseph Maroon is an expert in diagnosing and managing concussions.

He is part of the NFL's Traumatic Brain Injury Committee and has testified in front of two Congressional hearings, investigating concussion incidence and the prevention of concussion in professional sports. He is Vice Chairman of a Department of Neurosurgery, a Heindl Scholar in Neuroscience and Team Neurosurgeon for the Pittsburgh Steelers. He is also a consultant to many other professional and college teams concerning the management of concussion and spinal injuries in sports. He has published over 250 scientific papers, and written 5 books. He was recently inducted into the Lou Holtz Hall of Fame along with Kareem Abdul Jabbar and Joe Montana.

A Message from Dr. Joseph Maroon

Over the past 30 years, as a practicing neurosurgeon, I have treated thousands of athletes with sports related concussions—players from the NFL, NHL, NBA, NCAA and all the way down to kids playing youth sports.

When playing competitive sports, the possibility of head injuries is unfortunately part of the game. However, there is not a coach or parent, from Pop Warner to professional sports, anywhere in the world that isn't concerned with these issues. In fact, recently we have seen a major cultural shift in the management of concussions at all levels of sports.

A major consequence of a concussion is inflammation of the brain and the subsequent cascade of biochemical events that results in brain damage. Dr. Russell Blaylock, a fellow neurosurgeon, is an international authority in this neuro-inflammation.

After years of research into natural means to reduce this neuro-inflammatory process following trauma, he has formulated a product with ingredients scientifically proven to help protect the brain **before** concussion and also enhance recovery following a brain injury. I have personally recommended his product, **Sports Brain Guard**, to athletes at all levels following concussions. I believe it very reasonable for athletes, particularly those in contact sports, to consider using this product.

Tri-Delivery Formula

Joseph Maroon, MD

Read the Consensus Statement on Concussion in Sport 3rd International Conference on Concussion in Sport held in Zurich.

Sports Brain Guard recommended by Dr. Joseph Maroon

Expert in head injury treatment
Heindl Scholar in Neuroscience
Team Neurosurgeon, Pittsburgh Steelers

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Joseph Maroon, MD

The CHAIRMAN. Ms. Alexis Ball, I would like to call on you first.

STATEMENT OF ALEXIS BALL, ALBUQUERQUE, NEW MEXICO

Ms. BALL. Chairman Rockefeller and members of the Committee, I want to thank you for inviting me here today.

My name is Alexis Ball, and I am a senior at the University of New Mexico. Concussions have greatly altered my life, and I appreciate the opportunity to take an advocacy role on concussion awareness.

I have played soccer since I was 4, and I have always been the high-achieving student athlete. In high school, I was New Mexico's Gatorade Player of the Year and our valedictorian. By my junior year in college, I was an academic all-American, captain of my team, and had received first team all-conference honors.

However, for as many awards as I have accumulated, I have accrued about as many concussions. I was medically disqualified from playing collegiate athletics in December 2009. This decision came after a season of struggle, following two concussions I sustained in the beginning of the season.

The CHAIRMAN. Ms. Ball, what you are saying is so important and so moving and powerful that I want you to slow down just a tiny bit so we don't miss a syllable.

Ms. BALL. I am sorry.

The CHAIRMAN. OK?

Ms. BALL. During preseason, I was offered the opportunity to shadow a doctor in the ER. A man came in with a knee laceration, which I was not prepared to see. I fainted and hit my head. It was clear I had a concussion, due to the dizziness, vomiting, and seizures that followed.

My coaches were not pleased when I called them the following morning, informing them of the concussion. In accordance with the team doctor's requirements, I sat out for a week. After that week, I met with him again. He asked me the normal concussion questions. Do you have a headache? Are you dizzy? Can you remember these three words?

I was still experiencing headaches and bouts of dizziness at the time, but it was the week of our first game and I wanted to play. Thus, I supplied the necessary answers to get cleared. I played for about 2 weeks with minimal issues. However, in our third game, I took a header on the top of my head.

I was not able to stand up and needed assistance to leave the field. I had sustained another concussion. I sat out for about a week and returned to play. However, the weeks following this concussion were horrible. I was playing terribly and simply was not myself.

I was no longer able to sleep at night. I would fall asleep around 3 o'clock in the morning after lying restlessly in my bed since 10 p.m. the night before. I could not pay attention in any of my classes.

However, the most disturbing change was the twist in my personality. I no longer enjoyed partaking in anything. I would go to practice and feel void of emotions, or I would begin crying randomly in the middle of practice. I would also sit in my room and stare into space, not comfortable in my own body. I did not know who I was anymore.

I thought that Alexis, the high-achieving student athlete, was permanently gone. My mom was seriously concerned about my well-being and forced me to go see my doctor. I told him about all my struggles, and he, too, was rather concerned.

In an effort to see what was happening, I took a neuropsych test. The test revealed that my visual memory was impacted. I now fall in the 20th percentile of all people for visual recall, and my doctor also explained that I was experiencing prolonged symptoms from the combination of the two concussions I had sustained months prior.

I was shocked. My doctor and I also talked about the status of my future in soccer. We talked about implications for my future if I were to sustain another concussion. I had already accumulated 10 concussions in about 8 years, most of which while wearing protective headgear.

The doctor concluded that for the safety of my future, I should hang up my cleats. This was a crushing blow, yet one that needed to be done. Ultimately, I had to separate my head from my heart.

Concussions are a very serious insult to your brain. People frequently claim an athlete "just sustained a concussion," like it is no big deal. Too often, coaches, athletes, and parents dismiss the severity of concussions because it is not a visible injury. If an athlete tears their ACL or sprains their ankle, it is apparent externally that they are injured. This is not the case with concussions.

A doctor or coach often cannot see the physical manifestations of the concussion. Moreover, many of the symptoms of post-concussion syndrome are not usually associated with the initial blow. I had no idea that my insomnia or the sadness I had felt could be correlated to an injury that I had sustained in the months prior, which is something I really want to emphasize today.

Athletes must be aware that if they sustain a concussion, symptoms can last longer than a few days, or weeks, for that matter. They can last a lifetime.

Another issue athletes need to be aware of is the limited efficacy of headgear or helmets. I wore protective headgear since my second concussion in high school, per the recommendation of my trainers. It was supposed to be a preventive measure against concussions, and clearly, this did not hold true. I sustained about eight concussions since wearing that. It is essential for athletes and coaches to know that athletes are not free from concussions because they have protective headgear.

Furthermore, I believe it is important to note that the mentality to return to play as quickly as possible is very prevalent in the world of athletics. There is a lot of pressure on athletes to just deal with their injuries, or they will be in jeopardy of losing their starting position or playing time.

This cultures an environment in which it is really easy to lie about your symptoms, especially when it comes to concussions. I knew the answers needed to return to play. No one could prove whether I had a headache or not, so I was apt to lie. In retrospect, this was a very poor decision, but I did not understand the severity of concussions at the time.

I continued to play much longer than I probably should have, due to the high number of concussions I had throughout my career. And I most certainly returned to play too quickly. People have only one brain for life. I will never regain the visual memory I once had. I will also not be able to regain the respect I lost while I struggled through my final season of soccer.

I hope from my story you have learned that concussions and brain injury are not a minor injury. In order to prevent more stories like mine, concussion awareness needs to be more prevalent among coaches and athletes in our society. I believe that most coaches and athletes do not truly understand the long-term ramifications of concussions. And people also need to understand that wearing protective gear does not stop concussions from occurring.

Therefore, I want to thank you again for inviting me here today in a step to further public education about this invisible injury.

[The prepared statement of Ms. Ball follows:]

PREPARED STATEMENT OF ALEXIS BALL, ALBUQUERQUE, NEW MEXICO

Chairman Rockefeller, Ranking Member Hutchison, and members of the Committee, I want to thank you for inviting me here today. My name is Alexis Ball, and

I am a senior at the University of New Mexico. Concussions have greatly altered my life. I appreciate the opportunity to take an advocacy role in concussion awareness.

I have played soccer since I was four and have always been a high achieving student athlete. Throughout my career, I earned numerous academic and athletic awards. In high school, I was New Mexico Gatorade Player of the Year and our valedictorian. By my junior year in college, I was an Academic All American, captain of my team, and had received First Team All Conference honors. My coaches often spoke of my potential to lead our team to a place that it has never been. However, for as many awards as I have accumulated, I have accrued about as many concussions. I sustained approximately five concussions prior to college and five concussions throughout college while wearing "protective" headgear. In fact, it was a concussion that terminated my collegiate career a year early.

I was medically disqualified from playing collegiate athletics in December 2009. This decision came after a season of struggle following two concussions I sustained in the beginning of the season. During pre-season, I was offered the opportunity to shadow an ER doctor. I excitedly took the opportunity because I want to be a doctor. A man came in with a knee laceration that I was not prepared to see, and I fainted and hit my head. It was clear I had a concussion due to the dizziness, vomiting, and seizures that followed.

My coaches were not so pleased when I called them the following morning informing them of the concussion. I had already sustained three concussions at UNM, and no one wanted me to add any more to the list. In accordance with the team doctor's requirements, I sat out for a week. However, my rest time still forced me to be watching practices in the blistering hot temperatures of August in New Mexico. I met with the sports medicine doctor a week after the concussion in order to be cleared to play. The doctor asked me the normal concussion questions, such as "do you have a headache right now?" Or "can you remember these three words?" I had heard these questions all too many times before. I was still experiencing headaches and bouts of dizziness at this time, but it was the week of our first game and my coaches wanted me to play. Thus, I supplied the necessary answers to get cleared.

I played for about two weeks without many issues. I did not play well, but I was there. In about our third game, I took a header off the top of my head (an area of my head which was not covered by my head gear). I was not able to stand up and needed assistance to leave the field. I had sustained another concussion. I sat out for a week again and then returned to play.

However, the weeks following this concussion were horrible. Not only had I lost my starting position, but I seemed incapable of getting it back. I was playing terribly and simply was not myself. Many other things had changed as well. I no longer was able to sleep at night. I would fall asleep around 3 o'clock in the morning after lying restlessly in my bed since 10 o'clock at night. I could not pay attention in any of my classes. However, the most disturbing change was the twist in my personality. I no longer enjoyed partaking in anything. I would go home and sit in my room and stare into space, not comfortable in my own body. I did not know who I was anymore. I would either go to practice and feel void of all emotion or begin crying uncontrollably randomly in the middle of it. I was lost. My teammates initially asked if I was ok, and I would shrug my shoulders, replying weakly, "yes I'm fine."

As the weeks progressed and my playing continued to deteriorate, I felt my teammates distancing themselves from me. About two months into the season, I had a meeting with my fellow captains. They informed me that they had lost respect for me and felt that I was selfish by acting so introverted at practices. I was in disarray, and these comments only worsened my fragile emotional state. Only my best friend and my parents remained by my side. I didn't know who to be anymore. I thought that Alexis, the high achieving student athlete, was permanently gone.

My mom was seriously concerned about my well-being. She e-mailed a doctor that she knew with her concerns and urged me to consult with him. I was very resistant to this idea because I felt that not sleeping and having some gloomy days were such silly reasons to see the doctor. I finally went and talked to him. I told him all about my struggles, and he was rather concerned. In an effort to see what was happening, I took a neuropsychology test. The test revealed that my visual memory was impacted. I now fell in the 20th percentile of all people for visual recall. My doctor informed me that I was experiencing prolonged symptoms from the combination of the two concussions I sustained months prior. I was shocked.

My doctor and I talked about the status of my future in soccer. We discussed the numerous concussions I have had throughout my soccer career. I had accumulated 10 concussions in about 8 years. We also talked about the implications for my future if I were to sustain another one. The doctor concluded that for the safety of my fu-

ture, I should hang up my cleats. It was a crushing blow, yet one that needed to be done. Ultimately I had to separate my head from my heart.

Concussions are a very serious insult to your brain. People frequently claim an athlete *just* sustained a concussion, like it is no big deal. Too often coaches, athletes, and parents dismiss the severity of concussions because it is not a visible injury. If an athlete tears their ACL or sprains their ankle, it is apparent externally that they are injured. This is not the case with concussions. A doctor or coach often cannot see the physical manifestations of a concussion. Moreover, many of the symptoms of post-concussion syndrome are not easily associated with the initial blow. I had no idea that my insomnia or the sadness I had felt could be correlated to an injury that I had sustained months prior. That is one message that I want to emphasize today. Athletes who have had concussions must be aware that symptoms can last longer than a few days or weeks. They can last for months and in some cases for life.

Another issue athletes need to be aware of is the limited efficacy of head gear or helmets. I wore protective head gear since my second concussion in high school per the recommendation of my trainer. It was supposed to be a preventative measure against concussions. Clearly this gear did not prevent me from sustaining further concussions. It is essential for coaches and athletes to know that athletes are not free from concussions because they have protective head gear.

Furthermore, I believe it is also important to note that the mentality to return to play as quickly as possible is very prevalent in the world of high school and collegiate athletics. There is a lot of pressure on athletes to just deal with their injuries or they will be in jeopardy of losing their starting position or playing time. This cultures an environment in which it is really easy to lie about your symptoms, especially when it comes to concussions. I knew the test questions and the answers needed to return to play. No one could prove whether I had a headache or not, so I was apt to lie. In retrospect, this was a very poor decision, but I did not understand the severity of concussions at the time. I also believe that most coaches and athletes do not truly understand the long term ramifications of concussions. I continued to play much longer than I probably should have due to the high number of concussions I had throughout my entire career. I most certainly returned to play too quickly. People only have one brain for life. It is not something that can be repaired via surgery like most other injuries. I will never regain the visual memory I once had. I also will not be able regain the respect I lost while I struggled through my final season of soccer.

Concussions adversely impacted my life. I hope from my story you have learned that concussions and brain injury are not a minor injury. In order to prevent more stories like mine, concussion awareness needs to be more prevalent among coaches and athletes in our society. People need to understand that wearing protective gear does not stop concussions from occurring. Therefore, I want to thank you again for inviting me here today in a step to further public education about this invisible injury.

The CHAIRMAN. Thank you. You did extremely well.

Mr. Steven Threet, who is a student at Arizona State University, was a quarterback and is still there. A starting quarterback, but you are still associated——

Mr. THREET. Yes, sir.

The CHAIRMAN. Working with the team?

Mr. THREET. Yes, I am coaching with the team. Yes. Yes, sir.

The CHAIRMAN. OK. We welcome you.

STATEMENT OF STEVEN THREET, TEMPE, ARIZONA

Mr. THREET. Thank you, Chairman Rockefeller and the other Committee members, for inviting me.

It is a great honor to be speaking here on a topic that has changed my life, and I am happy to help raise awareness about such a critical issue in both male and female sports. Dealing with concussions can be a very difficult process for the injured player and their family. So it is exciting for me to see such a prestigious and capable group of individuals who are willing to learn more in an effort to help better educate and protect all athletes.

Throughout my playing career, I faced a multitude of injuries. However, none caused more confusion, both literally and figuratively, at the time they occurred than concussions. Each of the four documented concussions that I experienced were unique in the way in which they occurred.

I sustained concussions from hits directly to my head by another player, from my head hitting the ground, and also as a result of consecutive impacts on separate plays. While my symptoms were often similar—they ranged from slight dizziness and blurred vision to extreme light sensitivity and constant headache—the severity of my symptoms had no recognizable pattern.

In two of the cases, I returned to play 1 week after the injury I sustained. In one instance, it only took me 2 weeks to recover. However, my final concussion I suffered on November 26, 2010, and the resulting symptoms were the reason that I decided to end my football playing career.

During my playing days, brain injury was never a major concern to me. After my first concussion, which happened on the last play of a high school game senior season, I was able to start the next game. It was not until my symptoms became serious that my attitude about the injury changed.

At the time when I decided to retire, I saw my decision simply as the right one to make. However, in the aftermath, it has become apparent to me that my decision can also be seen as an example of how dangerous brain injury is.

I want to make it clear that my goal in speaking is not to deter athletes from competing. I only wish that they acknowledge the seriousness of brain injury and respect the process that comes with the recovery.

In all sports, a certain aggressive mentality is required to be successful. The passion and intensity a football player relies on is an example of this, and it is what I think makes the game beautiful. As a former quarterback at premier college football programs, I know the importance of and took pride in being physically and mentally tough, outworking my opponent and leaving it all on the field, and playing through injury.

However, athletes must understand that a mild brain injury is not a mild shoulder separation. It is not an injury to be played through. They must understand that playing through a brain injury is not a sign of toughness, but it is a sign that says athletes are still uninformed on the topic.

Statistics have recently revealed that about 40 percent of athletes who have sustained a concussion returned to play too early and that up to 50 percent of concussions go unnoticed. This makes me believe that the only focus should be to create an open dialogue between athletes, coaches, doctors, and families that address the seriousness of brain injuries in athletics and the need for a full recovery before we return to play.

I know it is possible to decrease those statistics, and I also know progress on this issue is already being made, and many states have passed legislation dealing with concussion protocols. Unfortunately, there is no brain brace. There is no concussion-proof helmet or magic pill for immediate recovery. However, I believe there is a

misunderstanding about concussion prevention and treatment within the athlete cohort, as well as the general public.

For example, a football helmet is often thought of as a brain protector when, in reality, it is designed to protect the bone structure of the individual and not the brain. If the helmet could guarantee concussion prevention, I would still be playing football.

Once again, I would like to thank you for the opportunity, but more importantly, thank you for taking the time to learn and show your support for this issue today. And I look forward to the future progress that I know can and will be made on the topic.

Thank you.

[The prepared statement of Mr. Threet follows:]

PREPARED STATEMENT OF STEVEN THREET

First I would like to thank Chairman Rockefeller and the other committee members for inviting me. It is a great honor to be here speaking on a topic that has changed my life and I am happy to help raise awareness about such a critical issue in both male and female sports. Dealing with concussions can be a very difficult process for the injured person and their family; so it is exciting for me to see such a prestigious and capable group of individuals who are willing to learn more in an effort to better educate and protect all athletes.

Throughout my playing career I faced a multitude of injuries. However, none caused more confusion both literally and figuratively at the time that they occurred than concussions. Each of the four documented concussions that I experienced were unique in the way in which they occurred. I have sustained concussions from hits directly to my head by another player, from my head hitting the ground, and also as a result of consecutive impacts on separate plays. While my symptoms were often similar, they ranged from slight dizziness and blurred vision to extreme light sensitivity and a constant headache. The severity of my symptoms had no recognizable pattern. In two of the cases I was cleared and played without problem one week after I sustained a concussion. In one instance I returned to play two weeks after the injury. However the most severe symptoms were a result from my last concussion, which I suffered on November 26, 2010. Those symptoms ultimately led to my decision to end my football playing career.

During my playing days, brain injury was never a major a concern to me. After my first concussion, which happened on the last play of a high school game my senior year, I was able to start the next game. It was not until my symptoms became serious that my attitude about the injury changed. At the time when I decided to retire, I saw my decision simply as the right one to make. However, in the aftermath it has become apparent to me that my decision can also be seen as an example of how dangerous brain injuries can be. I want to make it clear that my goal in speaking is not to deter athletes from competing. I only wish that they acknowledge the seriousness of a brain injury and respect the process that comes with recovery.

In all sports a certain aggressive mentality is required to be successful. The passion and intensity football players rely on is an example of this; and what makes the game beautiful. As a former quarterback at premier college football programs I know the importance of and took pride in being physically and mentally tough, out working my opponent, leaving it all on the field, and playing through injury. However, athletes must understand that a mild brain injury is not a shoulder separation. It is not an injury to be played through. They must understand that playing through a brain injury is NOT a sign of toughness, but it is a sign that says athletes are still uninformed.

Statistics recently revealed that about 40 percent of athletes who have sustained a concussion return to play too early and that 50 percent of concussions go unnoticed. This makes me believe that the only focus should be to create an open dialogue between athletes, coaches, doctors, and families that addresses the seriousness of brain injuries in athletics and the need for a full recovery before returning to play. I know it is possible to decrease those statistics. I also know progress on this issue is already being made and many states have already passed legislation dealing with concussion protocols.

Unfortunately, there is no brain brace, concussion proof helmet, or magic pill for immediate recovery. However I believe THERE IS a misunderstanding about concussion prevention and treatment within the athlete cohort as well as the general public. For example, a football helmet is often thought of as a brain protector. How-

ever, it is designed to protect the bone structure of the head, not the brain itself. If a helmet could guarantee protection from concussions, I would still be playing football.

Once again thank you for this opportunity but more importantly thank you for taking the time to learn and show your support for this issue here today. I look forward to the future progress that I know can and will be made.

The CHAIRMAN. Thank you very, very much.

And you talk about an elite program. You are exactly right. You are exactly right.

Dr. Kutcher, bring us some Michigan and NeuroSport wisdom.

STATEMENT OF JEFFREY S. KUTCHER, MD, ASSOCIATE PROFESSOR, UNIVERSITY OF MICHIGAN, DEPARTMENT OF NEUROLOGY; DIRECTOR, MICHIGAN NEUROSPORT; CHAIR, SPORTS NEUROLOGY SECTION, AMERICAN ACADEMY OF NEUROLOGY

Dr. KUTCHER. I will do my best, sir.

Chairman Rockefeller, members of the Committee, and distinguished guests, it is my distinct honor to join you today. I am extremely grateful to be given the opportunity to provide my testimony.

My name is Jeffrey Kutcher. I am a sports neurologist and team physician at the University of Michigan. Since 2005, I have been the director of Michigan NeuroSport, University of Michigan's comprehensive academic sports neurology program.

Our program provides clinical care for athletes of all ages and abilities, conducts clinical and basic science research on sports concussion, provides education to athletes, parents, coaches, administrators, and healthcare providers. In my clinical practice, I care for athletes at the time of injury, through the return-to-play process, over the course of their seasons, their careers, and after they retire.

Since 2009, I have also been the Chair of the Sports Neurology Section of the American Academy of Neurology. The American Academy of Neurology is dedicated to the neurological care of athletes at all levels and is a leading voice in the arena of sports concussion.

I am currently co-leading the academy's effort to produce an evidence-based clinical practice guideline on sports concussion, an effort that includes the critical review and grading of every academic paper ever published on sports concussion.

Also pertinent to this topic, I have recently been named the director of the National Basketball Association's concussion program, and I also consult for the National Hockey League Players Association.

Clearly, the issue of sports concussion has been gaining significant public and Government interest over the past several years. A majority of this interest has been focused on those athletes already in the spotlight, the ones who play our professional contact sports.

While these athletes are experiencing the greatest doses of head impact over their lifetimes, they represent only a small fraction of the population at risk of being injured, which is why I am encouraged that today's hearing is focusing on the protective equipment being used by all athletes, regardless of level of play, age, or gender.

It is a common misconception that concussion is a problem seen only in males. As Ms. Ball has demonstrated, concussions occur in females as well, with some data suggesting that concussion incidence is actually higher in females when compared to males playing similar sports.

Concussion is an injury that occurs at every age, at every level of play. Up to 3.8 million concussions are estimated to occur in the United States each year from sports and recreational activities, and the majority of those occur in our youth.

There is great uncertainty and great concern regarding the notion of possible long-term effects from concussion, especially on the pediatric population, which may be at even greater risk given the ongoing development of the pediatric brain.

So what is a concussion? I will spend a moment just describing that in my own words. It is an injury to the brain that occurs when the brain moves fast enough or suddenly enough to disrupt the normal electrical function of its component cells.

Given that the brain is floating in fluid inside of the skull and that the head can act as a pendulum when the body is struck, movements of the brain significant enough to cause concussion can occur with or without a direct blow to the head. As long as the skull and thus the brain inside of it is accelerated or decelerated with enough force, the normal processes of the brain may be compromised.

The resulting concussion can take on many different forms, but typically includes transient disorientation, slowed thinking, memory difficulties, or other signs of brain dysfunction. Symptoms such as headache, nausea, and sensitivity to light are also quite common.

Concussions cannot be diagnosed by any test. That is extremely important to remember. It is a diagnosis that can only be made after a careful clinical evaluation performed by a healthcare professional, and preferably one with training and experience caring for brain injuries.

It is important to realize that concussion is not the only brain injury that can occur from head trauma. Emergent injuries, such as bleeding in or around the brain or skull fracture, can occur anytime an athlete or an object is moving quickly in the field of play.

On the other side of the spectrum, there is emerging evidence—brought forth by Dr. McKee, for example with some of her excellent work—that forces from multiple impacts that may not even produce concussion may be having potentially negative long-term health effects on athlete's brains.

Helmets have an extremely important role to play in head injury prevention. Without them, the potential for serious injury would make many of our sports and recreational activities unacceptably risky. In this way, helmets are extremely effective pieces of equipment.

With the introduction of hard-shell helmets, for example, skull fractures from playing football have essentially been eliminated. What helmets do not do well is significantly slow down the contents of the skull when the head is struck or moved suddenly.

Since concussions occur not as a result of the forces experienced by the skull, but by those experienced by the brain, it is extremely

unlikely that any helmet can be designed that will prevent concussions to the same significant degree that they have been shown to prevent skull fractures.

Currently, there are no convincing data in the published medical literature that show any particular helmet being better than any other at preventing sports concussion. Such data is hard to collect, grant you, for two main reasons.

First, given the many variables that exist in the athletic population and the varied exposure to impacts, it is extremely difficult to perform a randomized, controlled clinical trial on similar populations of athletes. Second, given that concussion is a clinical diagnosis with no available reference standard or diagnostic test, any study of concussion is significantly limited by the ambiguity of the very clinical outcome that is being studied.

For these same reasons, there are no published data supporting the idea that other types of protective equipment, such as mouth guards or soccer headbands, prevent concussion. Moreover, in sports such as soccer, where protective headgear is the exception rather than the rule, I have seen the use of headgear result in athletes altering their playing style in the wrong direction as their newfound sense of protection encourages more physically aggressive play.

Every week, I am asked in my clinic by patients, parents, and coaches about the claims they hear and what equipment they should buy to prevent concussions. The simple truth is that no current helmet, mouth guard, headband, or other piece of equipment can significantly prevent concussions from occurring. They occur as the result of the nature of our sports.

Concussion prevention is much more about teaching proper technique, playing by the rules, and limiting the overall dose of impacts. The potential harm that I see caused by products that claim to prevent concussion when they do not is far more than simply the financial harm of paying more for something that isn't likely to work as claimed. It is the harm that comes from having a false sense of security, from not understanding how the injury occurs, and what can actually be done to prevent it.

The public deserves to know that equipment has a significant, but inherently limited ability to prevent concussion. There is still a tremendous amount yet to be learned about the nature of concussions and their possible effects on brain health. In the interim, I am deeply encouraged by today's hearing and honored to be included in the efforts of the Committee as we work together for the safety of our athletes.

Thank you.

[The prepared statement of Dr. Kutcher follows:]

PREPARED STATEMENT OF JEFFREY S. KUTCHER, MD, ASSOCIATE PROFESSOR, UNIVERSITY OF MICHIGAN, DEPARTMENT OF NEUROLOGY; DIRECTOR, MICHIGAN NEUROSPORT; CHAIR, SPORTS NEUROLOGY SECTION, AMERICAN ACADEMY OF NEUROLOGY

Chairman Rockefeller, members of the Committee, and distinguished guests, it is my distinct honor to join you today and I am extremely grateful to be given this opportunity to provide my testimony.

My name is Jeffrey Kutcher. I am a sports neurologist and team physician at the University of Michigan. Since 2005, I have been the Director of Michigan

NeuroSport, the University of Michigan's comprehensive academic program in sports neurology. The NeuroSport program provides clinical care for athletes of all ages and abilities, conducts clinical and basic science research on sports concussion and other issues in sports neurology, and provides education to athletes, parents, coaches, administrators, and health care providers. My experience allows me to speak directly to the complete spectrum of athletes that experience sports-related brain injuries. I care for athletes at the time of their injury, over the course of their season, their career, into their retirement, and beyond.

Since 2009, I have also been the Chair of the Sports Neurology Section of the American Academy of Neurology. The American Academy of Neurology, the world's largest professional association of neurologists, is dedicated to the neurological care of athletes at all levels by optimizing clinical practice, research, and education, and is a leading voice in the arena of sports concussion. I am currently co-leading the American Academy of Neurology's effort to produce a meaningful, evidence-based, clinical practice guideline on sports concussion, an effort that includes the critical review and grading of every academic paper published on sports concussion. Also pertinent to this topic, I am the Director of the National Basketball Association's Concussion Program and a consultant to the National Hockey League Players' Association.

The Scope of the Problem

Clearly, the issue of sports concussion has been gaining significant public and government interest over the past few years. Fueled by increasing awareness of possible long-term effects from head injuries, the majority of the media coverage has focused on those athletes already in the spotlight, the ones who play our professional contact sports. While these athletes are experiencing the greatest doses of head impact over their lifetimes, they represent only a very small fraction of the population at risk of being injured. That is why I am encouraged that today's hearing is focusing on the protective equipment being used by all athletes, regardless of level of play, age, or gender.

It is a common misconception that concussion is a problem seen only in males. Concussions occur in females as well, with some data suggesting that concussion incidence is higher in females when compared to males playing similar sports. Concussion is an injury that occurs at every age and at every level of play. Up to 3.8 million concussions are estimated to occur in the United States each year from sports and recreational activities, and the majority of these occur in our youth. There is great uncertainty, and with it significant concern, regarding the notion of possible long-term effects from concussion, especially on the pediatric population, which may be at even greater risk given the ongoing development of the pediatric brain.

What is Concussion?

Simply put, concussion is an injury to the brain. It occurs when the brain moves fast enough, and suddenly enough, to disrupt the normal electrical function of its' component cells. Given that the brain is floating in fluid inside of the skull, and that the head can act as a pendulum when the body is struck, movements of the brain significant enough to cause concussion can occur with or without a direct blow to the head. As long as the skull, and thus the brain inside of it, is accelerated or decelerated with enough force, the normal processes of the brain may be compromised. The resulting concussion can take on many different forms, but typically includes transient disorientation, slowed thinking, memory difficulties, or other signs of brain dysfunction. Symptoms, such as headache, nausea, and sensitivity to light are also quite common. I should also note that a loss of consciousness is relatively rare in concussion, occurring in less than 10 percent of cases. Concussion cannot be diagnosed by any one test. It is a diagnosis that can only be made by a careful clinical evaluation performed by a health care professional, and preferably one with training and experience caring for brain injuries.

It is important to realize that concussion, as defined above, is not the only brain injury that can occur from head trauma. More acutely serious or emergent injuries, such as bleeding in or around the brain or a skull fracture, can occur anytime an athlete or an object is moving quickly in the field of play. On the other side of the spectrum, there is emerging evidence that forces from multiple impacts that are not significant enough to result in a concussion may have potentially negative effects on long-term brain health.

Equipment Limitations

Helmets have an extremely important role to play in head injury prevention. Without them, the potential for bone fracture or intracranial injury would make many of our sports and recreational activities unacceptably risky. In this way, helmets are extremely effective pieces of equipment. With the introduction of hard-shell

helmets, for example, skull fractures and resulting deaths from playing football have essentially been eliminated. What helmets do not do well is significantly slow down the contents of the skull when the head is struck or moves suddenly. Since concussions occur not as a result of the forces experienced by the skull, but by those experienced by the brain, it is extremely unlikely that any helmet can be designed that will prevent concussions to the same significant degree that they have been shown to prevent skull fractures.

Currently, there is no data in the published medical literature that shows any particular helmet being better than any other at preventing sports concussions. Such data is hard to collect for two main reasons: First, given the many variables that exist in the athletic population and the varied exposure to impacts, it is extremely difficult to perform a randomized, controlled, clinical trial on similar populations of athletes. Second, given that concussion is a clinical diagnosis, with no available reference standard or diagnostic test, any study of concussion is significantly limited by the ambiguity of the very clinical outcome that is being studied.

For these same reasons, there are no published data supporting the idea that other types of protective equipment, such as mouthguards or soccer headbands, prevent concussion. Moreover, in sports such as soccer, where protective headgear is the exception rather than the rule, I have seen the use of headgear result in athletes altering their playing style in the wrong direction, as their newfound sense of protection encourages more physically aggressive play.

While clinical data that speaks to concussion prevention is hard to generate, there are many extremely well performed laboratory studies that provide excellent data on the amount of force a helmet allows to get through to a model brain in a mechanical head. This does not mean that these data can be used to construct an estimate of concussion risk. Concussions do not occur at a particular force threshold. They occur across a wide range of forces and are dependent on the complex and variable physiological nature of each individual's brain.

The Potential Harm of Misinformation

With the increased public awareness of an injury that occurs frequently in children and may produce significant negative long-term health outcomes, it is not surprising that the marketplace for products designed to prevent concussions is a busy one. Every week I am asked by patients, parents, and coaches about the claims they hear and what equipment they should buy to prevent concussions. I wish there was such a product on the market. The simple truth is that no current helmet, mouthguard, headband, or other piece of equipment can significantly prevent concussions from occurring. They occur as the result of the nature of sports. Concussion prevention is much more about teaching proper technique, playing by the rules, and limiting the overall dose of impacts. Preventing bad outcomes and long-term damage, meanwhile, is clearly about recognizing the injury when it occurs, removing that athlete from participation, and allowing for appropriate recovery before they return.

The potential harm that I see being caused by products that claim to prevent concussion when they do not is far more than simply the financial harm of paying more for something that isn't likely to work as claimed. It is the harm that comes from having a false sense of security, from not understanding how the injury occurs and what can actually be done to prevent it. This issue is a growing public concern, and rightly so. The public deserves to know that equipment has a significant, but inherently limited, ability to prevent concussions. For the health of all athletes, we must see that each player, parent, and coach becomes educated on concussion, including the use of proper technique, the need for reporting the injury, and the importance of allowing for a full recovery before returning.

There is still a tremendous amount yet to be learned about the nature of concussions and their possible effects on brain health. In the interim, I am deeply encouraged by today's hearing and honored to be included in the efforts of the Committee as we work together for the safety of our athletes.

The CHAIRMAN. Thank you very much, Doctor.

And can we go on now to Dr. McKee?

STATEMENT OF ANN C. McKEE, MD, PROFESSOR OF NEUROLOGY AND PATHOLOGY, BOSTON UNIVERSITY SCHOOL OF MEDICINE; DIRECTOR, VISN–1 NEUROPATHOLOGY LABORATORY FOR THE NEW ENGLAND VETERANS AFFAIRS MEDICAL CENTERS; DIRECTOR, BRAIN BANKS FOR THE BOSTON UNIVERSITY ALZHEIMER'S DISEASE CENTER, FRAMINGHAM HEART STUDY, AND CENTENARIAN STUDY; CO-DIRECTOR, CENTER FOR THE STUDY OF TRAUMATIC ENCEPHALOPATHY

Dr. McKEE. Chairman Rockefeller and members of the Committee, thank you for the invitation to testify today on sports concussions and their consequences.

My name is Dr. Ann McKee. I am a Professor of Neurology and Pathology at Boston University's School of Medicine, and I direct the neuropathology laboratory for the New England Veterans Affairs Medical Center at the Boston VA.

I am also Co-Director for the Center for the Study of Traumatic Encephalopathy. My testimony today reflects my professional opinion. I am not speaking officially on behalf of the Department of Veterans Affairs.

Mild traumatic brain injury, or concussion, is a temporary state of neurologic dysfunction resulting from forces on the brain—acceleration, deceleration, lateral and rotational forces. Subconcussion is caused by these same type of forces, but the forces are milder, and no symptoms are produced.

In all of these conditions, concussion or subconcussion, the brain looks normal after the injury, and there is no detectable damage on routine neuroimaging, such as CT scan or MRI, which is why these injuries are sometimes considered invisible. However, the acceleration, deceleration, rotational forces cause the brain to move rapidly within the skull, and the brain, which is firm, but gelatinous, is stretched and deformed by these forces. And as the brain as a whole is deformed, there is also stretch and strain of the individual nerve cells and support cells within the brain.

The brain abnormalities associated with concussion and subconcussion occur at the microscopic, cellular, molecular, and metabolic levels. If an athlete returns to play before the symptoms resolve, the athlete risks developing post-concussive syndrome and second impact syndrome, or SIS, a rare, but often fatal condition.

In addition, repetitive mild concussive injury can trigger a progressive deterioration of the brain called "chronic traumatic encephalopathy." Chronic traumatic encephalopathy is a progressive neurodegeneration that evolves slowly over decades and usually does not become apparent until many years after the player has retired from the sport.

CTE is triggered by repetitive concussive injuries superimposed on a brain that has not healed from a previous injury. This is why concussion awareness is so critical and why proper diagnosis and management of concussion, allowing the brain to completely rest and recover after an injury, is so important in youth sports.

The CHAIRMAN. Perhaps even more so on the part of very relatively young children whose brains are still growing?

Dr. McKEE. Absolutely.

The CHAIRMAN. They are still playing football, other things.

Dr. McKee. Right. The youth or immature brain is more susceptible to concussive injuries than the mature adult brain. Children and young adults recover more slowly from a concussion. Youth athletes are also more at risk for concussion due to their disproportionally large head size compared to body size and the weakness of their neck musculature.

Furthermore, young athletes are uniquely susceptible to second impact syndrome, which has only been reported in athletes under the age of 24 and most often under the age of 18. Second impact syndrome occurs when a young athlete sustains an initial head injury, then suffers a second head injury before the symptoms associated with the first impact have cleared.

Typically, the athlete returns to play too early and receives a second blow to the head, which may be remarkably minor. The affected athlete may appear stunned at first, but in the next few seconds to minutes, the athlete collapses to the ground, semi-comatose, and the outcome is often fatal or associated with severe and permanent disability.

Since 2008, as Director of the Center for the Study of Traumatic Encephalopathy Brain Bank, I have diagnosed chronic traumatic encephalopathy in the brains of 58 athletes and other individuals, which is more than double the history of the world's experience with this condition. I have diagnosed CTE in 40 football players, and that includes professional football players, college football players, as well as high school football players, 5 hockey players, and 15 military veterans.

Chronic traumatic encephalopathy causes changes in behavior and personality. In particular, individuals with CTE become more irritable, angry, or aggressive. They develop mood changes, such as depression, and sometimes become suicidal, and develop drug and alcohol abuse. As the disease progresses, they develop short-term memory loss, which leads to increasing cognitive impairment and ultimately dementia and, in some cases, parkinsonism.

Pathologically, CTE is caused by a buildup of a protein called tau. It forms neurofibrillary tangles within the brain. Under normal circumstances, this abnormal tau protein is found in only limited quantities, but in CTE, there is a striking buildup of this protein, even at young ages.

For example, advanced chronic traumatic encephalopathy was found in the brain of Dave Duerson, a former defensive back for the Chicago Bears. Dave Duerson began playing football at age 8 and experienced more than 10 concussions in his 11-year NFL career. After retiring from the NFL, he was very successful and had a loving family and four children.

At the age of 46, he experienced financial difficulties and the dissolution of his marriage. He became hot-tempered, physically and verbally abusive. He developed memory lapses, mood swings, and piercing headaches. And on February 17, 2011, he killed himself inside his Florida apartment. He left instructions to donate his brain to my laboratory, and my examination showed that he was suffering from moderately severe CTE, even though he was only 50 years old.

Another example is Owen Thomas, a defensive end for the University of Pennsylvania who played football since age 9. One day

in the spring of 2010, he called his parents and told them he was stressed by school and having trouble with several of his courses. And 2 days later, he hanged himself in his off-campus apartment.

When I looked at Owen's brain, I saw unmistakable changes of early CTE. In fact, if you compare the brain of Owen Thomas to the brain of Dave Duerson, there was remarkably similar, although milder pathology, suggesting that if Owen Thomas had lived another 30 years, his CTE would have progressed to the advanced stage demonstrated by Dave Duerson.

I have recently had the opportunity to study the brain of a 17-year-old high school football player. He suffered a concussion 3 weeks before the day of his death and had recently been cleared to return to play. During the game, he intercepted a pass, was tackled, and hit the ground. As he walked to the bench, he complained of a severe headache, then collapsed to the ground, unconscious. He died the following day.

Neuropathologic examination showed a thin subdural hemorrhage consistent with SIS and very early changes of CTE. He is the youngest player ever diagnosed with changes of CTE.

I have now examined the brains of 58 individuals with CTE, and I have found early CTE in college and high school players, including players as young as 17 and 18. We know that CTE is a neurodegeneration associated with repeated concussive injury that usually occurs in an individual's teens and 20s.

We know that once CTE is triggered, the neurodegeneration progresses slowly over decades to involve widespread degeneration of many brain structures. We know that the symptoms of CTE are subtle and begin in mid life with personality and behavioral changes, including irritability, short fuse, depression, suicidal ideations, impulsivity, and memory loss. We know there is a slow deterioration that progresses to dementia and parkinsonism.

However, there are many things that we do not understand about CTE. We do not understand or we do not know the exact incidence and prevalence of this disorder, even though we now clearly understand that this disease exists, and it is surprisingly common.

What factors determine who will develop CTE? How many concussions, how many subconcussive injuries, how close together the injuries, how severe, and at what age? All of these are aspects of the disease that are unknown at this time.

Importantly, we do not know how to diagnose this disease in living individuals, how to stop its progression, or how to reverse its course. But we can make important changes to prevent this disease from developing in young athletes, and those changes include understanding what a concussion is, recognition of concussion when it occurs, and proper medical management of concussion after it happens.

We can also teach our young athletes to play smart and keep their head out of the game as much as possible. Rule changes to protect athletes from dangerous styles of play, rule enforcement, and player and coach education will go a long way toward reducing the frequency of concussion and subconcussion.

With these changes in the way that sports are played, continued education, increased scientific interest and research into the mechanisms of CTE pathogenesis, and the development of diagnostic

tools and therapeutic strategies to interrupt this disease progression, we can make enormous improvements to protect the mental health of millions of young athletes and military service members for many years to come.

Thank you.

[The prepared statement of Dr. McKee follows. In addition to her written testimony, Dr. McKee submitted three articles:]

Brandon E. Gavett, PhD, Robert A. Stern, PhD, and Ann C. McKee, MD, "Chronic Traumatic Encephalopathy: A Potential Late Effect of Sport-Related Concussive and Subconcussive Head Trauma," *Clinical Sports Medicine* 30 (2011) 179–188

Daniel H. Daneshvar, MA, Christine M. Baugh, AB, Christopher J. Nowinski, BA, Ann C. McKee, MD, Robert A. Stern, PhD, Robert C. Cantu, MD "Helmets and Mouth Guards: The Role of Personal Equipment in Preventing Sport-Related Concussions," *Clinical Sports Medicine* 30 (2011) 145–163

Ann C. McKee, MD, Robert C. Cantu, MD, Christopher J. Nowinski, AB, E. Tessa Hedley-Whyte, MD, Brandon E. Gavett, PhD, Andrew E. Budson, MD, Veronica E. Santini, MD, Hyo-Soon Lee, MD, Caroline A. Kubilus, and Robert A. Stern, PhD, "Chronic Traumatic Encephalopathy in Athletes: Progressive Tauopathy After Repetitive Head Injury," *Journal of Neuropathology and Experimental Neurology* Vol. 68, No. 7, July 2009, pp. 709–735

PREPARED STATEMENT OF ANN C. MCKEE, MD, PROFESSOR OF NEUROLOGY AND PATHOLOGY, BOSTON UNIVERSITY SCHOOL OF MEDICINE; DIRECTOR, VISN–1 NEUROPATHOLOGY LABORATORY FOR THE NEW ENGLAND VETERANS AFFAIRS MEDICAL CENTERS; DIRECTOR, BRAIN BANKS FOR THE BOSTON UNIVERSITY ALZHEIMER'S DISEASE CENTER, FRAMINGHAM HEART STUDY, AND CENTENARIAN STUDY; CO-DIRECTOR, CENTER FOR THE STUDY OF TRAUMATIC ENCEPHALOPATHY

Mr. Chairman and Members of the Committee:

Thank you for the invitation to testify today on sports concussions and their consequences. My name is Dr. Ann McKee. I am a Professor of Neurology and Pathology at Boston University School of Medicine and I am the Director of the Neuropathology Laboratory for the New England Veterans Affairs Medical Centers at the Boston VA Medical Center. I also direct the Brain Banks for the Boston University Alzheimer's Disease Center, the Framingham Heart Study, and the Centenarian Study, and I am a co-director for the Center for the Study of Traumatic Encephalopathy at Boston University. My testimony today reflects my professional opinion; I am not speaking officially on behalf of the Department of Veterans Affairs.

I received my medical degree in 1979, and I am board certified in both Neurology and Neuropathology. I have broad experience in neuropathology of neurological disease and have written extensively on the neuropathology of many neurodegenerative diseases, including Alzheimer's disease, Parkinson's disease, Frontotemporal Dementia and Traumatic Brain Injury. For the past 25 years, I have been studying the brains of individuals after death and correlating the pathological findings to the patient's clinical symptoms during life. For the past 9 years I have been specifically analyzing the effects of repetitive mild traumatic brain injury or repetitive concussion on the brain.

A traumatic brain injury (TBI) is caused by a blow, a jolt to the head or a penetrating head injury that disrupts the function of the brain. A TBI may range from mild—with a brief change in mental status—to severe, with an extended period of unconsciousness or amnesia after injury. Eighty percent of all TBI is mild, approximately 10% is moderate, and approximately 10% is severe. What we are primarily concerned with today is repetitive mild TBI (mTBI) or concussion; the terms concussion and mild TBI are interchangeable. Mild TBI and concussion are temporary states of neurological dysfunction resulting from acceleration, deceleration, lateral and rotational forces on the brain. Subconcussion is caused by the same acceleration-deceleration-rotational forces but the forces are milder and no symptoms are produced. In all these conditions, the brain appears macroscopically normal after the injury and there is no detectable damage on routine neuroimaging, including CT scan or MRI, which is why concussion and subconcussive injury are sometimes considered "invisible" brain injuries. However, these acceleration deceleration-rotational forces cause the brain to move rapidly within the skull and the brain, which is firm, but gelatinous, is stretched and deformed by these forces. As the brain as a whole

is deformed, there is also stretch and strain of the individual nerve cells and supporting cells within the brain. The brain abnormalities associated with concussion and subconcussion occur at the microscopic, cellular, molecular and metabolic levels. There is mild, but widespread injury to axons, the long, slender projections of a nerve cell that conduct electrical impulses away from the nerve cell and contact other nerve cells. The nerve cell and axonal injury most often completely resolve with rest. Indeed, most individuals recover completely from a single mTBI or concussion within weeks to months, but in some individuals (fewer than 10%), post-concussive symptoms can last for months to years, especially in situations where an athlete is not properly treated after a concussion. If an athlete returns to play before symptoms resolve, the athlete also risks a rare but sometimes fatal event known as second impact syndrome (SIS). In addition, repetitive concussion or repetitive subconcussion can trigger a progressive deterioration of the brain called Chronic Traumatic Encephalopathy (CTE) (McKee 2009, McKee 2010, Gavett 2010, Daneshvar 2011, Gavett 2011).

CTE is a progressive neurodegeneration triggered by repetitive concussion and subconcussion that evolves slowly over decades and usually does not become apparent until many years later. Although the exact relationship between concussion, subconcussion and CTE is not entirely clear, most likely repetitive concussive and subconcussive injury superimposed on unresolved nerve cell and axonal injury initiates a series of metabolic, ionic, membrane, and cytoskeletal disturbances that triggers the pathological cascade that leads to CTE. This is the reason why concussion awareness is so critical and why proper diagnosis and management of concussion, allowing the brain to completely rest and recover after an injury, is so important in youth sports and all other activities that result in mTBI.

There is also evidence that the youth or immature brain may be more susceptible to concussive injuries than the mature adult brain. The brain continues to develop and mature, laying down myelinated fiber tracts, until the mid-twenties. Children and young adults recover more slowly from a concussion than adults. Youth athletes are also more at risk for concussion due to their disproportionately large head size compared to body size and the weakness of their neck musculature. Further evidence of the enhanced susceptibility of young athletes to mTBI is second-impact syndrome (SIS), an entity that has only been reported in athletes 24 years and younger, and the vast majority of the SIS cases in the literature have involved athletes under the age of 18.

SIS occurs when a young athlete sustains an initial head injury and then suffers a second head injury before the symptoms associated with the first impact have cleared (Cantu and Gean 2010). Typically, the athlete suffers post-concussion symptoms after the first head injury, which may include headache; dizziness; visual, motor, or sensory changes; confusion and memory problems. Before these symptoms resolve, which may take days or weeks, the athlete returns to competition and receives a second blow to the head. The second blow may be remarkably minor. The affected athlete may appear stunned, usually does not experience loss of consciousness but in the next few seconds to several minutes, the athlete, who is conscious yet stunned, precipitously collapses to the ground, semicomatose. The outcome is often fatal or associated with severe permanent disability. The pathophysiology of the SIS is generally believed to be caused by a loss of autoregulation of the cerebrovasculature. This dysautoregulation leads to precipitous brain swelling, high intracranial pressure, brain herniation and often, death. The adolescent or youth brain does not autoregulate well and is more susceptible to poor outcomes following mTBI (Chaiwat 2009).

In 2008, we created the Center for the Study of Traumatic Encephalopathy (CSTE) with the goal of studying the long-term effects of sports-related mTBI and CTE. We initiated a brain donation registry, a clinical registry of amateur and professional athletes, and the CSTE Brain Bank at the Bedford VA. The purpose of the VA CSTE Brain Bank is to study the effects of repetitive mTBI (repetitive concussion and subconcussion) by neuropathologically examining brains donated by deceased athletes and other individuals with a history of repetitive mTBI.

CTE was first reported in 1928 by Harrison Martland, a New Jersey pathologist and medical examiner, who described the clinical spectrum of abnormalities found in "nearly one half of the fighters who have stayed in the game long enough" (McKee 2009, Gavett 2011). Boxers exhibiting cognitive, behavioral, or motor abnormalities were well known within the community and were referred to by various terms, such as "punch drunk," "goofy," and "slug-nutty", and later by the more formal term "dementia pugilistica." By the 1970s, a sufficient number of boxers with dementia pugilistica had been studied pathologically to support the conclusion that this distinct neurodegeneration was a consequence of repeated mTBI and was not restricted to boxers, and the term "chronic traumatic encephalopathy" or CTE, be-

came most widely used. Over the last few decades, clinical and neuropathologic evidence of CTE has emerged in association with various sports, including American football, professional wrestling, professional hockey, and soccer, as well as other activities associated with repetitive mild head trauma, such as physical abuse, epileptic seizures, head banging and military service. Although the incidence and prevalence of CTE is currently unclear, it most likely varies by sport, position, duration of exposure, and age at the time of initial or subsequent head trauma, and additional variables, such as genetic predisposition.

In 2009, I reviewed the world's literature on neuropathologically-verified CTE and found 51 cases of CTE including 3 cases of our own from BU and the Bedford VA (McKee 2009). Over the past 3½ years, the brains and spinal cords of 97 athletes and military veterans who experienced mTBI or concussion have been donated to the VA CSTE Brain Bank. We have found CTE in 58 individuals, more than doubling the history of the world's experience combined. We have neuropathologically diagnosed CTE in 40 football players, at all levels of play, professional, college and high school, 5 hockey players, and 15 military veterans and are currently preparing a manuscript for submission describing our experience.

The onset of CTE is often in midlife, usually after athletes have retired from their sport. The early manifestations of CTE affect behavior and personality; in particular, individuals with neuropathologically documented CTE have been described as being more irritable, angry, or aggressive or as having a shorter fuse. There are mood changes, usually of depression, and increased suicidality, drug and alcohol abuse, and paranoia may be present. These changes are usually followed by short-term memory loss and executive dysfunction. Later in the disease, increasing cognitive impairment, movement disorders (*e.g.,* parkinsonism), and speech disorders may emerge.

Macroscopic pathological changes found in CTE include an anterior cavum septum pellucidum and posterior septal fenestrations. These changes are likely caused by the force of the head impact being transmitted through the fluid ventricular system, thereby affecting the integrity of the intervening tissue. Enlargement of the lateral and third ventricles is also commonly seen in CTE with the third ventricle disproportionately widened. In advanced cases, there is also atrophy of the frontal and temporal cortices and medial temporal lobe, thinning of the hypothalamic floor, shrinkage of the mammillary bodies, pallor of the substantia nigra, and hippocampal sclerosis.

Microscopically, CTE is characterized by an abundance of neurofibrillary tangles (NFTs), neuropil threads, and glial tangles within the brain, composed of hyperphosphorylated tau protein. CTE is distinguished from other neurodegenerations associated with build up of tau protein, such as Alzheimer's disease, by several unique features. First, the distribution of tau pathology in CTE is strikingly perivascular and most dense at the depths of cortical sulci, especially in early stages of the disease. The tau pathology in CTE is also extremely irregular and superficial, largely confined to foci in the frontal, temporal, and insular cortices. With increasing severity the tau pathology spreads to involve the limbic cortices, subcortical nuclei and brainstem.

Recently, in addition to severe tau neurofibrillary pathology, we have found that there is a widespread TDP-43 proteinopathy in more than 80% of their cases of CTE. Ten percent of athletes with CTE and a florid TDP-43 proteinopathy also develop a motor neuron disease similar to Amyotrophic Lateral Sclerosis (McKee 2010). The deposition of both tau and TDP-43 as aggregated phosphorylated proteins associated with neurodegeneration in CTE suggests that repetitive mTBI or repetitive axonal injury provokes the pathologic accumulation of both proteins.

Case studies

Cognitively normal individuals

Under normal circumstances, phosphorylated 1au protein, is found only in very limited quantities in the brains of cognitively normal people. I have examined over 70 brains of cognitively intact individuals ranging in age from 18–103 years using the identical techniques that I use in studying the athlete brains. Basically, unless the individual is in the preclinical stages of a neurodegenerative disease, there is very little "normal" build up of phosphorylated tau protein in the brain and then only in restricted regions of individuals aged 70 years or older (Figure 1).

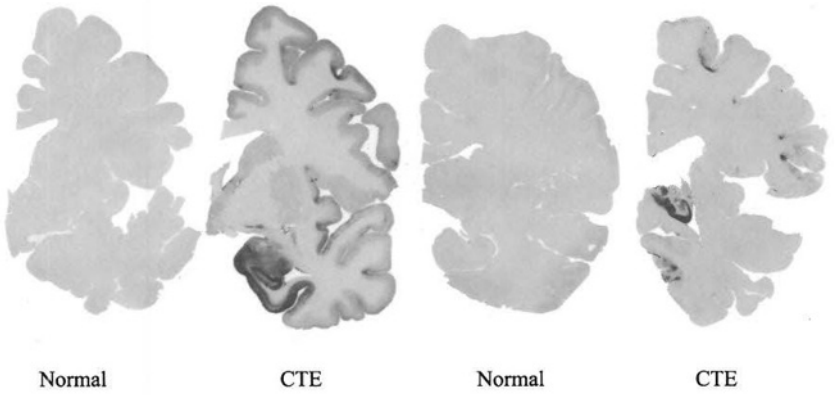


Figure 1. Coronal sections of brain from a 65-year-old cognitively normal individual without a history of mild TBI compared to the changes found in a 66-year-old former NFL player with CTE. The brain sections have been immunostained for phosphorylated tau protein, which appears as a dark brown color when the slides are viewed with the naked eye. The normal brain does not contain any appreciable amounts of phosphorylated tau protein, however there are substantial deposits of tau protein in many regions of the brain in the individual with CTE.

Case 1. Former professional boxer

In January of 2003, as part of my work with the Boston University Alzheimer's Disease Center and the Bedford VA, I examined the brain of a man who died at the age of 72 after 15 years of severe dementia requiring institutionalization. The man had been a world champion boxer and had been clinically diagnosed with Alzheimer's disease beginning at the age of 58. However, when I looked at his brain on postmortem examination, I found that there was absolutely no evidence of Alzheimer's disease; there was no evidence of *beta amyloid,* a protein that accumulates in the brain in people with Alzheimer's disease and is thought by many to be the cause of Alzheimer's disease. Instead, the brain of this world champion boxer showed a massive build-up of phosphorylated tau protein as NFTs and glial tangles throughout his brain. The neurofibrillary and glial tangles were distributed in a unique pattern that is diagnostic of CTE; this pattern not found in any other neurodegenerative condition. When viewed microscopically it was clear that many individual nerve cells of the boxer contained NFTs, in fact they were found in nearly every nerve cell and there were almost no normal appearing cells. In CTE, tau protein builds up in individual nerve cells and prevents them from making normal connections with other nerve cells, eventually killing the cells. In this man's brain, there were massive numbers of NFTs and glial tangles, so many in fact that you could see the abnormalities on the glass slides without the use of a microscope (Figure 2). This individual, a former professional boxer, had been clinically diagnosed with Alzheimer's disease during life, but the disease that actually caused his tragic 15 year decline in intellect and eventual hospitalization for severe dementia was CTE, a disorder that would have been entirely prevented if he hadn't suffered repeated head injury in his younger years as a boxer.

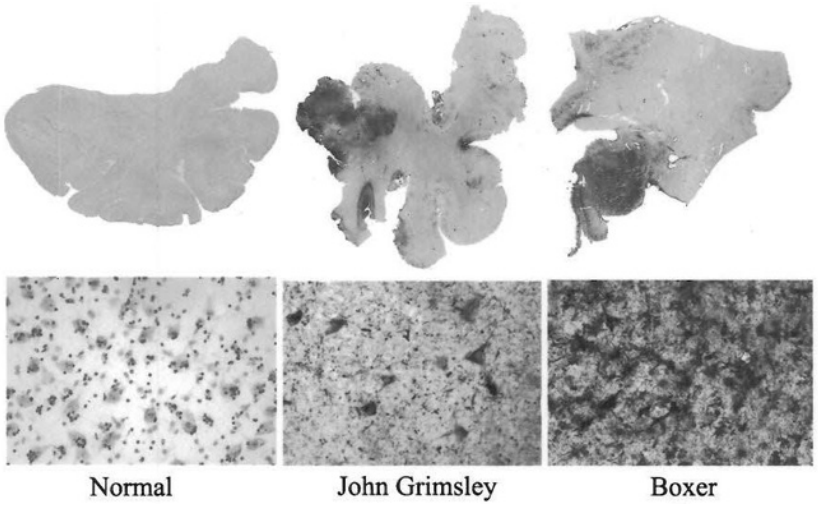


Figure 2. Left panel, top and bottom: coronal section of brain from a normal control showing the absence phosphorylated tau protein (dark brown). The bottom section is a microscopic view of a normal brain showing intact nerve cells and support cells. Middle panel, John Grimsley, showing marked deposition of tau protein in the amygdala and temporal cortex (top) and nerve cells filled with abnormal tau protein (bottom). The sections on the right are from a 72 year old professional boxer who died with advanced CTE. The top section shows dense deposition of abnormal tau protein in the amygdala and the bottom section shows a microscopic view of the dense accumulation of tau in nerve cells and support cells.

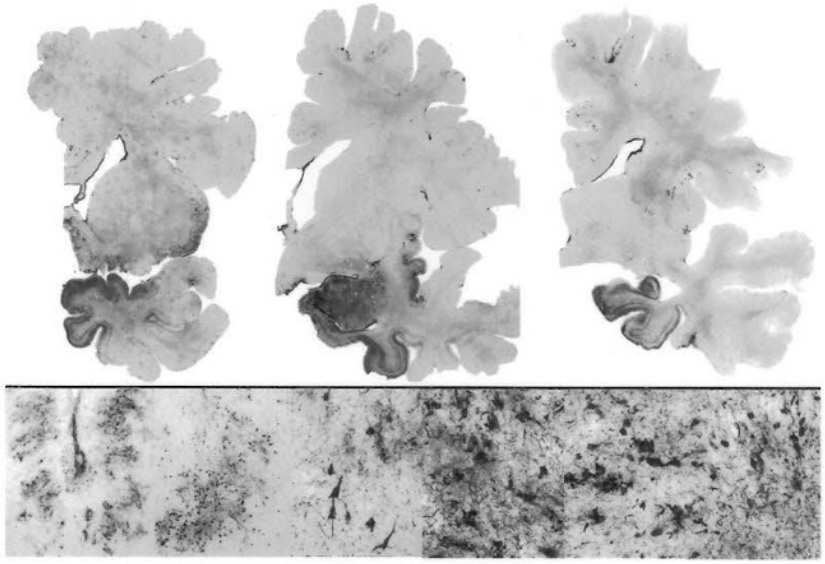
Case 2. John Grimsley, former linebacker Houston Oilers

John Grimsley, a former linebacker for the Houston Oilers died of an accidental gunshot wound while cleaning his gun at the age of 45. According to his wife, he was concussed 3 times during his college football years, and at least 8 times during his NFL career, however, only one "cerebral concussion" was medically confirmed. He was never formally diagnosed with post concussion syndrome and never sought medical attention for residual cognitive and behavioral difficulties. There was no history of ever losing consciousness for more than a few seconds and he never required being carried off the field or hospitalization. He never took any performance enhancing drugs or used illicit drugs. He was a nonsmoker and there was no known family history of dementia. According to his wife and close friends, he began showing changes in his behavior and cognitive decline at age 40. He developed difficulties in short-term memory, attention, concentration, organization, planning, problem solving, judgment, and the ability to juggle more than one task at a time. For example, he would ask the same questions repeatedly over the course of the day and he would ask to rent a movie that he had already seen. He had difficulty assembling his tax records, shopping alone, and understanding television. His symptoms gradually progressed and became quite severe by the end of his life. He also developed a "shorter and shorter fuse" and would become angry and verbally aggressive over seemingly trivial issues. When I first looked at his brain, it showed the exact same pattern of changes that I had found in the brains of boxers with CTE. There were large numbers of tau containing neurofibrillary tangles throughout all parts of the brain and there was absolutely no evidence of beta amyloid protein or Alzheimer's disease. The brain of this 45 year old husband and father, at the prime of his life, showed profound neurofibrillary degeneration, changes of CTE that were identical in nature to the changes I found in the brains of the boxers, but were now found in a football linebacker some 30 years younger. In John Grimsley's brain, there were striking changes in regions of the brain controlling personality and behavior, such as the frontal lobes, profound changes in the areas controlling impulsivity and rage behavior such as the amygdala, and severe changes in anatomic structures that are responsible for memory, such as the hippocampus, mammillary bodies and thalamus. In Figure 2, the brain of John Grimsley is seen in the middle; in the top middle panel, you can see severe tau deposition in the frontal lobe and microscopically; in the bottom middle panel, you can see numerous nerve cells containing tau and NFTs. In a normal 45 year old, absolutely none of these changes would be found.

Indeed these changes would not be found in a normal 65 year old, 85 year old or 100 year old.

Case 3. Louis Creekmur, former offensive lineman Detroit Lions

Louis Creekmur was a former offensive lineman for the Detroit Lions and eight-time Pro Bowler. Louis Creekmur played ten seasons for the Lions and was famous for suffering at least 13 broken noses and 16 concussions. Beginning at the age of 58, he began to show increasing cognitive and behavioral difficulties including memory loss, problems with attention and organization, and outbursts of anger and aggression. He died from complications of dementia at the age of 82. The brain of Mr. Creekmur showed advanced GTE including marked shrinkage of medial temporal lobe structures that control memory, shrinkage of the frontal and temporal lobes, and marked dilation of the spinal fluid cavities that line the brain's interior. There was widespread and severe tau deposition as NFTs throughout the frontal and temporal lobes, amygdala, hippocampus, thalamus and brainstem in the unique pattern that is only found in GTE. In Mr. Creekmur's case, the abnormalities were extremely severe. There was absolutely no evidence of beta amyloid, Alzheimer's disease or any other neurodegenerative disorder, and the findings again indicated that if Mr. Creekmur had not sustained repetitive head trauma during the play of football, he would be alive and well and enjoying his family and grandchildren today.



Lou Creekmur

Figure 3. Coronal sections of the brain of Louis Creekmur stained for phosphorylated tau protein show dense abnormalities throughout the brain. Bottom row: microscopic views of abnormal tau deposits. There was extensive nerve cell loss and advanced neurodegenerative changes throughout the brain.

Case 4. Dave Duerson, former defensive back Chicago Bears

Dave Duerson began playing football at age 8 and played a total of 24 total seasons as a safety in college and as a defensive back in the NFL He experienced more than 10 concussions in his 11-year NFL career, several with loss of consciousness, although he was never admitted to hospital. After retiring from the NFL, he was very successful in the food supply industry (Duerson Foods), active in NFL Players Association and Benefits Board; he had a loving family with three sons and a daughter and was considered in generally good health. In 2007, he began to experience business and financial difficulties that culminated in the loss of his business and the dissolution of his marriage. He was known to be smart, charming, kind and gentle but he became progressively more hot-tempered, physically and verbally abusive. He began to experience memory lapses; mood swings, piercing headaches on the left side of his head, difficulty spelling simple words, and blurred eyesight. On February 17, 2011, Duerson killed himself inside his Florida apartment at age 50. He left a note that carried a request: "Please, see that my brain is given to the

NFL's brain bank" (The VA CSTE brain bank). The request was accompanied by an unusual method of suicide; he shot himself in the heart. At autopsy, his brain showed extensive changes of moderately advanced CTE, without evidence of any other disorder including Alzheimer's disease (Figure 4).

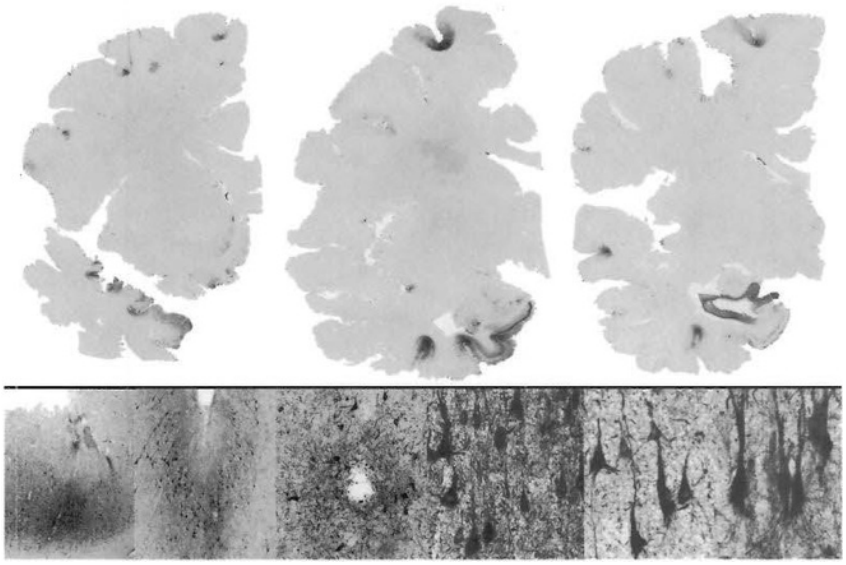
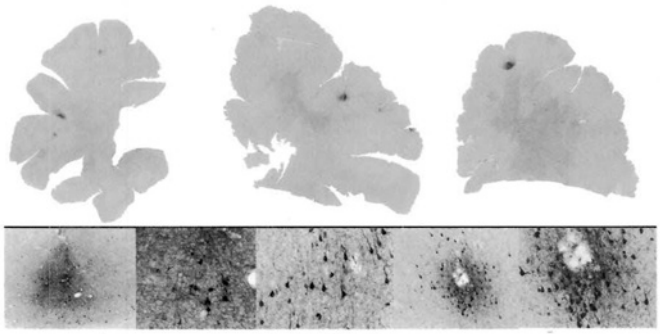


Figure 4. Coronal sections of the brain of Dave Duerson stained for phosphorylated tau protein show dense abnormalities throughout the brain. Bottom row: microscopic views of abnormal tau deposits showing extensive abnormalities of tau in nerve cells and support cells.

Case 5. Owen Thomas. defensive end University of Pennsylvania

Owen Thomas was a University of Pennsylvania defensive end who loved football and had played football since age 9. He was considered to be the life of the team and was unanimously voted team captain. There was no history of documented or undocumented concussion, depression or psychiatric difficulties, and no evidence of substance abuse. One day in the spring of 2010, he called his parents and told them he was stressed by school and having trouble with several of his subjects, two days later he hanged himself in his off campus apartment. Neuropathological examination of Owen's brain showed the unmistakable changes of early CTE with focal collections of NFTs in multiple areas of his frontal cortex and evidence of spread of the NFTs to adjacent cortical regions (Figure 6). Comparison of the brain of Owen Thomas to the brain of Dave Duerson shows remarkable similar pathology and suggests that if Owen Thomas had lived another 30 years, his CTE would have progressed to the moderately severe stage demonstrated by Dave Duerson.

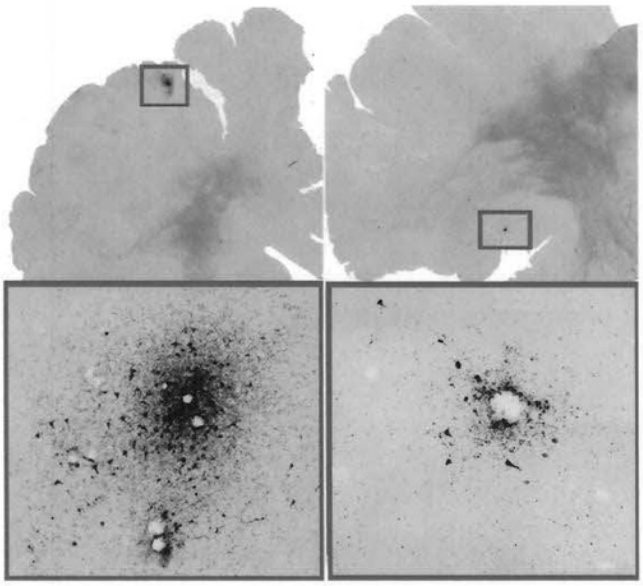


Owen Thomas

Figure 5. Coronal sections of the brain of Owen Thomas stained for phosphorylated tau protein show dense abnormalities throughout the brain. Bottom row: microscopic views of abnormal tau deposits. There was extensive nerve cell loss and advanced neurodegenerative changes throughout the brain.

Case 6. 18-year-old high school football player

I also have had the opportunity to examine the brain of a high school football player who died at the age of 18. He had played football and other sports for 4 years and suffered several concussions. The brain of an 18 year old should be pristine; there should be no abnormalities whatsoever. But in the brain of this young man, there were several areas of damage in the frontal lobe that you could see even looking at the slides with your naked eye (Figure 6, top row). In those areas, there were hundreds of degenerating nerve cells containing tau NFTs and disordered nerve cell processes indicative of early CTE.



18 year old

Figure 6. Brain sections from an 18 year old high school football and rugby player showing areas of damage in the frontal lobe (top row, red boxes), and microscopic views of views of phosphorylated tau containing NFTs in nerve cells and their processes in lower row.

Case 7. 17-year-old high school football player. death from Second Impact Syndrome (SIS)

A 17-year-old high school football player suffered a concussion 3 weeks before the day of his death and was cleared to return to play 2 days earlier. During the game, the running back and linebacker intercepted a pass and hit the ground. Nothing seemed exceptional about the tackle; it was considered a routine play. Yet as he walked to the bench, he complained of a severe headache and then collapsed to the ground unconscious. He died the following day. Neuropathological examination showed a thin subdural hemorrhage entirely consistent with Second-Impact Syndrome (SIS) and very early changes of CTE. He is the youngest player ever known to have changes of CTE on neuropathological examination.

Summary

I have now examined the brains of 58 individuals with neuropathologically verified CTE—including 40 professional and amateur football players, 5 hockey players and 15 military veterans.Ihave found changes of early CTE in several college and high school football players, including early changes in players as young as 17 and 18 years. We know that CTE is a tauopathy and TDP–43 proteinopathy associated with repeated mTBI that most commonly occurs early in life, usually an individual's teens and early twenties. We know that once CTE is triggered, the neurodegeneration progresses slowly over decades to involve widespread degeneration of many brain structures. We know that the symptoms of CTE are often insidious and begin in mid-life with prominent early personality and behavioral changes, including irritability, short fuse, depression, suicidal ideations, impulsivity, and memory loss. We know there is a slow deterioration that may progress to include dementia, parkinsonism, gait and speech disorders. However, there remain many things that we do not understand about CTE. An autopsy case series will never establish incidence and prevalence of this disorder, even though we now clearly understand that CTE exists—and that it is surprisingly common. What factors determine who will develop CTE—how many concussions or how many subconcussive injuries, how close together the injuries are, how severe, and at what age—all of these are aspects of this disease that are unknown at this time. Most importantly, we do not know how to diagnose this disease in living individuals, how to stop its progression or how to reverse its course at the present time. But we can make important changes to prevent this disease from developing in young athletes, and those changes include understanding what a concussion is, recognition of concussion when it occurs, and proper medical management of concussion after it happens. We can also teach our young athletes to play smart and to keep their head out of the game as much as possible. Rule changes to protect athletes from dangerous styles of play, rule enforcement and player and coach education will go a long way towards reducing the frequency of concussion. With these changes in the way sports are played, continued education, increased scientific research into the mechanisms of CTE pathogenesis, and the development of diagnostic tools and therapeutic strategies to interrupt disease progression, we can make an enormous improvements to protect the mental health of millions of young athletes and military service members for many years to come.

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The CHAIRMAN. That was excellent.

And so, we then finish with Mr. Mike Oliver. Let me repeat, Executive Director of the National Operating Committee on Standards for Athletic Equipment. And having read my preparation for this hearing, I am still a little bit confused about what you all do and what you don't do.

Mr. OLIVER. I think I can cover that.

The CHAIRMAN. OK.

STATEMENT OF MIKE OLIVER, EXECUTIVE DIRECTOR AND LEGAL COUNSEL, THE NATIONAL OPERATING COMMITTEE ON STANDARDS FOR ATHLETIC EQUIPMENT (NOCSAE)

Mr. OLIVER. Thank you, Mr. Chairman, Ranking Member Boozman, and members of the Committee.

I appreciate the invitation to come here today and provide some testimony and answer questions of the Committee on a topic that is extremely important to me personally, as well as to the organization I represent.

My name is Mike Oliver. Since 1995, I have served as the Executive Director and General Counsel for NOCSAE. NOCSAE is the National Operating Committee on Standards for Athletic Equipment. We are a nonprofit corporation which develops and publishes standards for athletic equipment, including helmets, faceguards, safety balls, and even soccer shin guards.

We operate as a board of 18 directors representing a wide variety of national sports, sports medicine, and other interested organizations. Each organization, by definition through our bylaws, selects one or two of its members to sit as a director on the board. And in addition to the 18 voting directors, NOCSAE has 2 nonvoting positions, representing the national sports governing bodies of the NCAA and the National High School Federation, the NFHS.

There is no single controlling interest or interest group on the NOCSAE Board, and a balance of interests and nondominance is inherent in the operational structure and function that is provided through our bylaws. NOCSAE is not a trade organization. There is no membership category. Funding for the operations and research that we undertake is received through licensing fees that we charge to manufacturers who want to certify equipment to our standards and to use our trademarked and registered logos, properties, and phrases.

Although NOCSAE is not a certifying body—we do not certify equipment independently of the manufacturers—we do engage in market surveillance of certified equipment, and we monitor product performance through mandatory third-party laboratory validation testing as required by our standards, as well as direct product testing through an A2LA accredited testing laboratory with whom we contract to provide technical support and services.

Decisions regarding changes to standards or the creation and adoption of new standards are driven exclusively by science and motivated by the desire of all board members to protect athletes, not by issues of manufacturer liability, profit, market share, or any other interests.

The mission of NOCSAE since its inception in 1968, is to commission research and establish standards for athletic equipment where feasible and to encourage the dissemination of research findings on athletic equipment and sports injuries. In fulfilling that mission, NOCSAE has funded more than $6 million in research grants since the first grant was issued in 1994, and that number includes more than $5 million dedicated to concussion-related research.

To be certified as meeting our standards, helmets, whether they are football helmets or batter's helmets, must score less than 1,200 severity index units on each of 16 impacts conducted at 12 miles per hour, including 2 high-temperature impacts and impacts on 2 randomly selected locations. In addition to those, there are four impacts at lower speeds, which have lower threshold requirements.

Although the standard for helmets that NOCSAE publishes are not concussion specific, the NOCSAE standard does directly address linear forces that are involved in most concussive events, and a helmet that passes the NOCSAE standard does provide some level of protection against those concussions caused primarily by induced linear accelerations to the brain. We do not promote helmets as being concussion preventive or anti-concussion because there is no way to accurately measure the extent of protection provided.

What the NOCSAE standard does not yet address and cannot yet address, and is a subject that is not addressed by any other helmet standard in the world, is how to establish and incorporate a threshold for rotational accelerations of the head that result from impact forces not directed through the center of gravity of the head. These rotational accelerations are directly involved in causing a significant number of concussions, and these types of accelerations can occur even without a blow to the head.

There is no protective equipment standard available today from any source that specifically addresses concussion prevention, and the development of a concussion-specific standard for any protective equipment requires substantial scientific support that compliance with the standard would, in fact, further eliminate or reduce the severity of concussions without increasing the risk of injury in other areas.

While helmets certified to the NOCSAE standards play a very important role in protecting athletes on the field of play, certainly helmets are not the only solution to providing better protection against concussion. Prevention, diagnosis, treatment, and management decisions about when athletes should return to play are equally important and, in fact, in some circumstances may be more immediately effective in reducing the number of concussions.

Education programs that have been referenced earlier today address these issues and are underway for coaches, and in fact, NOCSAE has entered into a partnership, as mentioned earlier, with the CDCP to create a specific Heads Up to Parents program

as an educational resource to promote this education among those who are certainly motivated to provide the best level of protection and education to their children.

NOCSAE recognizes that concussions are complex events, both biomechanically and physiologically. And scientists are working hard to understand these issues so that improvements might be made in protection, prevention, and treatment.

We are one of the primary funding sources for this research, and we are hopeful that answers will be found that will permit an amendment to our standards that will effectively and specifically address concussions. Any device, including helmets, promoted as being able to prevent, diagnose, or cure a concussion must be supported by scientific data and peer-reviewed research. The same is true with regard to standards for athletic equipment.

We fund concussion research with the intent to advance the science so that changes can be made to standards that will reduce concussions without increasing risk in other areas, and we have taken specific steps to be ready to do that when the answers are found. But without solid scientific support for a concussion-specific change to an existing helmet standard, any changes made to address concussions becomes nothing more than a hopeful experiment, turning players into involuntary test subjects. And that is something that we will not do.

I look forward to the Committee's questions and the discussion today on a topic that we consider to be extremely important.

Thank you.

[The prepared statement of Mr. Oliver follows:]

PREPARED STATEMENT OF MIKE OLIVER, EXECUTIVE DIRECTOR AND LEGAL COUNSEL, THE NATIONAL OPERATING COMMITTEE ON STANDARDS FOR ATHLETIC EQUIPMENT (NOCSAE)

Parents, athletes, and coaches, are becoming more aware and informed regarding concussion prevention, diagnosis, treatment, and the importance of following recognized return-to-play criteria. This increased awareness and public discussion is vitally important to advancing athlete safety, but it also creates a demand for quick solutions. Unfortunately, there are quick solutions offered for sale which have neither scientific nor medical support, and which carry the potential for creating a false sense of security and reliance on a level of protection that does not exist.

The neurobiology and biomechanics of sports concussions present complex and rapidly evolving areas of expertise both as to cause and prevention. Through its grant research funding program, NOCSAE has been one of the international leaders in helping to advance the scientific and medical knowledge relating to concussions. Despite the dedication of more than $5,000,000 in research grants since 1994, directed specifically towards the issue of understanding and preventing sports concussions and to developing protective equipment performance standards that could eliminate concussions or reduce their frequency and severity, scientific support for such standard does not yet exist.

NOCSAE, the National Operating Committee on Standards for Athletic Equipment, is an independent and nonprofit standard-setting body with the primary mission to enhance athlete safety through scientific research, education, and where feasible, the creation of performance standards for protective equipment. NOCSAE efforts include the development of helmet performance and test standards for football, baseball and softball, ice hockey, and lacrosse, as well as faceguards and face protectors used in connection with these helmets. NOCSAE bylaws provide that the Board is comprised of representatives selected by national organizations representing a broad base of interested parties and expertise. Broken into three general categories, NOCSAE directors representing end-user or direct athlete involvement include two new members from the National Athletic Trainers Association (NATA), the Athletic Equipment Managers Association (AEMA), and the American Football Coaches Association (AFCA). NOCSAE directors representing sports medicine and related sci-

entific research include representatives from the American College of Sports Medicine (ACSM), the American College Health Association (ACHA), American Orthopedic Society for Sports Medicine (AOSSM), the American Academy of Pediatrics (AAP), and the American Medical Society for Sports Medicine (AMSSM). NOCSAE directors representing product and manufacturing interests are selected by the Sporting Goods Manufacturers Association (SGMA) and the National Athletic Equipment Reconditioners Association (NAERA). In order to maintain balance between the interests represented and to preclude dominance or control by any group or interest, some organizations have one seat, while others have two. Currently there are 18 voting directors, five of which represent manufacturing and retail interests, 7 represent the athlete and end user interests, and 6 representing medical and scientific interests. NOCSAE also has two non-voting directors, one representing the National Federation of State High School Associations (NFHS) and one representing the National Collegiate Athletic Association (NCAA).

In support of its mission, the NOCSAE board utilizes a Scientific Advisory Committee consisting of independent leading experts in the areas of neurology, neurosurgery, orthopedics, biomechanics, and epidemiology. This committee meets as needed, and provides support, guidance, and advice in the areas of standards development as well as identifying areas for directed or targeted research.

NOCSAE also maintains an ongoing independent contract with an A2LA accredited and ISO 17025 certified testing laboratory, and a contract with Fred Mueller PhD who, as the Director of Research, oversees and administers the NOCSAE research grant application and funding program.

History of NOCSAE

NOCSAE was created in 1968 through the combined efforts of the NCAA, the American College Health Association, the NFHS, and the Sporting Goods Manufacturers Association to develop a football helmet standard that would be effective in reducing or eliminating fatalities from head injuries such as skull fractures and subdural bleeding that were occurring in organized football.

The standard which resulted from the efforts of the original NOCSAE directors and scientists mandated that football helmets meet a specific injury threshold criteria, commonly referred to as the Gadd Severity Index, Severity Index, or simply SI. The SI threshold in the NOCSAE standard works by limiting the magnitude of linear head accelerations that result when the helmet is hit. The first NOCSAE football helmet standard was originally published in 1973 and new helmets began to appear on the market certified to this new standard shortly afterwards. Eventually a requirement of compliance with the NOCSAE standard was incorporated into the rules of play by the NCAA and the NFHS in 1978 and 1980 respectively, and within a few years, helmets certified to the NOCSAE standards became required in all rules of play for governing bodies controlling football, even extending to the United States Military through the Department of Defense-Education Activity (DoDEA).

To be certified as meeting the NOCSAE standard, helmets must score less than 1200 SI on each of 16 impacts at 12 mph including two at high temperatures and two randomly selected locations, plus 4 additional impacts at two different lower speeds which have lower SI threshold requirements. Although not concussion specific, the NOCSAE standard directly addresses linear forces that are involved in most concussive events, and a helmet that passes the NOCSAE standard does provide some protection against those concussions caused by induced linear accelerations.

What the NOCSAE standard cannot yet address, and which is not addressed by any other helmet standard in the world, is how to establish and incorporate a threshold for rotational accelerations of the head that result from impact forces that are not directed through the center of gravity of the head. These rotational accelerations are directly involved in causing a significant number of concussions, and these types of accelerations can occur even without a blow to the head. Even less is known scientifically about concussion threshold values when the blow to the head results in a combination of linear and rotational accelerations occurring at different points in the same impact and with different magnitudes.

There is no helmet standard available today from any source that specifically addresses concussion prevention, and the development of a concussion specific standard for any protective equipment requires substantial scientific support that compliance with such a standard will in fact further eliminate or reduce the severity of concussions without increasing the risk of injury and other areas.

Protecting Against Concussions

While helmets certified to NOCSAE standards play an incredibly important role in protecting athletes in the field of play, improved protective equipment is not the

only solution to providing better protection against concussion. Prevention, diagnosis, treatment, and management decisions about when athletes should return to play are equally important, and prevention can be enhanced by enforcing the rules of play in a particular sport.

- Teaching and enforcing proper tackling techniques, which include not using the head as a weapon or primary contact point. These types of changes can make an immediate and likely measurable impact on the number and severity of concussions.
- Teaching athletes and active children at all ages that the signs and symptoms of a potential concussion should not be ignored, and should be followed up with an evaluation by someone properly trained and skilled in evaluating concussions.
- Adopting and enforcing return to play criteria that will prevent an athlete from returning to play until a complete and objective evaluation is completed.
- Helping parents, coaches, and players understand that although helmets provide a substantial level of protection, no helmet can prevent all head injuries, including concussions.

The Centers for Disease Control (CDC) estimates approximately 1.6 to 3.8 million sports-and recreation-related concussions occur each year in the United States, and children and teens are at highest risk. Parents, coaches and trainers must exercise caution in deciding when athletes can and should return to play. The Center for Injury Research and Policy at Nationwide Children's Hospital, funded in part by grants from NOCSAE, found that in 2008, more than 40 percent of high school athletes were allowed prematurely to return to play after suffering concussions. And, of those players, 16 percent of concussed football players were actually allowed to return to play *in the same game* after losing consciousness.

NOCSAE ongoing efforts to address concussions

As stated earlier, there are currently no helmet standards published in the world which contain performance thresholds specific to concussions. Helmet standards which limit linear accelerations do provide a level of protection for those concussions where linear acceleration may be the primary cause, but a concussion specific helmet standard to be effective must incorporate not only limitations to linear accelerations, but also reflect and incorporate an understanding of injury thresholds associated with rotational accelerations and strong scientific support for the concussion injury thresholds utilized. For many years, NOCSAE has dedicated its resources to answering those questions NOCSAE's first concussion research grant award of $49,000 was given in 1996 to Dr. Kevin Guskiewicz at the University of North Carolina to study the "Effect of Mild Head Injury on Cognition and Postural Stability" in evaluating potential concussion diagnostic modalities. In the past 10 months, NOCSAE has funded specific targeted concussion research grants totaling $2,319,000 to scientists and biomechanical researchers at Dartmouth Medical School, Dartmouth Department of Engineering, Wayne State University School of Engineering, Ottawa University Bioengineering Laboratory, and the Southern Impact Research Center. From that first concussion grant in 1996 through today's date, NOCSAE has dedicated over $5,000,000 to the study of sports related concussions to advance medicine and science in that area to the point that concussion specific changes to the NOCSAE standards can be adopted. These concussion specific grants are in addition to other NOCSAE funded research in the areas of sports medicine and science, including research that eventually identified the biomechanics and physiology of which may be preventable through the use of an appropriately tested chest protector that meets an impact standard currently being developed by NOCSAE.

As early as 2002 and 2003, NOCSAE was becoming aware through its sponsored research and from the research of others that any performance standard that might effectively address injury thresholds from rotational accelerations would require a new testing methodology in addition to the drop test which is utilized by all existing helmet performance standards. To that end, NOCSAE advanced funding for the fabrication of five prototype horizontal ram impactor devices, sometimes referred to as a linear impactor. This impactor is designed in such a way as to permit a testing apparatus to induce rotational accelerations into a helmet and headform in unlimited magnitudes, direction, and orientation, which no existing helmet impact drop tests are able to accomplish. NOCSAE decided in 2004 that the validation of such a testing component was necessary so that there would be no delay in incorporating rotational acceleration thresholds and testing in the NOCSAE standards once those thresholds were identified. A proposed revision to the NOCSAE standard incor-

porating this new testing protocol was published in 2004, and work has continued to this day in validating and refining the linear at five different laboratory locations around the country.

Public Education programs

In addition to regular public speaking engagements, daily interaction with the public to telephone calls and e-mails, and providing and disseminating research and educational information through the Internet, NOCSAE has entered into a partnership with the CDC National Center for Injury Prevention and Control to develop and disseminate a concussion awareness and educational campaign called "Heads up to Parents." This national campaign utilizes multiple informational outlets, including social media, to present parents and athletes with concussion information, building on the CDC's already-successful "Heads Up" initiative, featuring free tools that provide important information on preventing, recognizing and responding to a concussion. Materials can be found on the CDC's website, *www.cdc.gov/concussion/sports/*. These tools are an invaluable resource for parents as their athletes take the field, and NOCSAE is proud to be a partner with the CDC Foundation to provide financial and substantive support for the program.

Changes to the NOCSAE helmet standards

The NOCSAE helmet standard, unique among all existing helmet standards for the use of a biofidelic headform, the use of a pass fail criteria which incorporates both impact force and time duration (SI), and the requirement of low-speed and high-speed certification impacts, has undergone significant and substantial revisions and improvements since it was first adopted and published in 1973.

- In 1992, NOCSAE undertook a multi-factor revision to its testing protocol, which included implementation of a scientifically proven calibration method of the NOCSAE headform using a specially designed impact surface, added a requirement that headform calibration be performed rigid, and the air craft cable guide wires were replaced with smoother music wire. This decreased friction in the drop system and increased stability of the carriage assembly throughout the drop impact. The test impact pad was hardened from a 36 Shore A hardness natural rubber surface to a 43 Shore A hardness urethane to produce a more consistent impact surface. These changes resulted in significantly higher impact velocities and increased impact energies to the helmet, a more demanding test than in the previous standard. The increased impact energies now required in the testing were so significant that the impacts began to break expensive head forms and attachment assemblies, which required a redesign of those components.
- In 1996, NOCSAE amended its helmet standards by toughening pass fail criteria for helmets. The original SI value of 1500 was reduced to 1200, making it is 20 percent more demanding, and bringing the pass fail threshold in line with Federal Motor Vehicle Safety Standards.
- In 1999 an anthropometrically correct size medium testing headform was introduced along with other design changes to allow the headforms to withstand the new impact energies that resulted from the changes in 1992 and 1996.
- In 2003, a proprietary data acquisition system and standardization of data collection was developed by NOCSAE and implemented with all licensees, requiring that the pretest and posttest system checks be performed correctly or all helmet test data performed between these system checks becomes invalid. A temperature sensor incorporated in the software automatically invalidates all test data generated when the temperature of the test lab is outside the specified range. Additionally, the results of all impact certification tests are stored in encrypted files and available to NOCSAE by direct download or electronic exchange.
- In 2011, the football helmet standard was revised to add low level pass/fail thresholds for drop impacts at 7 miles per hour This low speed impact threshold is in addition to the 1200 SI pass/fail for drops of 12 mph.

NOCSAE enforcement of its standards

The NOCSAE name, and the various sport specific logos, phrases, and designs that are incorporated into the NOCSAE standards are registered and trademarked properties, and NOCSAE controls the use of those properties through a license agreement. Any manufacturer which intends to certify equipment to the NOCSAE standards must first sign a license agreement to do so. This agreement obligates the manufacturer to not only comply with the specific requirements of the standards, but also requires that each licensee provide certification testing data, quality assur-

ance and quality control program documentation, and annual reports from third party independent testing laboratories certified compliant with ISO 17025 requirements proving compliance with the NOCSAE standards for every piece of equipment certified by that licensee in the previous 12 months. In exchange for permitting the manufacturer to use the intellectual property of NOCSAE, a license fee is also charged. This license fee is non-negotiable, and is assessed on a per unit basis. The fees per unit are extremely small, but generate the revenue used by NOCSAE to fund the scientific research grant program which supports the content of standards.

The license agreement also obligates each licensee to obtain prior approval of proposed advertising which uses the NOCSAE name or references NOCSAE as part of its advertising.

Although NOCSAE is not a certifying body, we do engage in market surveillance of certified equipment, and we independently investigate certified equipment performance through mandatory annual third party laboratory validation testing, and direct product testing through our own contracted and A2LA accredited testing laboratory.

Recertification of reconditioned equipment

In addition to the standards that apply to the certification of new athletic equipment, NOCSAE has also published standards that permit previously certified equipment to be recertified as part of a formal reconditioning process. NOCSAE standards for the recertification of previously certified athletic equipment provide schools, clubs, universities, and even professional teams with a way to economically maintain the performance and integrity of their certified helmets, and provide NOCSAE with the opportunity to reevaluate helmet performance even after they have been in use for one or more seasons. The recertification standards require that reconditioners test a statistically significant number of helmets submitted for reconditioning and recertification. These helmets must be tested first in the condition they are in "as received from the field" before any repair or reconditioning is undertaken. Following completion of the reconditioning process which includes a thorough and complete inspection of every individual helmet for cracks and defects, and the replacement of worn or damaged padding and fitting components, these same randomly selected helmets are retested utilizing a proprietary data acquisition software program developed for NOCSAE by engineers at the University of Tennessee. The test results of the nearly 50,000 helmets from both pre-and post reconditioning tests are collected and evaluated every year.

Conclusion

Concussions are complex events both biomechanically and physiologically, and scientists are working hard to understand these issues so that improvements can be made in protection, prevention, and treatment. Any device or supplement promoted as being able to prevent, diagnose, or cure a concussion must be supported by scientific data and peer reviewed research. The same is true with regard to standards for protective equipment. Without solid scientific support for a concussion specific change to an existing helmet standard, any changes made to address concussions becomes nothing more than a hopeful experiment, turning players into involuntary test subjects.

The CHAIRMAN. Thank you for that excellent testimony.

We have been joined by Senator Klobuchar from Minnesota, where they are having quarterback difficulties.

[Laughter.]

Senator KLOBUCHAR. We do have a team, however.

The CHAIRMAN. Yes, you do. That is true.

Senator KLOBUCHAR. Thank you.

The CHAIRMAN. I am from West Virginia. I deserve that.

What is interesting—that is good, Amy.

[Laughter.]

The CHAIRMAN. I have spent a lot—my mother spent I think about 12 years dying from Alzheimer's. Actually, you couldn't really be sure. But die she did. My wife's father died from Alzheimer's. There are so many—there are 5 million people that have Alzheimer's in this country.

And one of the stunning things about Alzheimer's, which, incidentally, if you are working in that traumatic brain injury area, you can do that while you are working on Alzheimer's because there is a lot of sort of common threads in there. The stunning thing is the *New York Times* came out with an article 6 or 8 months ago basically saying that the last 30 years of research at the great institutes of research in this country had produced absolutely no progress whatsoever on finding out the cure for Alzheimer's.

Not for preventing and not for slowing it down, not even yet for testing to find out whether you have it, although that may be on the way. But that doesn't cure it, which is what we want. That is a stunning figure.

Now comes along the injuries that are sustained by concussions, made more poignant by the fact that they come so early in life and can have such terrible consequences that you, Mr. Threet, and you, Ms. Ball, decided not to do what you had spent your whole life preparing to do. It is not necessarily typical. I mean, it was a very mature, wise decision to make.

So I just want to kind of throw this at all of you. You could develop a 50-pound helmet and all it would do is more securely, I think—unless I am wrong—it would just more securely make sure that your head doesn't get split open. But it wouldn't do one thing for the movement of the brain, to stop the movement of the brain.

Which then, if you say that emphatically enough, it raises the question of what can you do medically? You can analyze. We do that with Alzheimer's. People—you have a registry of Alzheimer's brains. People leave their brains to be studied just like you have had, and you learn from that, from the synapses and all those kinds of things, the tangles. You can tell.

But that doesn't do them any good. And so, I want to raise two questions. One is to the medical side of this. Do you think I am wrong? I mean, do you think that this is just because it is a relatively early discovery?

To be quite honest, I didn't know at all that somebody who played soccer could get this until I watched that movie about the winning when we beat China back in 19—whatever it was, in 1980. And that incredible, powerful back that the Chinese all stayed away from because she just flattened them, she had chronic fatigue syndrome. She didn't have a brain concussion of any sort.

And you see soccer a lot now. All of us watch soccer a lot more, and you see people using their heads and you don't notice whether bands are on there or not. But just the amazingness of the ignorance of the American people about this problem, even though we now know much more than we did know about it.

I want to know just right off the bat how hopeful you all are realistically about being able to find a solution to this so that the brain is not thrown off of its axis, you know, electric stimulus and all the rest of it. Can this happen?

Dr. McKee. Well, I personally am very hopeful. We didn't know about this disease 5 years ago in any real way, and what we have learned in the last 5 years has been extraordinary. We have just made enormous gains in understanding how it affects the disease,

what the disease looks like, how it progresses through the nervous system.

And now we understand this disease exists. We can try to model it in experimental systems and come up with those therapies that might help us treat living patients.

And I actually think that this disease may ultimately be a window or provide insight into the diseases like Alzheimer's disease. Alzheimer's disease is characterized by a buildup of this protein tau as well, and maybe by understanding how this disease starts and how it progresses, we may actually have insight into Alzheimer's disease and how it starts.

One of the most difficult things about Alzheimer's disease is we don't have any idea. It starts silently. Maybe in a person's 50s. We can never identify it precisely, how it exactly starts. But this is a disease we know has a time course, and we know what to expect, and it develops over time. And I think it is going to give us an enormous opportunity for intervention.

The other thing about Alzheimer's disease is most of those therapies——

The CHAIRMAN. Do you mean a prevention of the disease because of helmets or other——

Dr. MCKEE. No. I think understanding the actual pathologic process and intervening there, intervening maybe at the start of the disease where it is triggered or preventing it from progressing through the nervous system. There appears to be a transmissibility through the nervous system that it develops in one nerve cell, and then it causes the disease to be propagated in another nerve cell.

If we could interrupt that progression, we could make an enormous difference in this disease, and that may be applicable to Alzheimer's as well. One of the issues with Alzheimer's is we were focused on the beta amyloid protein, and that has really come up pretty—we haven't come up with much. But we haven't focused on tau that much, and maybe that is the cellular element we really need to start paying attention to.

The CHAIRMAN. Can I ask one of you two athletes, is it the prevention of something that you now know you already have from becoming worse that interests you the most? Well, the answer has to be yes. Or is it the absolutely vast amount of change in the way everybody in this country thinks about the playing of sports, the carrying out of sports, the responsibility that people have?

I mean, there are a lot of coaches in rural states that are also math teachers. That probably isn't very good for either coaching or math. But that is the way that works. People don't know.

So if you are talking about not letting it happen in the first place, that means you have got to tell the person to keep their head up. Well, try telling that to an NFL player who has just been chopblocked by somebody, and he has a chance to get back at them. You know, human behavior is very hard. Human behavior under stress is very hard to control.

And so, I don't know what the chances are or if we have enough time, or maybe if the shock of what people are learning or if we do more of this that coaches and parents—and parents are often a lot less helpful than they think they can be in this. Have a lot less influence on their kids because kids just want to go ahead and

do it. "I am 17. Don't tell me I can't do this again." So, I mean, you do it after you know you have it, and try to prevent it from happening?

Mr. THREET. I would say yes. I mean, obviously, I believe awareness would be the biggest issue. If you could just increase the knowledge base for the general public and for the athletes, I feel like recovery would—that athletes would do a lot better with recovery. They would take time to allow their brains to recover.

I don't think brain injury is viewed as a serious issue throughout athletes. It wasn't for me until I had a concussion that changed what I was able to do in school on a daily basis.

The CHAIRMAN. In your locker room—I am way over time. I apologize. In your locker rooms, both of you, is there any discussion about all of this among the athletes themselves?

Ms. BALL. Concussions are talked about kind of lightly still, at least when I went through playing. It is a lot of people, even if you have got your concussion one day and then you are resting, players are like, "Well, I don't see them hurt. Why are they sitting out?"

And I think that mentality needs to change is you see that your fellow athlete got a concussion. You need to give them the respect to let them rest, and that just comes from the culture that we have right now about the ignorance about concussions.

The CHAIRMAN. I will bet our doctors, do our doctors get any good training on this in their medical?

Dr. KUTCHER. I would have to say not as good as I would like.

The CHAIRMAN. It is like geriatrics, right? They study it.

Dr. KUTCHER. Essentially.

The CHAIRMAN. They go into it for a while, find they can make more money elsewhere, and they depart?

Dr. KUTCHER. Pretty much. I mean, that wraps it up. I would like to make a comment on your original question, if I could, about am I optimistic or not? And the answer is yes. I am optimistic.

But your story about Alzheimer's and the lack of improvement and understanding for treatments is very applicable to this situation, but it is also not unique to brain pathology in general. Think about stroke, multiple sclerosis. We don't have cures for these things either, and decades and decades and billions of dollars. So the bottom line is the brain is complicated.

I do want to make a quick comment that I think we are talking about more than one thing here, at least two or three as far as diagnoses go. CTE, on the one hand, a degenerative neurological process that most likely is coming from repetitive blows to the head, and concussion are two different things. And I don't think for a moment that these folks here are a risk—a high risk of developing CTE, the neurodegenerative disease itself.

I think we are at a stage now where we are just starting to understand the scope of the problem. As Dr. McKee mentioned, we don't know the prevalence of this. We are finding the tau more and more often in brains of athletes who have had impacts, and military personnel as well. But how does the tau relate to the neurological disease? We don't know that.

There are people that she has found tau in that had no neurological problem at all. So I don't want to over alarm these folks

over here that because they have had concussions that they are going to have CTE later in life.

The CHAIRMAN. I am way over my time. I apologize to my colleagues.

Senator Boozman?

Senator BOOZMAN. I am glad you mentioned that because I was going to ask Dr. McKee. She mentioned the 17-year-old that had one reported concussion then passed away. Were there other reported concussions prior to that?

Dr. MCKEE. No. I don't have—I don't have any other reported concussions.

Senator BOOZMAN. So we really don't know if he played through——

Dr. MCKEE. Right.

Senator BOOZMAN.—concussion or just the repeated blows of being in whatever position he was in. It really is a real problem. I think you all testified so well, Ms. Ball and Mr. Threet, the problem is to play athletics at the level that you played at, you are in pain every day that you go out there.

Sometimes they are not significant injuries, but there are broken fingers—a fingernail that was pulled off, or something. I mean, these nagging things that can be very, very painful and athletes are taught you have got to play through that or you don't get to the level that you all were able to play through. So it is very difficult.

To follow up, you really didn't feel like then that head injuries, the concussion aspect, really was talked about very much in your career?

Mr. THREET. Yes, for me, it wasn't a serious topic until my last concussion I had playing quarterback. I had to be out on the field, whether it was shoulder separation, ankle sprain, whatever it was. You know, shoot it up. I am ready to go. And that is not the case with brain injury.

You can't—like I said, you can't just take something to get rid of the pain and then deal with it later and let it recover at a later time.

Senator BOOZMAN. And sometimes not really being in horrible pain——

Mr. THREET. Right.

Senator BOOZMAN.—compared to some of these other injuries that aren't that significant.

Mr. THREET. Right. Exactly.

Senator BOOZMAN. Do you agree with that, Ms. Ball? You didn't get much education in that regard?

Ms. BALL. I agree completely. I think now concussions are something that is being taught in youth sports, but when I was growing up, playing both high school and college, it was just a concussion. That is all it was.

Senator BOOZMAN. Dr. McKee, working with the VA, I have been on the VA Committee in the House and now in the Senate, and we really spend a lot of money trying to figure out the IED component of this, which is similar or the same. Do we have a test now that we can identify if somebody has gotten a pretty good blow? Is there an easy test to determine?

Dr. MCKEE. No. We need lots of research to determine that. And that is something we don't have. We don't have a way of identifying definitively a concussion, other than a series of neuropsychometric tests, balance tests, all sorts of things. So we don't have an easy way of detecting it or monitoring it.

And that is definitely a very important issue that the VA is addressing, as well as the Department of Defense. That is a crucial issue.

Senator BOOZMAN. You two are board certified and well trained, and I suppose that with your licensure, you have to achieve so many hours of continuing education to continue your certification. What I am wondering in the course of this, we hadn't really talked too much about the education aspect of people that are wanting, Mr. Threet, you are wanting to get into—you are coaching a little bit now, and perhaps maybe you are going to pursue that.

Were you a PE major?

Mr. THREET. No, sir. No, sir. I am coaching as my playing career ended.

Senator BOOZMAN. What I am concerned about, and maybe we can visit with somebody at some point, is when you are taking the course "Coaching Football," or "Coaching Basketball," if they are talking about this and the importance of education.

Dr. KUTCHER. I can speak to that. At the NCAA level, they have made essentially a policy that all athletes and coaches need to receive concussion education annually. You see conferences like the Big 10 and the Mid American Conference that I work with having that policy as well.

When they started their careers, we didn't do that. At the University of Michigan now, every year, all of our athletes get a lecture from me or one of my delegates on concussion. So do the coaches. So things are improving.

There is a long way to go, especially as we go down the levels to high school and junior high school and the Pop Warner leagues. We have a lot more work to do, but there is sort of a push in that direction to make people need to get education before they participate either as a player or a coach.

Senator BOOZMAN. No, I think that is excellent. And I do think that those are the little things that really are going to make a difference.

And then, again, encouraging our teaching institutions to include that in the curriculum. And then, also in the State sanctions, as they do their continuing education, to make this something that is talked about every year would be very, very helpful.

The other thing I would like to touch on very briefly, and you all can comment, Dr. Kutcher, Dr. McKee—and Mr. Oliver, I know that you are probably going to talk much more about this. But the idea about being able to certify a helmet as something that won't prevent concussions.

The Chairman mentioned about a 50-pound helmet. Theoretically, as you reinforce the helmet and make it heavier, if you could do that, then it is more of a weapon. So you actually create another problem in doing that.

But can you just comment briefly about that.

Mr. OLIVER. Certainly. Senator Boozman, I appreciate that comment because I think it is very apropos of the difficulties that we face in trying to come up with a standard to address a specific issue like concussions.

To a certain extent, the mass of a helmet is protective. The more the mass, the more energy it takes to move the helmet and move the head. In theory, the ideal helmet weighs, has an infinite mass at the point it is struck and then goes back to zero mass afterwards, which is clearly impossible to do.

But there are limits to what you can do with a helmet as far as mass. You get to a certain point, that extra weight becomes a risk in other areas, and you increase the risk of neck injuries. You increase the risk of other injuries by doing that. So there is a tradeoff in that regard.

I do think there is progress that can be made once science gets to the point where they can identify those specific forces or combinations of forces and the resultant forces that are likely responsible for some of these concussive issues. The thing that is probably most restrictive is the fact that right now you can't study a living human brain at that level, at the molecular level or at the axonal level, while it is being subjected to blows to the outside to see how they respond.

There are ways to collect data in the field to show how much the forces are and how much the head is seeing, and we just started a very large research project with Dartmouth University, Dartmouth School of Engineering, and Wayne State University to look at the use of diffusion tensor imaging, MRIs, which can look at actually the nerve fibers following an injury, to follow a football player from a concussive event.

We know the forces. We can do the DTI imaging and then take that information and put it into a finite, what is called a finite element analysis program that Wayne State is creating that would then, hopefully, let us model what happens to the brain when it is struck in certain circumstances and with that model be able to start coming up with concepts about how to address those forces, how to attenuate certain kinds of forces better than they are being done right now.

With the goal, and I am very hopeful that we will get there at some point, to be able to come up with a standard that we can confidently say if a helmet meets this standard, which would include these issues, then you can have a comfort level that it will provide against, provide protection against concussions.

Now, not all concussions and it certainly would never be said to prevent a particular amount, but it would be designed to meet those specific issues that we know cause concussions. But having the science behind that is absolutely preliminary, and you can't move forward without it.

Senator BOOZMAN. Thank you, Mr. Chairman.

The CHAIRMAN. Thank you, Senator.

Senator Udall?

Senator UDALL. Thank you, Mr. Chairman.

Dr. Kutcher, your testimony states, and I think you said this also orally here, there is no data in the published medical literature

that shows any particular helmet being better than any other at preventing sports concussions.

Last year, however, the CEO of Riddell testified before a different Congressional committee that Riddell has "independent, peer-reviewed, published research in the medical journal *Neurosurgery,* February 2006, showing that Revolution"—that is the name of their helmet—"reduces the risk of concussions by 31 percent when compared to traditional helmets."

One of the authors of the 2006 study told the New York Times earlier this year that he disagreed with Riddell's marketing the 31 percent figure without acknowledging its limitations. Yet Riddell has extensively used this concussion safety claim in its marketing, and here is just one example with this poster that is behind me.

[An image of the poster follows:]

This is an example taken today from the website of Riddell's parent company, and I think you can read that.

The CHAIRMAN. I can't read it.

Senator UDALL. Do you think this single 2006 study provides a reasonable basis for Riddell to claim that the research shows that Revolution helmets reduce the risk of concussion by 31 percent compared to the traditional helmets?

Dr. KUTCHER. No, I do not. I am aware of this study, and what I said was that there is no significant data to make that claim in the literature. I know there is data. That study is in the literature.

There are mainly two problems with that study. First is the quality of the study itself, how it was set up in trying to look at two different populations, one wearing a certain helmet, one wearing another kind of helmet. You want those populations to be as equal as possible, other than which helmet they are wearing. And that was not very well done in that study, to the point where I would not really consider the study design to be acceptable scientific protocol.

The second main critique is that the 31 percent figure is a relative percent change. So the two populations, the one that had the old helmet had a 7.6 percent concussion rate over the study period. The new helmet had a 5.3 percent rate. The change was 2.6 percent. The absolute percent change. That is a relative percent change.

But when you put the 31 percent figure in front of people like that, they are going to think that there are 31 percent less concussions. Well, actually, it is 2.6 percent and that amount, given the study limitations, would more than account for sort of that noise in the data.

Senator UDALL. And you can see why a parent who would be concerned about concussions with all the awareness, increasing awareness that is out there would see something like this and see 31 percent and think, "I am going to get a really protective helmet for my child." And really, what we are talking about is something that is very, very misleading.

Dr. KUTCHER. Well, I can see that, and I do see that every week in my clinic. I see patients coming in with their parents saying they want to buy the new helmet. This is the concussion helmet. What do you think about it? That is a very real conversation I have all the time.

Senator UDALL. And they are asking you that question over and over again?

Dr. KUTCHER. Correct.

Senator UDALL. And typically, what do you tell them? And then, do you know what they do afterwards?

Dr. KUTCHER. So my advice is the most important thing is to have a new helmet if you can get one. In other words, try to avoid the reconditioning situation where you don't know whether the helmet is still up to standards provided by NOCSAE.

But fit is really important. Make sure the helmet is fit correctly. And then, after that, I say look at the different manufacturers, and if money is not an option, buy the highest one on the line because what is lost in this conversation is you can't have a concussion without force, right? But force is not the only thing going on here, right?

So if I took 100 athletes or 100 people and gave them the same blow to the head I am going to get 100 different responses. So to say that concussion is the issue is ignoring the fact that it is forces acting on a brain that is very individualized and very dynamic.

So, at the end of the day, if I am going to pick between a helmet that gets the least amount of force through versus one that gets a

little more force through, I am going to pick the one that gets the least amount of force through. I think that is a fair thing to say. But to say that it is going to prevent concussion is not understanding the whole complexity of the issue.

Senator UDALL. Thank you very much.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you, Senator.

Senator Klobuchar.

STATEMENT OF HON. AMY KLOBUCHAR, U.S. SENATOR FROM MINNESOTA

Senator KLOBUCHAR. Thank you very much, Mr. Chairman.

And again, I heard about this really for the first time. You had heard stories in my State, but at the Alzheimer's dinner, this big dinner they have in Minnesota. And an athlete actually came and spoke about the research, and I just walked away from that sort of blown away at some of the facts and things that are out there and the need for more education.

And I then held an Alzheimer's forum this summer, and one of the things that I learned was that just this early diagnosis of Alzheimer's and the same thing what I learned was that a lot of the players are donating their brains, I understand, that get dementia to research. But how the early diagnosis of Alzheimer's and also of this any advancement of problems due to a concussion could really help us not just help the patient, but potentially develop a cure.

Because the Mayo Clinic is the one that diagnosed Pat Summit, the most winningness high school basketball coach in history—college. Thank you, Mr. Pryor. And the Mayo Clinic was able to do that because they have these advanced ways to now recognize early diagnosis.

And I finally realized that that is part of finding a cure because you can't practice different kinds of solutions and medications and things without knowing early on. If you wait too long, when someone is too advanced, you can't actually tell whether things are working or not. And do you want to comment on that, Dr. McKee?

Dr. MCKEE. Well, absolutely. You have to have some sort of test that can monitor the course of the disease in order to be able to tell in a living patient if it is being effective. So the first thing we have to do is develop diagnostic markers, biomarkers of both concussion and these other phenomenon.

So, concussion, post-concussive syndrome, and CTE, they are all quite different. But we definitely need the diagnostic marker so that we can monitor living patients. And in that way, once we develop therapies in the lab in experimental models and we get to the point where we are testing them in living people, we can actually see if they are working. Without that, we can't tell if they are working or not.

Senator KLOBUCHAR. And Dr. Kutcher, the Academy of Neurology headquarters based in Minnesota, we are proud of the work of the Neurology Association in our state, and could you talk about the work that is being done to develop meaningful, evidence-based clinical practice guidelines? I know that is happening.

Dr. KUTCHER. Sure.

Senator KLOBUCHAR. So that we are able to get guidelines for athletes, and if there is any scientific data available on that?

Dr. KUTCHER. Well, right now, if you look in the literature, you will see maybe a dozen or more consensus statements. Groups get together and come up with what the experts think should be the best way to approach concussion diagnosis and management. But to date, there has not been an effort that has looked at the totality of the literature in a critical way, looking at the quality of the data, sorting through the papers, and coming up with what do we have that is evidence based in this issue. So that is what our effort is.

We started this 2½ years ago. It is a committee of 12 people—5 neurologists, 7 non-neurologists. The other seven folks are from other medical specialties—sports medicine, physiatry, neurosurgery, neuropsychology. And the goal here was to really create a sense of where we are and where we need to go.

Now there are some of our management practices that have some evidence, but I will tell you that most of them don't. And so, the goal here, and we are hoping to be published in the spring of 2012, is to really set forth what are the steps we need to take to get the data to have a good sense that we are doing something that is evidence based.

Senator KLOBUCHAR. Very good. Ms. Ball, Mr. Threet, thank you so much for being here today.

I know that organizations like the Brain Injury Association, NFL, Athletic Trainers Association, Centers for Disease Control are working to increase awareness, educate the public. As students who had this happen, what do you think the best ways are to get the information out there to your fellow students and players?

Mr. THREET. Well, I believe there is a lot of progress being made already through information, educational seminars that we have at the schools. I know in Arizona, I was part of Bill 1521 that implemented protocol for high school athletes that they have to attend a class, their parents have to attend a class, their coaches have to.

I think just a requirement to understand what the brain is doing when it is injured and how serious that it is.

Senator KLOBUCHAR. And we did that in our state this year, too.

Mr. THREET. Exactly, yes.

Senator KLOBUCHAR. And I would hope that is happening.

Mr. THREET. And it is spreading, and I think it will only increase, to gain significance.

Senator KLOBUCHAR. Ms. Ball?

Ms. BALL. I agree with preventive measures needs to start, we are doing high school. But if we can even start younger, youth sports that are like I know within soccer, there is club soccer, which is very prevalent among youth. And within New Mexico, different clubs are taking initiatives to teach the coaches about concussions, and I think that needs to be spread out to the teams and to the parents as well.

Because once people are aware of what a concussion is and how serious it can be, I think that is when we finally take that next step forward.

Senator KLOBUCHAR. One last question. After you had your concussions and you decided not to keep playing, did you feel any pressure to keep playing from your peers, from other parents, from——

Mr. THREET. I personally didn't. All my doctors, coaches, family, fellow players were very supportive of my decision to stop playing.

Ms. BALL. Yes. I think people respect your decision to stop. Obviously, they want you to keep playing because they miss you playing with them. But overall, people have been very supportive.

Senator KLOBUCHAR. Very good. Thank you very much for being here.

The CHAIRMAN. Thank you, Senator Klobuchar.

Senator Pryor?

STATEMENT OF HON. MARK PRYOR, U.S. SENATOR FROM ARKANSAS

Senator PRYOR. Thank you, Mr. Chairman.

And thank you for having this hearing. It is a very important issue that touches this country all over the map and also in many different sports.

Let me start with you, if I may, Mr. Oliver, I would just like a little context on the legal framework here in terms of are there state laws on helmets in sports? Do athletic conferences—like high school athletic conferences and associations—do they have rules about this and standards?

And also, the NCAA and the NFL, when it comes to football, do they have standards? What is the legal framework here?

Mr. OLIVER. Well, the legal framework is actually fairly simple. The standards that we publish, for example, for football helmets, and that is the best example because it probably applies across the board to other sports. We publish the standards that are performance standards that indicate what helmets are supposed to do to meet the standard, and it is a multifactored standard.

Then an organization, for example, like the NCAA will incorporate into their rules of play a requirement that helmets that are worn by those athletes meet our standard.

Senator PRYOR. In terms of the helmet itself?

Mr. OLIVER. In terms of the helmet itself. You cannot wear a helmet for play in the NCAA unless it has been certified as being—as meeting our standard.

Senator PRYOR. And then they may also change their rules in terms of, like, hitting the quarterback or——

Mr. OLIVER. Absolutely.

Senator PRYOR.—head-to-head contact, that type of thing?

Mr. OLIVER. Absolutely. The rules of play then control, if you will, how the helmets are used. But certainly, things like spearing or butting or ramming an opponent using your helmet as a weapon are also prohibited by the rules of play.

The same process applies to high schools through the National High School Federation, although because it is a federation, it doesn't control directly each of the state associations. But they participate voluntarily.

There are some states, for example, California, has a law that requires at the high school level that athletic equipment, including helmets, be cleaned or sanitized on an annual basis. That has been interpreted to mean that the helmets included in football play must be also reconditioned. And if they are reconditioned, then they are

going to get recertified, which means you are going to be subject to recertification testing and evaluation.

Senator PRYOR. Which means new pads, no cracks——

Mr. OLIVER. Exactly. And it means they have to be subject to a fairly rigorous sample testing program. They are tested before they are reconditioned and tested again after they are reconditioned.

But that is the only state to my knowledge that actually imposes that requirement by law.

Senator PRYOR. But on the high school level generally, is it voluntary?

Mr. OLIVER. For the reconditioning?

Senator PRYOR. Yes.

Mr. OLIVER. It is voluntary. There is no requirement that helmets be reconditioned or recertified on any frequent basis at the high school level.

Senator PRYOR. And how long—in your organization's view, how long—again, let us stay with the football helmet—how long is it good for? Is it good for one season before it needs to be reconditioned or——

Mr. OLIVER. That is really going to depend upon how hard the helmet is used and what kinds of use and abuse it has been subjected to. We strongly recommend any time I am contacted that helmets be subject to reconditioning and recertification every year, simply because there is no way to tell in advance whether a particular helmet needs it or doesn't.

And we know from the reconditioning data because we get this data back from them every year that about 90 percent of the helmets that they recondition and recertify have been in the previous year. So a large percentage of them are done on an annual basis.

What is not happening, which is something we are trying to address, both through the CPSE as well as individual work, is those football organizations at the youth level that aren't subject to state control or NCAA control, where very little is known about the nature of the population of those helmets. If they don't voluntarily submit those helmets to a recertification program or replace them on their own, there really is no umbrella organization that is in charge of most of those players in those clubs. And that is an area that does need to be addressed.

Senator PRYOR. One last thing, Mr. Oliver, what is the general life expectancy of a football helmet?

Mr. OLIVER. You know, it depends on the manufacturer. Riddell has for years put what is basically a 10-year life on their helmet. They have said that after 10 years, no warrantees apply. They don't allow helmets that are older than 10 years to be reconditioned or recertified, and that has been their policy for a long time.

Schutt, one of the other major manufacturers, has said as long as the helmet is properly cared for and it has been properly reconditioned, which means parts replaced, padding replaced, shells inspected, at the end of 10 years, the only part of that helmet that is 10 years old is probably going to be the shell.

And you can't replace the shell in the reconditioning process. If it is cracked or damaged, the helmet is done. So it really just depends on the helmet and the company as far as how long it is going to last and how well it is cared for.

Senator PRYOR. Dr. Kutcher, if I may ask one more question? Dr. Kutcher, what is the—and you maybe covered this earlier, and I am sorry I was late coming to the hearing—but what is the sort of age scale we are looking at for concussions in sports? I mean, I assume you have some at very early ages, but is there—do they get more common and more severe as you get older, as the players get bigger, stronger, faster? Is that how that works, or tell me what the statistics say.

Dr. KUTCHER. So the range goes down to the youngest athlete you could imagine, whenever they start playing organized sports. So 7, 8, 9 years old, I see kids with concussions that young.

As they mature and get faster and stronger, you will see larger impacts and more injuries. I think as they go up, junior high, high school, you are going to see greater numbers of concussions. And actually, there is some data that shows that basically every level you go up from organized youth to high school, to college, to pros, the incidence will go up. And you can imagine why. Because the play is a little faster. Athletes are a little stronger.

The other idea, though, is that the younger kids may have longer injuries. They may have more complex injuries, maybe more difficult to get them back as quick. So that sort of adds a different wrinkle to it.

Senator PRYOR. Mr. Chairman, if I can ask just one more question? Again, maybe you covered this earlier. But when I think of concussions and sports, I think of football, but I may be totally wrong on that. Is that the most common, and sort of what is the list of the most risky sports for concussion?

Dr. KUTCHER. I would say football is at the top of the list.

Senator PRYOR. It is way ahead of everybody else or——

Dr. KUTCHER. So, first, it is tough to get good data that compares sport to sport because you have to study it in the same population. There are some pretty good studies that have looked at in the high school population. For example, in Fairfax County, Virginia, researchers did some great work there looking at the different sports.

And football had about a double the incidence of the next highest sport, which I believe was lacrosse. But women's soccer was right there. And then, after that, it was men's soccer, wrestling, basketball, softball, going down the list. Ice hockey wasn't in that study, but I would put ice hockey probably a little bit lower than football, maybe 20 percent lower than that in general.

Senator PRYOR. Thank you, Mr. Chairman.

The CHAIRMAN. Thank you.

We can start another round. Incidentally, every time the bell rings, what you have to understand is that is telling you precisely that there is nothing happening on the floor of the——

[Laughter.]

The CHAIRMAN. It is only when it keeps ringing that we have to go vote.

Ms. Ball, we are talking about soccer. And Mr. Threet, just like Tony Romo, you were slammed down to the ground. I mean, that is part of the deal, right? It is not just that you hit a helmet, but you slam the guy down. So his head has to hit the ground, which is often hard.

There are so many ways in football to see how a revenge hit, just a mean player who is famous for that and loves it and gets endorsements because of it, commercial endorsements. Soccer is extremely brutal, exhausting, on a huge field where there is usually, what, one, two, three, or four goals scored, and that is it.

So in thinking about it myself, and I have watched a lot of it basically because of that 1980 triumph, it is heading the ball. Or because I don't think that you probably are slammed down to the ground or tripped up, a lot of tripping up, deliberate tripping up. Does that mean the head hits? I don't know.

But what are some of the ways, if it was ranked number three by Dr. Kutcher, what are some of the ways that concussions come about in soccer other than heading the ball? And if it is heading the ball, is it heading the ball from any part of your head?

Ms. BALL. Concussions come about in a lot of different ways while playing soccer. Heading the ball tends to be relatively safe if you use your forehead. The concussions come when you take the ball off the top of your head, most likely from a punt because of the ball is moving at much greater speeds, or when a ball gets shot and you happen to be in the way, you will take it on the side of your head. That is how concussions can also occur.

For me, the most common way of sustaining a concussion was actually I hit my head to the ground. It was the type of player I was. I would get my legs knocked out from underneath me, and I would hit my head on the ground. And when you watch soccer, you are watching where the ball is at.

So that play might happen, and you just don't even see that that player goes down and hits their head. And so, that is why I think oftentimes those thoughts are bypassed is because you are not aware because you are following the ball, where that is going.

And then another risky area is where you are going in confrontations against the goalie. The goalie is either going to get—I have seen goalies get their heads kicked, and I have also seen players going up against the goalie getting kneed in the head.

And so, there are a lot of different circumstances that you can get a concussion.

The CHAIRMAN. Like in hockey?

Ms. BALL. Right.

The CHAIRMAN. Yes. There is so much work to be done by so many. I think of—I am a sports fan. You know, you watch college and professional football, and there is almost an instinct to look, Mr. Threet, for the player who plays dirty. And then, if he does, you turn your wrath on Roger Goodell and the NFL for not having him ejected from the game. Referees have that responsibility. They can fine him or push him back 15 yards. They should be ejected from the game.

How do you influence—I mean, young men who play football are in it to win. They don't have long careers.

Mr. THREET. Right.

The CHAIRMAN. If you are a running back or if you are a quarterback, what is your career?

Mr. THREET. Running back has the shortest, yes.

The CHAIRMAN. Yes. So that adds sort of a desperation to succeed. How do you get at that stuff? I mean, somebody comes in and

gives you a lecture, all the athletes are gathered in a big locker room, somebody gives them a lecture on concussions. I will bet half the people aren't listening because they haven't had them.

Mr. THREET. Yes, and I think it is very difficult, especially in football, from the defensive side of the game, violence is probably the biggest, the biggest characteristic you need to be successful on defense. You have to be able to be violent, and that is——

The CHAIRMAN. And known to be violent?

Mr. THREET. Right. Yes, and that is part of—yes, exactly.

The CHAIRMAN. You have to show your violence, right? You have to prove it?

Mr. THREET. Right. Right. And that is part of the football game. And so, as far as that sport is considered, I feel like it is more of the understanding about brain injury and understanding of the recovery process, as opposed to, yes, you know, they are changing the game, getting rid of head-to-head contact and that aspect. But I think more of it is the recovery when it happens because there is always going to be big hits in football.

The CHAIRMAN. And a lot of those big hits——

Mr. THREET. And a lot of them are legal, too. But it is not just like the doctors have said. Exactly.

The CHAIRMAN. Yes, a lot of them—if another, a third person involved clobbers the second or the first.

Mr. THREET. Exactly. And it is blows to the body just as well as it is blows to the head, as Dr. Kutcher noted also. So I think it is——

The CHAIRMAN. Oh, I mean, if you get clobbered in the chest or something, that can concuss you?

Dr. KUTCHER. Absolutely.

The CHAIRMAN. I am sorry. I missed that.

Dr. KUTCHER. Yes. Anytime your head moves fast enough and the brain inside is moving fast enough. So you get a whiplash type of thing.

The CHAIRMAN. What will do that?

Dr. KUTCHER. What is that?

The CHAIRMAN. What kind of hit will do that?

Dr. KUTCHER. Hit to the body, hit from the side, anything that transmits enough force to stop your movement.

The CHAIRMAN. So that means that quarterback and tight ends ought to be very, very large?

Dr. KUTCHER. Right. Steve gets sacked, gets hit in the chest and the body hard enough, his head whips back. He doesn't have to hit anything else, and that could do it.

Mr. OLIVER. Chairman Rockefeller, a perfect example of that, last year we all heard about DeSean Jackson's concussion playing in the game between the Atlanta Falcons and the Philadelphia Eagles, and I don't recall whether there was a fine or a penalty for that hit. But if you watch that hit in slow motion, and it is available I think even on the Internet, you will see that there was no head-to-head contact between the tackling player and DeSean Jackson.

He was hit here in the shoulder. But it snapped his head violently forward and then violently backward as he is going down, and that is, I think, exactly the kind of mechanics that you are

talking about. You have these concussions where you don't have a blow to the head, but the head itself is moving through so many different planes of motion so rapidly that the brain sort of doesn't have time to catch up to itself and sort of gets folded over and compressed.

The CHAIRMAN. I am over my time once again. I thank everyone.

I am going to have to leave. I have to go to a cybersecurity hearing. That is a different kind of threat, and Senator Udall is going to take over the hearing.

But the Ranking Member? Oh, Senator Thune? He could have been a tight end.

[Laughter.]

The CHAIRMAN. Please?

STATEMENT OF HON. JOHN THUNE, U.S. SENATOR FROM SOUTH DAKOTA

Senator THUNE. I am up?

The CHAIRMAN. You are up.

Senator THUNE. Oh, OK. Thank you.

Well, I appreciate that very much. Thanks for holding the hearing, and I thank our panelists for sharing your thoughts with us. And I kind of want to follow up on some of the line of questioning that was started earlier, but this is—you know, you are seeing participation at an all-time high in terms of kids, young people across the country participating in sports and an incredible number of sports-related injuries among youth.

And sometimes they are head injuries, a lot of other injuries as well. And I think when most people think of concussions, as was mentioned, we think about football. I think there are lots of other sports where we are seeing that.

We have got a lot of younger people participating in football, for example, and I know my—I have got an 11-year-old nephew who got a concussion. He is out for a month. And it was a hit where he went back and hit his head on the ground.

But it just seems like we have got, with young people out there, more and more injury occurring at an earlier and earlier age. And my question relates to whether that is something that we should be concerned about? I mean, are we starting kids too early in sports like football, where they are experiencing concussions at higher rates than they have in the past?

I mean, what is your perspective on the rise in the number of concussions? And I guess—are some of these kids developed enough, capable enough of taking the kind of shots that they are taking and the kind of hits that they are taking at that age and the types of injuries that they are sustaining at an earlier and earlier age?

Dr. KUTCHER. I will start. I think concussions—the issue with concussions being up, we are seeing more of them. I think it really has three main causes. The biggest one is awareness. I think that would explain the vast majority of the increased numbers that we see over the past really 5 to 6 years.

The second one would be kids being faster and stronger at earlier ages and playing perhaps more violently, but also our games have changed, too. If you look at how football has evolved, for example.

I had one of our ex-coaches, old-time coach, lecture me on how people have been blocking over the years and tackling over the years, and now we see a lot more hitting and a lot less tackling.

When actually if you think about the point in football on the defensive side is to stop the ball, you do a much better job if you have got somebody up, bring him to the ground, rather than trying to launch yourself and cause this big, violent hit. And so, for those three reasons, I think the numbers are up.

As far as concussions in the younger ages, I think there is always a sense for me that we have to keep track of the dose of hits that the kids are taking. I think the younger ages, yes, you want to be more careful. And do we want to postpone when you can hit in hockey, postpone when people can start wearing pads and playing tackle football?

I think that is a very good idea, but it is more complicated than that because at some point, kids have to learn how to hit and how to be hit and how to avoid the big forces, and that can only come with practice. So it is a pretty complicated question there.

Senator THUNE. Well, I think that, you know, I look at the advances in equipment—just my dad played football back in the late 1930s. He was a senior in high school in 1937. I remember at that time, they had leather helmets, and he was 130 pounds. He played middle linebacker, and he was hitting a lot of guys coming across. And I know he got knocked out, got knocked cold in one game. And I think at that time, they treated everything with whiskey.

But when I played in the 1970s, the helmets had gotten a lot better, and I look at the athletes today, and the equipment has improved a lot. I mean, the amount of padding in there, protective gear that athletes are able to wear. And so, we have made great advancements.

But as you have said, these athletes are bigger, stronger, faster, and the contact, the hits that I watch just every Sunday watching the NFL, there are some real contact being made there. And so, you wonder if the type of equipment that we have is adequate to that.

And that, specifically, might be more to football, but I am interested in knowing, too, in some of these other sports like soccer or rugby, water polo, that haven't traditionally required a great deal of safety gear, is there additional equipment available that could lessen injuries and concussions in those types of sports? Anybody on the panel who would care to answer that?

Mr. OLIVER. Well, I mean, I can address that in general. Whatever you can do to reduce the severity of concussions or the frequency or perhaps even eliminate some concussions in one sport would be the same in the other. I mean, you are talking about the same brain responses, the same input forces, the same accelerations.

And if you can determine how that can be done from a biomechanical standpoint and a biophysical standpoint in football, you can probably figure out how to do that in other sports. So I think the key is first finding those answers that would let you to address it in a particular sport, and then you can extend those by reference to other sports, if you can get to that point.

Senator THUNE. Anybody else want to add to that, soccer player, no?

OK. I see my time has expired, Mr. Chairman. So thank you.

Senator UDALL [presiding]. Thank you, Senator Thune.

And Senator Boozman, you want to——

Senator BOOZMAN. Just very quickly.

Senator UDALL. Yes, you have some things that——

Senator BOOZMAN. It seems that 99.9 percent of the injuries that are suffered are not due to current equipment failure. You guys, when you were hurt, your pads were there. Something didn't break and sustain. Now I don't know about through the little leagues, but in the stuff that is being tested, most of that is working pretty well.

I don't worry so much about the big hits that we see where somebody is actually having to be helped off the field because we all know something is wrong. I worry more about the injury where you tackle somebody, and as you tackle them, he knees you in the face and smacks you pretty good. And you are able to get up.

We are conditioned or you guys were conditioned, we were all conditioned to play through injury, and you go ahead and stay out there. The way I would like to close, as we have a lot of moms and dads and coaches and players watching this is with any messages that you can send out to the parents, how they can be better prepared to deal with this if it does come up? And chances are, it probably will.

Mr. THREET. Yes. Well, I mean, I think from the athletes' standpoint, just increasing their ability to be honest with coaches and parents and athletic trainers and understanding for themselves when something doesn't feel right. Light-headedness, dizziness, any of the symptoms. If the symptoms are known and they start feeling those, then it needs to be required that they make that known because it can happen on any hit.

I have had ones that happened on not severe hits, and the Riddell helmet is 30 percent less.

Ms. BALL. I think it is important not only to address your symptoms when you have them, but even once you finish having the symptoms is give yourself the little bit of extra time because that can prevent you from maybe not having to end your career is if you give yourself those few extra days of leeway, then you can prevent the long-term injury.

Dr. KUTCHER. I will add to that. I think the recognition of the injury issue is huge, and athletes hide their injuries. I know that. I see that every day. But acutely concussed people also don't know they are concussed often. They are not aware of it.

And what that means is that falls on the responsibility of everybody else around—their teammates, the coaches, parents, whoever—to look after them. And when a kid says, "Oh, I am fine. I am straight. I can go," you have to question that a little bit. So recognizing the injury, and I am actually starting to see teammates coming to me and saying, "Hey, I think he is not right. Go check him out."

And as Steve said, once it has been recognized, you have to report that to the medical staff, to whoever, and have that patient or that athlete removed from participation and then allow them to

recover fully before they get back to play. So, actually, it is four Rs. It is recognition, reporting, removing, and recovering.

Senator BOOZMAN. Very good. Dr. McKee?

Dr. MCKEE. I guess what I would say is that I don't see this—I think I would say that I don't see this problem going away with equipment. I think equipment is going to improve this issue, but it is not going to solve this issue.

And we really have to address the way sports are played, the nature, the style of play, the amount of hitting that we allow, the amount of contact we allow in the play of the sport. And that is what is going to make a tremendous difference, I think, down the road. But I don't see, even a perfect helmet, there is always going to be those acceleration, deceleration sort of whiplash forces that we can't control.

Senator BOOZMAN. Mr. Oliver?

Mr. OLIVER. I think I would simply echo the panel's comments. There are a number of interventions that need to be enforced and encouraged. And depending on the circumstances, one may be more important than another. But overall, you can't avoid any of them. And to the extent that you shouldn't just rely on better diagnosis and return to play criteria, you also can't rely on just having good equipment. You have to do all of those things.

You have to change the attitudes of the players and the parents about reporting those symptoms. Take that stigma away from this need to be macho or strong or invincible.

One of the things that I have seen, and it has been effective, is changing behavior based upon some of the data that has been collected at the collegiate level through the helmet instrumentation. They have noticed the ability to identify players who have more hits on the top or the crown of their helmet than other players, which shouldn't be happening because there is an association with an increased likelihood of concussion there.

We see schools, I know University of North Carolina specifically, with Dr. Guskiewicz, identifying those players and going in and engaging in behavioral modification so that they are taking that act out of the game.

If you start that at the very beginning with youth players and teach those coaches and teach those players that you don't hit with the top of your head, you don't hit with your head at all. The helmet is there to protect you in case you get hit, and you can't avoid it. You change all those things, I think you make significant reductions in the number of concussions and the severity.

And you certainly can reduce the chance of having these catastrophic consequences of returning to play too soon or having multiple concussions that aren't properly treated that let you heal. So all of them are important, and I don't think you can ignore one or treat one as more important than the other.

Senator BOOZMAN. Thank you, Mr. Chairman.

Senator UDALL. Thank you, Senator Boozman.

I wanted to return just a little bit to some of the misleading claims on equipment. I know there has been a lot of discussion about equipment, and Dr. McKee, talk a little bit about anti-concussion mouth guards. Have you seen ads such as this one for a mouth guard that is sold for use by kids 11 years and under?

And you can see the poster here in the background. This mouth guard was purchased last month. The product packaging states this mouth guard reduces the risk of concussions, and it creates brain safety space. Given your firsthand knowledge of the dangers of repetitive brain trauma, are you troubled by this type of marketing for youth sports equipment? Do you think young athletes who have already had a concussion might be particularly susceptible to advertising claims for so-called anti-concussion devices?

[An image of the poster follows:]

Dr. MCKEE. Well, I believe there is no clear evidence that any mouth guard or chin guard reduces either the rate or the severity of concussions. So I would have great objection to this claim.

The only thing that I am aware that mouth guards and chin guards do is they reduce oral and facial, dental, dental injuries. But the nature of concussion would not be improved by the use of a mouth guard.

Senator UDALL. I know you weren't able to see the one I was holding up, and I think it has been produced down there just in case you see anything else on it you wanted to comment on.

Dr. KUTCHER. I agree on that.

Senator UDALL. Yes, please?

Dr. KUTCHER. I don't know what "brain safety space" really means. That term—that is little alarming, really.

Senator UDALL. Well, there is a diagram on it.

Dr. KUTCHER. Yes, I see it.

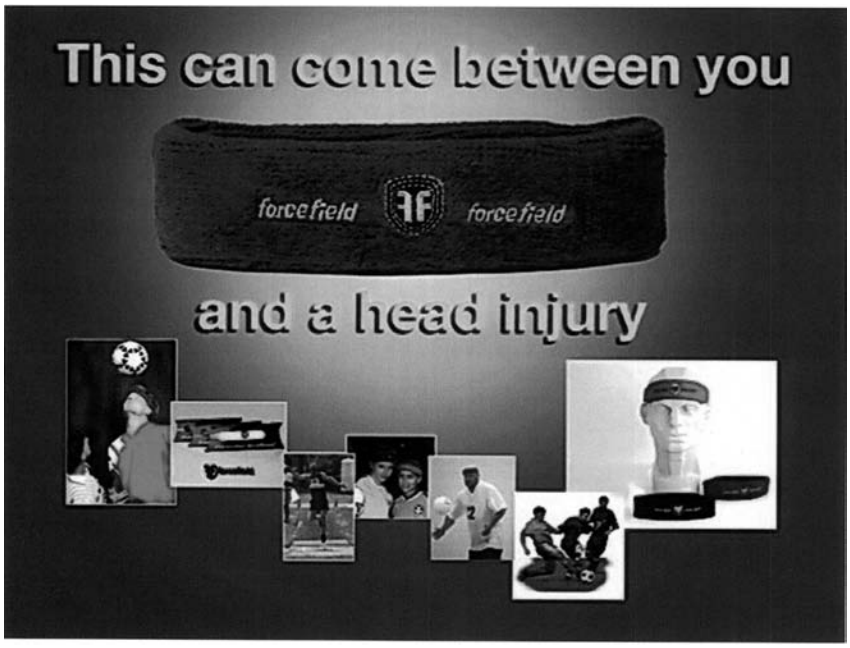
Senator UDALL. You can see it. There is a diagram, and it shows a space, and it says "creates brain"—I believe specifically it says, "creates"—what is the term it uses? "Creates brain safety space."

Dr. KUTCHER. Again, the idea from some of the work that has been done with accelerometers and helmets of football players and seeing at what forces they end up having clinically diagnosed concussions, those concussions are occurring over a wide range of forces.

There are 15-g hits that do it. There are 115-g hits that don't, right? And so, if you are taking amount of force that is 115 and you are reducing it to 110 or so—I don't want to get the numbers wrong—because of a mouth guard, you might be reducing the forces a little bit if the hit is coming from this way, but concussions are occurring on a spectrum of forces that that won't address.

Senator UDALL. I know Ms. Ball mentioned headbands in soccer, and I want to ask, Dr. Kutcher, you about this one. You discuss in your testimony the potential harm from creating a false sense of security when companies falsely claim that products prevent concussions.

This is not just about helmets, and it is not just about football. Here is another example. This is a protective headband sold to soccer players and other athletes. Here is an image taken from this company's website that says, "This can come between you and a head injury."



Does this type of advertising for a protective headband trouble you? Is there a danger that a young athlete might put himself or herself at greater risk of injury if they believe that this headband will come between them and a head injury?

Dr. KUTCHER. I do believe there is a problem there. This type of advertising is a little more vague because it just mentions head injury and not concussion. So you could make an argument that perhaps there is a mechanism there to prevent some superficial lac-

erations and bruising and that kind of a thing. But for concussion, I don't believe that—well, there is no data that supports that they decrease the risk of concussion.

I have seen in my own practice, as I testified, athletes who have become more aggressive and have actually injured themselves and others because they have the headband on. They go up and they head the ball more. They get involved in head-to-head hits more when they would not have done that without the equipment before.

Mr. OLIVER. Senator?

Senator UDALL. Yes, please, go ahead.

Mr. OLIVER. What I was going to say is there is another risk here. We have seen this both with helmets as well as devices like headbands that a player who has sustained a concussion now sees this or the parent sees this as the answer. My kid has had a concussion. He is just now getting over it. But if I put this on, everything is fine.

And so, not only a false sense of security from being protected from the first concussion, but being protected because I just had one, and this will give me this extra layer. And it is incredibly dangerous.

Senator UDALL. Did either of you as athletes experience any of this that we are talking about here in terms of the headband being protective or—yes, Ms. Ball?

Ms. BALL. I wore headgear that is not this brand, but similar after I got my second concussion as a preventive measure. And I will say that I did adjust my play, whether I had my headgear on or off.

And I didn't really think about it critically, whether it would be actually doing anything for me. If I had my headgear on, I would head the ball more aggressively. I would play differently because I thought for some reason, I would like be secure from getting another concussion. And if I didn't have my headgear on, I played much differently.

Senator UDALL. Mr. Threet?

Mr. THREET. For me, I used a variety of different football helmets. I would always get a new one after a concussion. I would alternate brands, styles. Yes, so I would try different things, but they all—I guess the risk is still there.

Dr. KUTCHER. And that is really common, by the way, to college football or football in general. You get a concussion, go on to the next brand because, obviously, that brand is not the right one for you.

Right? That is——

Mr. THREET. Yes. I mean, that is the equipment managers would say that, well, maybe just try a different style and be better next time.

Senator UDALL. Let me return to the Riddell helmet testimonial claim, the one on no repeated concussions. In a July 23, 2010, memorandum to head coaches, head athletic trainers, and club equipment managers, NFL Commissioner Roger Goodell wrote, and this is a quote, "It is important to remember that no helmet can prevent concussions or reduce the risk of concussion to any specified degree."

Yet one NFL head athletic trainer has made several product endorsements for the Riddell Revolution football helmet. And a Riddell video news release, titled "Riddell Revolution UPMC Media Campaign," highlights Tim Bream of the Chicago Bears, states that, "We have had some players who have had ongoing problems with head injury, and we made the switch to the new protective headgear when it came out at its inception, and these players have had no problems since then or no repeated concussions."

Dr. Kutcher, do you expect a youth or high school football team to have no repeated concussions after switching from traditional helmet designs to Riddell Revolution helmets?

Dr. KUTCHER. No, I don't.

Senator UDALL. Pretty straightforward in your opinion.

Dr. KUTCHER. Yes.

Senator UDALL. Dr. McKee, I don't know if you have any thoughts?

Dr. MCKEE. I think this is beyond my level of expertise. It is not my area.

Senator UDALL. And Mr. Oliver, I want to ask about the maximum life span of football helmets. I think you talked about that a little bit in relation to Senator Pryor questioning you. The National Athletic Equipment Reconditioners Association announced that starting next year, it will no longer recondition helmets that are 10 years or older.

NAERA executive director stated that he would not want his son wearing a helmet that old. NOCSAE's technical director Dave Halstead told the New York Times that he, and this is his quote, "would never let his kid wear a helmet that is more than 10 years old."

Well, Ralph Conradt's 17-year-old son Max was unknowingly wearing a 20-year-old football helmet when he suffered a brain injury. Ralph wrote to me. It was after some of this came out. "How is it possible that our son was issued a helmet 3 years older than he was?" Why does the NOCSAE standard not set a maximum life span or number of years before a helmet should no longer be used?

Mr. OLIVER. There are a number of reasons why we don't, and the first reason is you have to tell me what the helmet is you are looking at. If it is a 10-year-old helmet that has never been used or has been used two seasons, should that helmet be replaced simply because it has reached a birth date of 10 years?

There is no data that suggests that that helmet, because it has reached an age of 10 years, is more or less protective than any other helmets that are of a similar age. The other thing has to do with whether or not you are using a 10-year life or a 12-year life or an 8-year life because there has been a change in technology.

If 10 years ago or 9 years there was a radical change in the technology of helmets such that older helmets don't provide the same measurable level of protection, then it would make sense to have that life span cutoff. We have always relied on the manufacturers to specify if there is a safe life on their helmets.

And one of the reasons we do that is because we, by intent, maintain our standards as design neutral. Part of the design neutral process is to not impose upon a manufacturer an obligation to use a particular kind of material or a particular shape of the shell

or a particular design to allow innovation and progress in those areas.

If a helmet company makes a helmet and they say this helmet is good for 15 years as long as it is regularly reconditioned and recertified, then they must have data to support that, and it is their helmet, their design. What we do know, and we know this from reconditioning testing data, that helmets that are properly cared for—they are properly reconditioned. Their padding is replaced when it starts to wear. They are inspected for cracks, and they are properly cared for.

When they are retested after being used in the field and after being reconditioned, those test numbers look very much like they did when that helmet was brand new. No way for us as an association or as an organization that sets the standards to say from our tests that a helmet that is now 8 years old or 10 years old that scores essentially the same as it did when it was new should be replaced and force schools, for example, to replace maybe a third or half of their helmets, when maybe the helmets don't need to be replaced.

And the other question that you have to ask yourself is, right now, there are Revolution helmets on the market that are approaching 8 years old. And I am not endorsing any particular helmet. But there has been a great cry, if you will, to move from older style helmets to newer style helmets.

If there is a helmet on the market today or being used today that is 8 years old and it is a new technology helmet, and it has been properly cared for, padding replaced, and retested on an annual basis, what is it that happens at 10 years that makes that helmet suddenly need to be thrown away if it was safe at 9 years or safe at 8 years? And we don't have the data to suggest that.

I think the position, the decision that NAERA made with regard to 10-year helmets was a policy decision they made that they just weren't going to do that for helmets older than 10 years. And I know they see some helmets that are 15 and 20 years old.

Senator UDALL. Does NOCSAE require the helmets have a clearly visible date of manufacture and a date of last reconditioning label?

Mr. OLIVER. We do. We require both of those things.

Senator UDALL. And do you know how many high school or younger football players are wearing helmets that are 10 years or more in age?

Mr. OLIVER. We don't know specifically. What we know is from the data for helmets that come back in for reconditioning because we get that test data back at the end of each season. And we know that sample, and this is a ballpark figure. But approximately 89 to 92 percent of those helmets are less than 10 years of age.

Again, it is going to vary year to year, but that is the best we can come up with.

Senator UDALL. And do those helmets 10 years and older still meet NOCSAE current helmet standards?

Mr. OLIVER. They will if they have been through the proper program and have been properly reconditioned and had the padding replaced. They will. If they don't, they get failed, and they won't make it through the reconditioning process.

Senator UDALL. Yes. There is—I am shifting the issue a little bit here to supplements, and I think both of our physicians realize there has been a lot of evidence recently on supplements. And this has kind of surprised me.

There is a company selling supplements which claims that they "protect against concussions." It is called Sports Brain Guard. What are your thoughts on these claims about supplements and concussions?

[The information referred to follows:]

And I am going to send one of these down to you, but it is a dietary supplement that is called Brain Guard. Do you have any thoughts on that?

Dr. KUTCHER. I do. What are the components of Brain Guard? Is that the DHA, one of the DHA products, I imagine? Much like the other discussions we have had, there is no data that this type of thing will help prevent concussion at all really.

And I just kind of go back to a conversation we had earlier in the hearing about the amount of time and money that has gone into neuroprotective agents for things like stroke. I mean, decades and decades and billions of dollars, and we haven't found anything for a mechanism that we know much more about, cell death and stroke. We know that. We know how that works at the molecular level a lot more than concussion anyway.

And yet we don't have any answer there. So I don't see any data that would support the use of this, nor would I expect that we would be able to find any.

Senator UDALL. Let me just briefly just say in closing, first of all, thank you to the entire panel. I think your testimony has been very, very helpful, and I think parents and families out there are increasingly wanting to hear more about this, and I think the way you have engaged this today helps them a lot.

I think this issue of awareness, I think all of you have talked about raising the awareness level, and we need more education, and we need to start younger. And those are very, very important points.

And then the second, which you can see that I am passionate about, is this whole idea about misleading claims when it comes to equipment. It just seems to me that there is so much work that we need to do there to educate people. And people need to realize the old statement that is always used, "Buyer beware." I mean, you need to check out when you have one of these products, whether it is supplements or whether it is a mouth guard or a headband, you really need to look a little deeper than the advertising there.

So let me thank you again, and the hearing is adjourned.

[Whereupon, at 4:39 p.m., the hearing was adjourned.]

A P P E N D I X

PREPARED STATEMENT OF HON. FRANK R. LAUTENBERG, U.S. SENATOR FROM NEW JERSEY

No parent should ever have to fear for their child's life when they play sports. Minor injuries are always a risk, but no young athlete should ever walk off the field with life-threatening brain trauma. All it takes is one serious injury to keep a young person on life's sidelines forever.

In 2009 alone, almost 250,000 people aged 19 and younger ended up in an emergency room with traumatic brain injuries they suffered while playing sports. These injuries affect girls and boys alike. Girls soccer and boys football are the sports where most concussions occur among high school students.

This is a problem in college sports, too. In my state, Eric LeGrand—a Rutgers University football player—was paralyzed from the neck down during a game a year ago. Mr. LeGrand is improving, but his story reminds us we have a lot of work to do to make sports safer for all athletes.

I am working with Senator Tom Udall to strengthen safety standards for helmets. Parents are increasingly aware of the danger of concussions, and they deserve safe helmets that will protect their children from injury. Our bill will also make it a crime for helmet makers to make false or misleading claims about safety benefits.

Parents need the straight truth about helmets—not exaggerated claims that lull them into a false sense of security. I look forward to working with my colleagues to pass this bill and help parents, schools and helmet makers work together to protect our children.

I thank the Chairman for holding this important hearing.

PREPARED STATEMENT OF HON. MARK WARNER, U.S. SENATOR FROM VIRGINIA

Thank you, Chairman Rockefeller, for calling this hearing. I'd also like to thank my colleague, Senator Tom Udall, who has been a leader in highlighting this important issue for our country's student and professional athletes. Understanding the dangerous nature of concussions, better educating parents, coaches, trainers, and the athletes themselves on the symptoms and the precautions to avoid concussions, is critically important. Ensuring that all parties have the best, scientifically accurate information also is an important step in both the education and precaution of all of those involved.

I am fortunate to represent Virginia Polytechnic Institute and State University, *Virginia Tech,* located in Blacksburg, VA, which is home to both the four-time ACC championship team and a group of researchers who are doing groundbreaking research into understanding how different helmet construction can impact the severity of the impact of concussions. Led by Steven Rowson and Stefan Duma, Virginia Tech and Wake Forest researchers have developed a five-star rating system to better evaluate helmet performance for football players. Similar to the current star-rating systems for cars, the *National Impact Database* will provide better clarity on the construction of helmets and how that may impact exposure and risk of concussion. The database's first analysis of 10 adult helmets was published in May of this year, and it was first time researchers have provided the public with a bioengineering impact data study with comparative test results. The rating system was funded in part by the National Institutes of Health and the Department of Transportation, and this research is independent of helmet manufacturers.

This research indicates that current helmet performance is not directly related to cost. The database can now help consumers make better informed decisions based on independent data that compares the biomechanical performance of these helmets. I hope the star-ratings may also help push manufacturers to come up with better designs. The researchers do note, and I believe appropriately, that no helmet can provide full protection against concussions. There is considerable chance involved in

head injuries in football and other sports, and what advanced-design helmets can do is lower the risk. However, transparency and information certainly can help consumers, players, coaches and trainers make better-informed decisions.

I understand there have been concerns that some manufacturers have inappropriately marketed sports equipment, including helmets, by overstating the protections they provide. I share that concern, and I believe we must educate players, parents, coaches and trainers on the dangers of concussion and other injuries regardless of the equipment used. I look forward to working with the members of this Committee to ensure that there is minimal confusion in the marketplace over what it is that sports equipment can do. Helmets and other sports equipment provide one layer of protection, and it certainly does not eliminate the need for more awareness and public education about ways we might prevent and better manage concussions during sports activity.

I do, however, continue to strongly support continued research, based on sound science that helps us to help better understand how we can keep our young people safer while competing in sports activity. This includes—but it certainly is not limited to—the groundbreaking research on concussions that is currently going on at Virginia Tech.

I thank the Committee for holding a hearing on this important topic and stand ready to work with the Committee on possible solutions as we move forward. Thank you.

PREPARED STATEMENT OF SPORTING GOODS MANUFACTURERS ASSOCIATION (SGMA)

The Sporting Goods Manufacturers Association (SGMA) appreciates this opportunity to submit a statement for the record of this important hearing. We regret not being able to be represented in person but could not accommodate the hearing schedule due to a long-planned Board of Directors meeting in Chicago.

SGMA is the national trade association of sports footwear, apparel, equipment and accessories manufacturers, distributors and marketers. Our membership consists of hundreds of brands which produce and sell sports products in the United States and around the world. SGMA believes sports and physical activity enhance people's lives. Our industry's products make sports, fitness, recreation and exercise accessible, enjoyable, fulfilling and healthy for millions of Americans every day. Our member companies are proud of the role they play in supporting healthy, active lifestyles for all.

The primary business for many SGMA member companies focuses on designing, building, selling and maintaining protective sports equipment. We all recognize that participation in sports activities carries some risk of injury. While our products are designed to reduce that risk, no protective equipment can completely eliminate the risk. No helmet, regardless of design, material construction or technology can prevent all concussions or for that matter, all injury. With that realization, our companies strive through research, innovation, testing, refinement and consumer education to deliver products with improved protective qualities and properties, thereby enhancing the sport experience for the participant.

From its very inception, SGMA has been a leader in bringing the industry together to face challenges around reducing risk of injury. When SGMA was founded in 1906, national concern over football related injuries dominated the sports landscape. SGMA's original member companies banded together and joined forces with the newly formed National Collegiate Athletic Association (NCAA) to change the way football was played. Among the major rule changes implemented at that time were the prohibition of the Flying Wedge blocking technique and re-design of additionally protective football pants, rule changes that brought virtually immediate reduction in football injuries. The complementary nature of problem identification, rules modification, product innovation and culture change is a recurring theme in successful action to reduce sports injury, and one that bears thoughtful analysis as we address the urgent need to comprehensively address concussions in sport. Our experience tells us reducing sports injury requires a multi-disciplinary approach that engages the views and expertise of athletes, parents, coaches, trainers, sports league administrators, medical professionals, rules makers, standards setting bodies, scientific investigators, product developers and marketers, and the media.

In 1931, the industry adopted 11 Trade Practice Rules, " to provide new standards of competition, and . . . to abandon all that is unfair to the public and to one another." One of those Trade Practice Rules was "to work closely with various governing bodies to assure standardization of equipment specifications." This statement foreshadowed the need for an independent, science-based standards-setting organi-

zation, a subject we will revisit later in this testimony when discussing the National Operating Committee for Standards in Athletic Equipment (NOCSAE).

That same year, legendary Notre Dame Football coach Knute Rockne said of the SGMA membership: "I want to compliment the sporting goods manufacturers on the fine protective measures they have given football. Despite the much larger number of football players, there are fewer injuries now than in the past. The biggest factor in reducing the number of injuries has been the added protection which has been built into football equipment. Your industry is a fine asset to college athletics. You are making equipment right."

A few years later in 1934, SGMA founded its educational and instructional arm known as The Athletic Institute, which evolved for a time into a world leader in the production of educational books, films, and videos. One of the goals of The Athletic Institute was "to develop educational/training aids for athletes and coaches." For many years, SGMA and The Athletic Institute produced and distributed more sports instructional materials than virtually anyone in the United States. While SGMA is no longer in the training video business, we do believe tremendous progress in reducing risk of sports injury is attainable by utilizing new media capabilities to teach coaches, players and parents about proper technique. USA Football, the national governing body for youth football, has created an impressive on-line program that provides specific guidance on teaching age and size appropriate blocking and tackling technique. Pop Warner also has an excellent coaching education program. These are the basic cornerstones of reducing risk of injury. Matched with the NFL's concerted effort to reduce and ban head to head contact, sustainable cultural change is happening across the football community.

The sports products industry absolutely has a role to play here. It starts with product design and innovation. Helmet technology is steadily improving. Our companies invest heavily in research and development exploring new materials, design, construction, and durability. They explore performance and protective qualities at extreme temperatures and repeated use, direct impacts and glancing blows, linear and rotational forces. Currently, a tremendous effort is being directed at managing energy from low impacts, reflecting the possibility that concussions may be generated from lower energy forces than have traditionally been the focus of helmet design.

Football helmet manufacturers study videotapes of actual impacts to analyze and develop responses to concussive impacts. New technologies are being developed and implemented that measure in real time the nature and severity of impacts players receive on the field. There are several schools that currently employ this technology in their helmets, with immediate data being transmitted to sideline computers for trained professionals to monitor.

These innovations are not limited to football. Technology transfers amongst lacrosse, baseball and hockey head protection are raising quality of protective products in these sports as well.

The marketplace is vibrant. Two manufacturing brands have entered the football helmet business in recent years. Both have created excitement and awareness for their product, giving consumers additional choices of head protection.

A reflection of the product improvements generated by the overall football helmet industry may be found in a recently published paper from Virginia Tech University's Dr. Stefan Duma. While SGMA is not in a position to speak to Dr. Duma's ranking of different helmet models, Dr. Duma's broad conclusion merits mention. Dr. Duma stated, "The results clearly show that the newer technologies across all manufacturers are significantly better at reducing the risk of concussions compared to older models."

In addition to creating innovative products, the sports equipment industry can help leverage our connection to players and parents to communicate critically important pieces of information. One area the football helmet industry is exploring today centers on the appropriate fitting of a football helmet. Regardless of brand or model, one of the most important factors in the effectiveness of a football helmet is that it is correctly fitted to the player's head. Correct fitting is fundamental to ensuring the protective properties of a helmet are maintained. All football helmets are designed to fit snugly, they should never come off in normal course of play. Yet, on any given Saturday or Sunday in the fall, television images of helmets flying off players heads are far too common. Our industry is exploring ways to work together in educating coaches, league administrators, parents, equipment managers—anyone responsible for providing helmets to players—on how to ensure the helmet is properly fitted.

Further to the point of education, the football helmet industry is in early stages of discussing if there is a way to improve warnings—messages to consumers as to what the product can do, and perhaps as important, what the product cannot do.

Of course, all sports protective products currently carry warnings. The industry, in consultation with many partners and interested parties, is exploring whether standardized language, graphics and placement would improve the clarity of the message to the consumer.

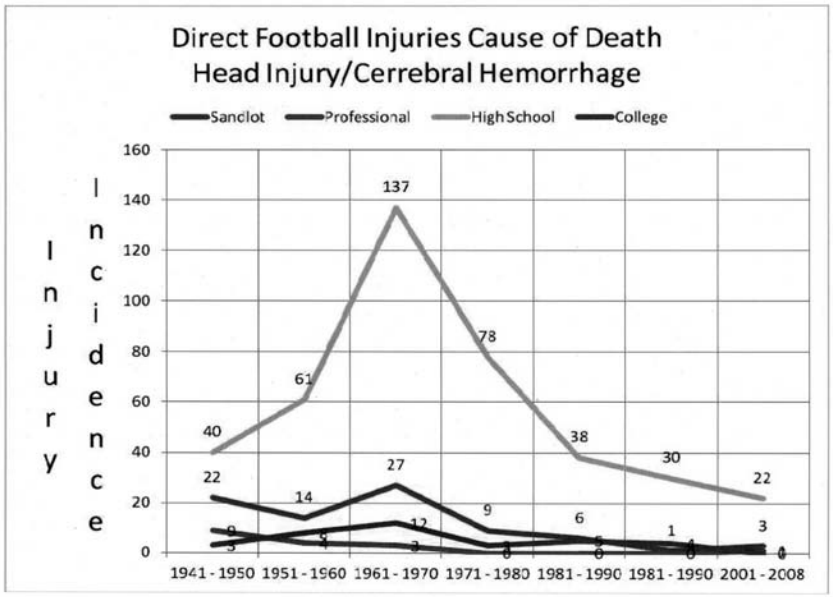
Recognizing so much that can and should be done to address concussions, it's important also to note some of the significant and specific challenges we face in developing a successful integrated approach to reducing incidence of concussions in sport. Most vexing is that scientific consensus of what is a concussion and what causes concussions is evolving. Clearly, the medical and scientific community has gained a better understanding of the symptoms, proper precautions, cumulative impact and long term effect of concussions. The "Return to Play" protocols being enacted around the country are a great response certain to improve player health. These new understandings have led to new helmet technology and innovation, but the direct effects of low force impacts and their causal relation to concussive events remain unclear. Influences such as ambient temperature and hydration levels of players may be important, along with "g" forces and direction of impact. Simply put, more research is needed. Products innovations will continue based on available data, but helmet manufacturers need more conclusive data.

The issue of a special performance standard for youth football helmets arises here. At one level, it may be intuitive that a specific standard for youth helmets is required. However, many in the scientific and helmet research community have raised concerns that creating a new standard without understanding the risks of unintended consequences is bad policy. Again, lack of scientific consensus raises a red flag for some. SGMA members welcome the call for additional dedicated research on this specific question, as soon as possible.

The National Operating Committee on Standards for Athletic Equipment (NOCSAE) is the primary standards-setting body for sports equipment in the United States. Product performance standards are created and managed by NOCSAE, along with test protocols to ensure product integrity. The 20-member Board of Directors oversees NOCSAE operations. SGMA sits on the Board, along with representatives of the American College Health Association, American College of Sports Medicine, American Orthopedic Society for Sports Medicine, American Football Coaches Association, and the American Medical Society for Sports Medicine, amongst others. The organization is independent and science-based. NOCSAE ensures the sports products industry is regulated and monitored. SGMA believes NOCSAE has been effective in establishing, promulgating and enacting strong voluntary standards, with demonstrable results.

Since the advent of the NOCSAE football helmet standard, catastrophic head injuries in the sport have declined by 85.5 percent. It is important to note this reduction was accomplished during a period when the number of athletes playing football more than tripled and the size, strength and speed of the players increased exponentially. It's penetration of the football helmet market, for example, is total. SGMA believes that virtually no helmet sold in the U.S. marketplace fails to meet the NOCSAE Standard.

The chart below highlights the impact the NOCSAE standard has had on catastrophic football injuries since it was introduced.



NOCSAE Football Helmet Standard published 1973. Reconditioner's Standard Revised to NOCSAE standard, 1977.

Source: Football Fatalities and Catastrophic Injuries 1931—2008. Dr. Fredrick Mueller and Dr. Robert Cantu, Carolina Academic Press.

The NOCSAE football helmet standard has been modified more than 20 times since it was created in 1973. The NOCSAE Scientific Advisory Committee consists of many of the country's leading researchers on helmet protection and neuroscience. They have a primary responsibility for recommending changes to the standard. Unfortunately, the science of preventing concussions is limited. The science of severity of concussions is constantly changing. The industry believes NOCSAE has brought together the best thinking on the prevention of sport concussions in the NOCSAE Scientific Advisory Committee to formulate leading edge approaches to concussion management. NOCSAE has made, and continues to make, substantial grants to these and other researchers to do concussion-related research. SGMA and its members support this use of NOCSAE funds.

Though we have focused much of this statement on football-related matters, it is important to note that concussions are not limited to football, and a variety of protective products are being created to offer protection across many sports. Mouthguards have evolved from a simple piece of plastic to a more malleable product intended to better absorb the shock from a blow to the chin, knee braces are more common now due to lighter and stronger materials, eyewear is required in field hockey and girls' lacrosse and the use of face-masks for fielders in fast-pitch softball has increased. The growing use of these products is evidence of the sports equipment's industry's commitment to reducing injuries in sports. Although participating in sports comes with the inherent risk of potential injury, equipment manufacturers and governing bodies work hard to reduce injuries through innovations in protective equipment and rules changes to better protect players.

In closing, the industry is aware of the need to work aggressively to address concussions in sports. We also know, until there is more definitive medical science, there is a limit in what a helmet can do to eliminate concussions in sports. Until there is a consensus in concussion science, the helmet industry is taking a multidisciplinary approach working with trainers to insure equipment is fit correctly, sport governing bodies to create rules for protecting players from unnecessary helmet to helmet contact and working with coaches to adopt proper sport play techniques changing the current football culture to understand the seriousness of the concussion issue. Through NOCSAE, the industry is working with the Center for Disease Control providing educational materials to consumers, helping them understand and evaluate the concussion risk in sports.

Thank you.

PREPARED STATEMENT OF SCOTT HALLENBECK,
EXECUTIVE DIRECTOR, USA FOOTBALL

Chairman Rockefeller and Members of the Committee:

My name is Scott Hallenbeck. I am the executive director of USA Football, the sport's national governing body in the United States.

Approximately 3.0 million American children age 6–14 and 415,000 adult volunteers power youth tackle football, making it one of our country's most popular youth sports. USA Football is an independent non-profit organization with members residing in all 50 states and the District of Columbia. Our members are youth football coaches, players, league commissioners and football game officials. Within our spectrum of responsibility is to lead and serve the youth football community. We do this in several ways, including giving information in the area of health and safety through our work with the Centers for Disease Control and Prevention (CDC) and other experts.

USA Football was endowed by the National Football League (NFL) and the NFL Players Association (NFLPA) in 2002 through the NFL Youth Football Fund. The NFL Youth Football Fund is a non-profit foundation created by the NFL and NFLPA in 1998. I have served as USA Football's executive director since 2005.

Twenty-six (26) youth sports organizations, including USA Football, began working with the CDC since 2007 to educate the youth sports community on concussion awareness and management. Fortunately, this number of youth sports organizations has increased in recent years. Player health and safety, including concussion education and management, is a point of emphasis for USA Football.

USA Football's CDC-approved concussion awareness work has garnered national media attention. This underscores the public's thirst for additional knowledge and education on this topic.

Summary of USA Football's CDC-Approved Concussion Awareness Information

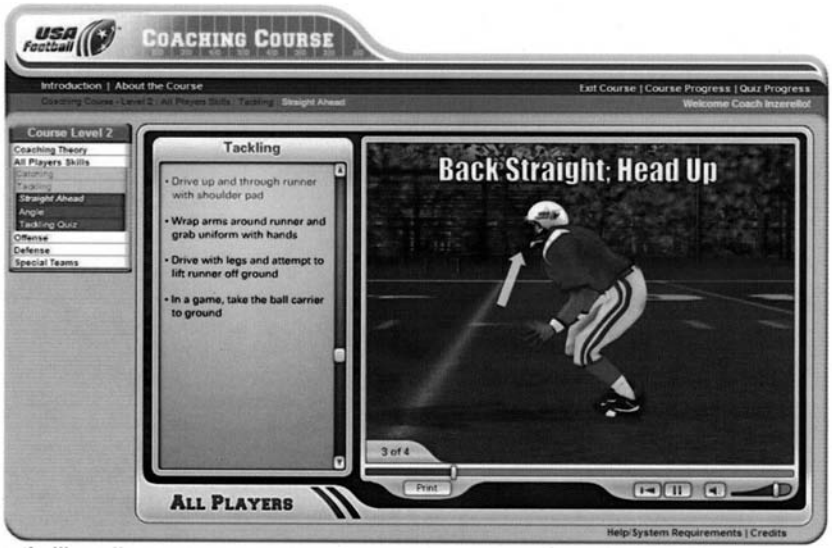
USA Football's coaching education curriculum, football training events, and resources provide youth football players, parents, coaches, league commissioners, and game officials with a strong knowledge base of football's fundamentals. Although no physical activity is injury-proof, coaches who understand how to properly teach blocking and tackling within the rules will foster a positive football experience and will likely lessen the chance of injury.

The following summarizes how USA Football, with CDC-approved practices, educates the youth football community on how to recognize a concussion and how to respond if one occurs. This information is promoted on our website—*www.usafootball.com*—and is available without cost.

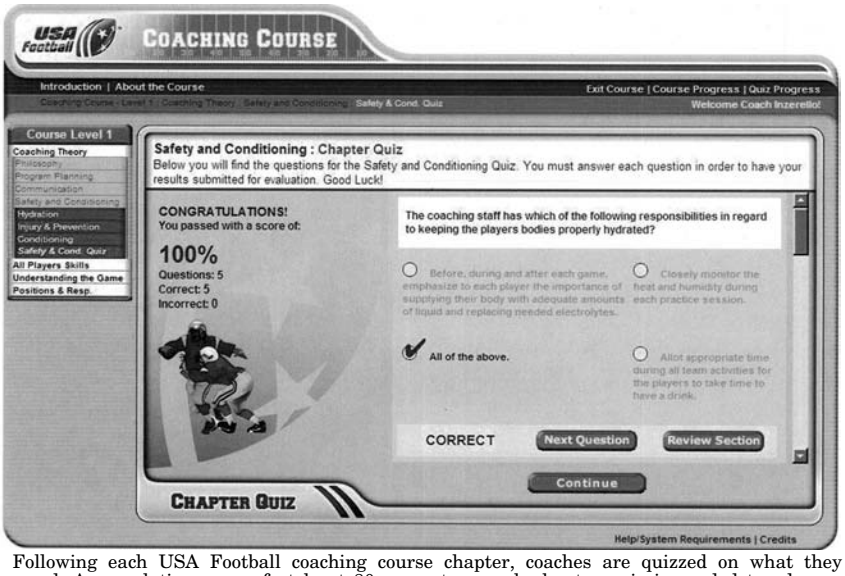
USA Football's online tackle and flag coaching courses were bolstered in April 2010 with 35 minutes of video addressing concussion (11 minutes), heat and hydration (13 minutes), proper helmet fitting (7 minutes) and proper shoulder pad fitting (4 minutes). USA Football earned national publicity for these courses promoting player safety (*Associated Press,* 4/28/10). All videos may be viewed at *usafootball.com* at no cost at *usafootball.com/health-safety/videos-and-downloads*.

Each of the tackle football coaching course's 15 chapters are followed by a quiz to strengthen comprehension. A coach's progress within the course can be tracked by a league's commissioner. A coach must correctly answer at least 80 percent of the questions in a chapter quiz in order to advance to the next chapter.

More than 75,000 youth football coaches have been educated by USA Football in our organization's history. Of these 75,000 coaches, more than *43,000 have been trained by USA Football in the past 18 months*, illustrating the increasing value that youth leagues place in our educational resources. USA Football does not operate youth leagues nor does it have the ability to mandate youth coaches to complete its coaching courses. Leagues independently decide to employ USA Football's courses and resources on a value-based proposition.



USA Football's online coaching course, successfully completed by more than 61,000 youth football coaches, teaches how to properly coach football fundamentals.



Following each USA Football coaching course chapter, coaches are quizzed on what they learned. A cumulative score of at least 80 percent on each chapter quiz is needed to advance through the course.

Youth sports leagues—not only those pertaining to football—are encouraged to adopt USA Football's CDC-approved concussion awareness and management policy (below). USA Football recommends that every youth sports league employs a policy such as this:

Prevention and Preparation for Coaches *(Primary Source: CDC)*

(1) *Educate athletes and parents about concussion*

(a) Talk with athletes and parents about preventative measures, symptoms, and proper action to take relative to concussions.

(b) Emphasize the dangers of playing through a concussion.

(2) *Insist that safety comes first*

(a) Teach athletes safe playing techniques and good sportsmanship

(b) Review the "Concussion Fact Sheet for Players" found at *usafootball.com* with players and their parents

(3) *Teach athletes and parents that it is not safe to play with a concussion*

(a) Explain that it is not "courageous" nor does it show strength to play with a concussion

(4) *Prevent long-term problems*

(a) "*When in doubt, sit them out*." Keep athletes with known or suspected concussion off the field until an appropriate health care professional clears them to return. Returning to play must be a *medical* decision.

Signs & Symptoms of Concussion *(Primary Source: CDC)*

Observations made by Coaching Staff	Symptoms reported by Athlete
• Appears dazed or stunned	• Headache or "pressure" in the head
• Is confused about assignment or position	• Nausea or vomiting
• Forgets plays	• Balance problems or dizziness
• Unsure of game, score, or opponent	• Double or blurry vision
• Loses consciousness (even briefly)	• Sensitivity to light or noise
• Shows behavior or personality changes	• Feeling sluggish, hazy, foggy, or groggy
• Can't recall events prior or after the hit or fall	• Concentration or memory problems

What a Coach Should Do When a Concussion is Suspected *(Primary Source: CDC)*

(1) *Remove the athlete from play*

(a) Look for signs and symptoms of concussion if an athlete experienced a bump or blow to the head

(b) "When in doubt, sit them out"—athletes with signs or symptoms of concussion must not return to play

(2) *Ensure that the athlete is evaluated immediately by an appropriate health care professional*

(a) Do not try to judge the severity of the injury yourself

(b) Coaches recording the following can help a health care professional in assessing the athlete:

(i) Cause of the injury and the force of the hit or blow to the head

(ii) Any loss of consciousness and if so, for how long

(iii) Any memory loss or seizures immediately following the injury

(iv) Number of previous concussions (if any)

(3) *Inform the athlete's parents/guardians of the possible concussion and give them the concussion fact sheet for parents found on usafootball.com*

(a) Ensure at parents know the athlete must be seen by an appropriate healthcare professional

(b) Provide formal documentation of the injury and notify the league commissioner

(4) *Allow the athlete to return to play only after an appropriate healthcare professional clears his or her return*

(a) A repeat concussion that occurs before the brain recovers from the first can slow recovery or increase the likelihood of having long-term problems

USA Football Educational Resources & Initiatives

The following outlines USA Football's educational resources and initiatives, including information distribution channels.

Education

- *USA Football Events*: Knowing the game's fundamentals and how to teach them fosters a positive football experience
  - *AUSA Football Coaching Schools*: youth coaches are instructed how to teach the sport's fundamentals properly
  - *USA Football Player Academies*: youth players (aged 7–14) are taught proper football fundamentals

- *Football State Leadership Forums*: commissioners learn best practices, including insight on concussion
  - *USA Football stresses that athletes who have or are suspected to have suffered a concussion must not return to play until an appropriate healthcare professional clears them to do so.*

- *USA Football's Online Coaching Education Program for Youth Tackle and Flag Football*
  - Concussion awareness and management information is part of USA Football's basic online coaching courses for both tackle and flag football
    - USA Football's concussion-related course content is created by its Football & Wellness Committee, the CDC, and the National Athletic Trainers' Association (NATA)
    - USA Football's Football & Wellness Committee is composed of experts in several areas, including concussion, hydration, and nutrition

- *National Federation of State High School Associations (NFHS) "Fundamentals of Coaching Football" Course*
  - Produced by USA Football, this course teaches proper coaching fundamentals to America's high school football coaches
  - High school head football coaches in Arkansas and Massachusetts are mandated by the high school athletic associations in those states in order to successfully complete the NFHS's three-part online coaching curriculum; USA Football's coaching course accounts for one of these three parts.

Rules

- *USA Football Youth Football Rulebook*
  - USA Football's Youth Football Rulebook, made available to all youth football leagues in the United States, is written with assistance from the National Association of Sports Officials (NASO) and the NFHS to establish important youth football standards
  - Work done by USA Football's Rules Committee in Nov. 2010 enlarged the scope of illegal contact made to a player's helmet to increase player safety. The rule change earned coverage from *The Associated Press* (Nov. 10, 2010).

Research

- *Youth Football Participation and Safety Surveillance Studies*
  - USA Football continues youth football's most accurate participation study monitoring players, coaches, and teams
  - USA Football will invest to execute a study to learn more about youth football injury rates and how they are affected by varying standards of play (Age & Weight, Age and Grade-based)
    - Data collection will begin during the 2012 football season

USA Football Equipment Grant Program

USA Football, through financial support provided by the NFL Youth Football Fund, has awarded more than $4 million in football equipment based on merit and need to youth and high school programs across the United States since 2006. More than 700 youth and high school football programs in 44 states were assisted through USA Football grants awarded in 2011 alone.

USA Football equipment grants make youth and high school football safer and compliments programs' existing fundraising endeavors for new equipment. Selected youth leagues choose one of 14 equipment packages, each valued at $1,000. Selected high school programs also choose one of 14 packages, each valued at $1,500.

Dozens of football program leaders have expressed appreciation for equipment grants awarded by USA Football:

"This is going to enable a lot more kids to play. This grant keeps kids on the field. It'll definitely help us and we are so very grateful."

—Cassandra Jetter-Ivey, Newark (N.J.) North Ward Scorpions Youth Football Program

"We appreciate USA Football's help. This allows a sense of relief that we're keeping our children safe from injury by placing them in new and sturdier helmets. Since we are supporting children who are predominately underprivileged, this assistance is especially valuable as it keeps our registration fees as low as possible."

—DeAndrea Singleton, Westbury Redskins; Houston, Texas

"The equipment grant we were awarded from USA Football will provide equipment and uniforms to young athletes in low-income, inner-city neighborhoods. Most of the youths are between the ages of 5–12 years and the majority of them are financially disadvantaged. USA Football helps us make a difference in the lives of our kids and we appreciate their non-profit office's support."

—Steve Billingslea, Middle Tennessee Bulldogs; Nashville, Tenn.

USA Football's Football and Wellness Committee

USA Football has assembled a Football and Wellness Committee to further promote best practices for America's youth football community. The committee, composed of 26 experts spanning football coaching, player health, and other areas, share insight with youth football coaches, game officials, league commissioners, youth players, and parents to lead the game's development and foster a positive football experience for youth and amateur players. The committee's expertise will be shared with USA Football members through *www.usafootball.com,* our quarterly *USA Football Magazine,* and our football training events, which are conducted in more than two dozen states.

This committee roster represents a variety of organizations including the American Red Cross, the Andrews Institute, the National Center for Sport Safety, and several medical centers from across the United States. USA Football's Football & Wellness Committee Members:

Name	Expertise	Organization
Tom Bainter	Football expert, running backs	Bothell (Wash.) High School
Tom Bass	Football advisor	USA Football
Marcus Boyles	Football expert, receivers	Wayne County (Miss.) High School
Jody Brylinsky	Coaching performance	Western Michigan University
Ron Courson	Sports medicine	University of Georgia
Ted Crites	First aid, CPR/AED, injury prevention	American Red Cross
Jeremy Gold	Football expert, defensive line	Chicago Morgan Park High School
Dr. Ann Grandjean	Medical and nutrition education	University of Nebraska Medical Center
Dr. Brad Hatfield	Kinesiology	University of Maryland
Dr. Stan Herring	Concussion awareness and management	University of Washington
Kirk Heidelberg	Football expert, offensive line	Rockford (Ill.) Christian High School
Kent Johnston	Football expert, physical skills	Cleveland Browns
Dr. David Joyner	Medical expert, orthopedic physician	Penn State University
Chuck Kyle	Coaching performance	Cleveland St. Ignatius High School
Dr. John Lehtinen	Family medicine	Peninsula Medical Center
Dr. Larry Lemak	Sports Medicine	Lemak Sports Medicine
George Maczuga	Equipment	Riddell
Chris Merritt	Football expert, defensive backs & sp. teams	Miami Christopher Columbus High School
Dr. Joel Morgenlander	Neurology	Duke University Medical Center
Dr. Lonnie Paulos	Orthopedics	The Andrews Institute
Mike Price	Insurance	Essix Insurance
Dr. JohnEric Smith	Hydration	Gatorade Sports Science Institute
Steve Specht	Football expert, linebackers	Cincinnati St. Xavier High School
Gary Swenson	Football expert, quarterbacks	West Des Moines (Iowa) Valley High School
Kim Schwabenbauer	Nutrition	Corporate dietitian, Super Bakery
Dr. Dave Yukelson	Sport psychology	Penn State University

Player Progression Development Model

America's youth football community is learning how to coach and play the sport in a way never done before.

Developed throughout 2010 and 2011, USA Football introduced a Player Progression Development Model (PPDM) earlier this year. Youth football coaches in 15 states completed USA Football's age-appropriate teaching and learning approach to the game prior to the start of the 2011 football season.

USA Football's PPDM develops youth football players by having them learn the game, increase their skills and build confidence at age-appropriate levels. It directs youth coaches how to teach the game in a progression based on a player's age and physical abilities as well as the player's mental, emotional and social maturity.

Player age segments within USA Football's Player Progression Development Model:

- Under-6 (flag football)
- Under-8 (tackle)
- Under-10 (tackle)
- Under-12 (tackle)
- Under-14 (tackle)

USA Football's Player Progression Development Model is woven into all USA Football programming—more than 80 football developments events for coaches,

players and commissioners and its online educational and skill-strengthening resources for coaches and players.

USA Football created its Player Progression Development Model (PPDM) under the direction of the following experts:

Name	Area of Expertise
Tom Bainter, Bothell (Wash.) H.S. Football Coach	Running Backs
Jeremy Gold, Chicago Morgan Park H.S. Football Coach	Defensive Line
Kirk Heidelberg, Rockford (Ill.) Christian H.S. Athletic Director	Offensive Line
Kent Johnston, Cleveland Browns Strength and Conditioning Coach	Physical Abilities
Chuck Kyle, Cleveland St. Ignatius H.S. Football Coach	Principles of Coaching
Larry Lauer, Ph.D., Michigan State University	Exercise & Sport Science, Sport Psychology
Chris Merritt, Miami Christopher Columbus H.S. Football Coach	Defensive Backs and Special Teams
Anne Pankhurst, Independent Consultant	Physical Abilities, Growth and Maturation
Cathy Sellers, United States Olympic Committee	Principles of Coaching
Steve Specht, Cincinnati St. Xavier H.S. Football Coach	Linebackers
Gary Swenson, West Des Moines (Iowa) Valley H.S. Football Coach	Quarterbacks
Dave Yukelson, Ph.D., Penn State University	Sport Psychology

"A structured player development model is good—and needed—for football, particularly youth football," said Cleveland St. Ignatius head football coach Chuck Kyle, a 10-time Ohio state champion coach and member of the Ohio High School Football Coaches Association Hall of Fame. "This is a game of innovation, rooted in fundamentals," Kyle adds. "USA Football's Player Progression Development Model is an extraordinary example of how these two dynamics work together and form the foundation of an exceptional team sport of the mind, body and spirit."

USA Football Tackle Advisory Committee

Head football coaches with NFL, collegiate, high school and youth experience as well as a leading sport psychologist were selected for USA Football's Tackle Advisory Committee in June 2011, the first committee of its kind to benefit America's youth football community.

The group of experts helps youth coaches teach tackling fundamentals and strengthen player safety on a national level through USA Football resources.

The five-member committee has assisted in developing a tackle progression model—a step-by-step process for youth coaches to teach tackling fundamentals in proper order. The tackle progression and its drills were created by USA Football. USA Football's tackle progression model further strengthens player safety and identifies ways to build confidence in youth players by appropriately introducing them to contact.

USA Football's Tackle Advisory Committee Members:

Name	Position	Organization
Pat Fitzgerald	Head Football Coach	Northwestern University
Merril Hoge	Youth Football Coach and NFL Analyst	ESPN (NFL Alumnus)
Chris Merritt	Head Football Coach	Miami Christopher Columbus High School
Jim Mora	Youth Football Coach and Former NFL Head Coach	Atlanta Falcons and Seattle Seahawks
David Yukelson	Sport Psychologist	Penn State University

A series of 12 instructional videos within USA Football's Tackle Progression Model divides tackling into five fundamentals—breakdown position, buzz, hit position, rip and shoot—providing drills to teach each step, beginning in a non-contact environment and progressing to player-to-player contact. The instruction is designed to improve tackling skills, increase safety and limit helmet-to-helmet contact, lessening the chance for injury, including concussion.

Within the model, a USA Football-produced Level of Contact video directs youth coaches on how they may incrementally introduce their players to contact to build their confidence and help them learn the game's fundamentals. Drills can be run at varying speeds, starting slow when they are first introduced and accelerated as players master skills and techniques. The video introduces contact in the following ways:

Level of Contact	Definition
Air	Players run a drill unopposed without contact.
Bags	Drill is run against a bag or another soft-contact surface.

Level of Contact	Definition
Wrap	Drill is run between two players until the moment of contact; one player is pre-determined the "winner" by the coach. Contact remains above the waist and players stay on their feet.
Thud	Drill is run between two players until the moment of contact; no pre-determined "winner." Contact remains above the waist, players stay on their feet and a quick whistle ends the drill.
Live-Action	Drill is run in game-like conditions and is the only time that players are taken to the ground.

"Directing youth football teams to incrementally incorporate contact into their practices lessens the amount of incidental contact that players receive through their helmets," said Dr. Stanley Herring of USA Football's Football and Wellness Committee and the NFL's Head, Neck and Spine Committee. "This is a strong step forward for player safety in youth football that any youth sport should consider emulating."

Concussion-Related Education

USA Football works with the CDC to promote concussion-related education materials for its members and the entire youth football community at *www.usafootball.com.* In addition to the CDC, USA Football is advised by Dr. Stanley Herring on concussion awareness and management. Dr. Herring is a member of USA Football's Football & Wellness committee and is a board-certified physical medicine and rehabilitation specialist who has been in practice for more than 27 years. Dr. Herring also is a clinical professor in the departments of Rehabilitation Medicine, Orthopaedics & Sports Medicine, and Neurological Surgery at the University of Washington.

Dr. Herring is USA Football's internal advisor on concussion awareness material for our coaching course, which was shared with the CDC for review prior to being made available to the youth football community. USA Football informs coaches of the CDC-approved message that athletes who are even *suspected* of having suffered a concussion must not return to play until an appropriate health care professional clears them to return. Returning to play must be a *medical* decision.

In September 2010, USA Football introduced a national campaign called "*Put Pride Aside for Player Safety*" to emphasize concussion awareness in youth sports, particularly football.

"Put Pride Aside for Player Safety" is the only national youth sports initiative promoting concussion education and management uniting a sport's national governing body (USA Football), collegiate athletic conferences (Atlantic Coast Conference, Mid-American Conference, The Patriot League) and a professional sports league (NFL).

Through television, radio and website media placements, "Put Pride Aside for Player Safety" continues USA Football's commitment toward youth sport concussion education and management. "Put Pride Aside for Player Safety" challenges and instructs coaches, parents and youth players to make the right decision when a concussion is suspected, which is to remove an athlete from play the day of the injury and not allow him or her to return until a medical professional deems the athlete symptom-free and gives clearance for a return to play.

Key components of USA Football's "Put Pride Aside for Player Safety" campaign:

- Television PSA airing on NFL team, ACC, Mid-American Conference and Patriot League programming as well as on *usafootball.com*
- Radio PSA airing on NFL team-owned inventory
- Player safety videos (12) covering proper equipment fitting, tackling techniques and concussion management on websites of NFL teams, the ACC, the MAC, the Patriot League and *usafootball.com*
- Banner ads on websites of NFL teams, the ACC, the MAC, the Patriot League, and *usafootball.com*

Legislation

USA Football has joined other sports and medical organizations across the country in testifying in person or via letters of support for state legislation to foster greater awareness and management of concussion.

Many of these state laws, most of which have been passed since August 2010, require:

- Information handouts to parents and players on the signs and symptoms of concussion; returned and signed by parents and youth athletes acknowledging the risk of concussion and head injuries prior to practice or competition.
- Removal of a youth athlete who is suspected of or sustains a concussion or head injury from play—"*When in doubt, sit them out*."
- Written clearance prior to returning to play from a licensed health care provider knowledgeable in the diagnosis and management of concussion for a youth athlete who has been removed from play.
- Compliance from private, non-profit youth sports associations with the policies adopted in that state.

Such laws cannot prevent an initial concussion from happening on a football or soccer field, a basketball court, a baseball diamond, or a hockey rink, but they can help prevent damaging repeated concussions from happening in all of these places.

USA Football is committed to concussion awareness and management and would encourage other sports' national governing bodies to join us.

Concussion is not relegated to football—or even boys' athletics. According to a study titled, "Concussions Among United States High School and Collegiate Athletes" in the *Journal of Athletic Training* in 2007, concussion rates per 1,000 athlete exposures were as follows (an "athlete exposure" is one practice or one game):

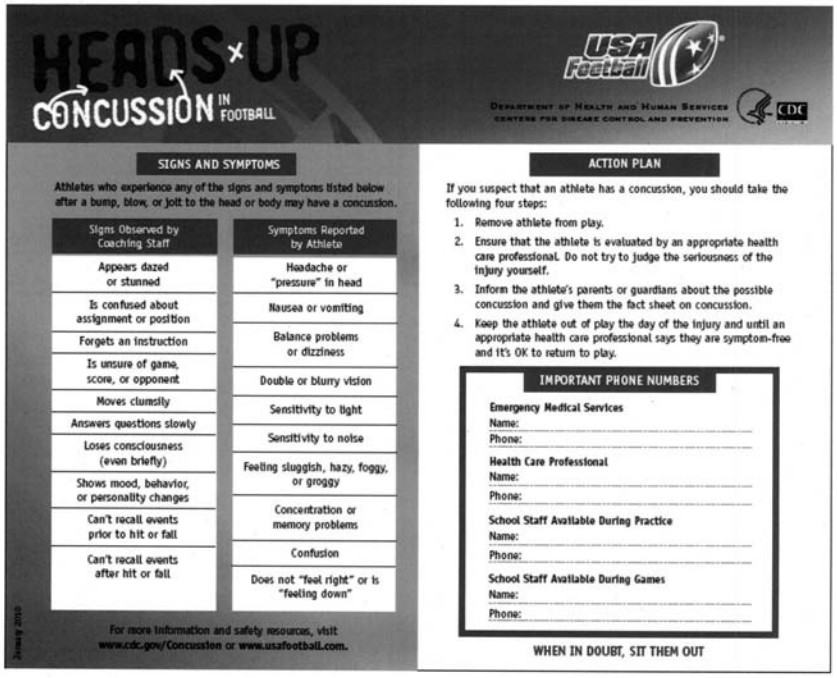
- Football: 0.47
- Girls Soccer: 0.36
- Boys Soccer: 0.22
- Girls Basketball: 0.21
- Boys Basketball: 0.07

These numbers underscore the need for all sports to recognize the seriousness of concussions and the need for further education among our coaches, league administrators, game officials, athletes, and parents.

More Education Needed

Concussion awareness, even within the medical community, is limited. The CDC has even created a concussion fact sheet for *physicians* in addition to the general public. This drives the point that consistent nomenclature and the coordinated cooperation of all youth sports stakeholders is necessary to continue this positive change that we are experiencing in youth sports relative to concussion.

APPENDIX



HEADS UP CONCUSSION IN FOOTBALL

USA Football

Department of Health and Human Services
Centers for Disease Control and Prevention
CDC

SIGNS AND SYMPTOMS

Athletes who experience any of the signs and symptoms listed below after a bump, blow, or jolt to the head or body may have a concussion.

Signs Observed by Coaching Staff	Symptoms Reported by Athlete
Appears dazed or stunned	Headache or "pressure" in head
Is confused about assignment or position	Nausea or vomiting
Forgets an instruction	Balance problems or dizziness
Is unsure of game, score, or opponent	Double or blurry vision
Moves clumsily	Sensitivity to light
Answers questions slowly	Sensitivity to noise
Loses consciousness (even briefly)	Feeling sluggish, hazy, foggy, or groggy
Shows mood, behavior, or personality changes	Concentration or memory problems
Can't recall events prior to hit or fall	Confusion
Can't recall events after hit or fall	Does not "feel right" or is "feeling down"

For more information and safety resources, visit www.cdc.gov/Concussion or www.usafootball.com.

January 2010

ACTION PLAN

If you suspect that an athlete has a concussion, you should take the following four steps:

1. Remove athlete from play.
2. Ensure that the athlete is evaluated by an appropriate health care professional. Do not try to judge the seriousness of the injury yourself.
3. Inform the athlete's parents or guardians about the possible concussion and give them the fact sheet on concussion.
4. Keep the athlete out of play the day of the injury and until an appropriate health care professional says they are symptom-free and it's OK to return to play.

IMPORTANT PHONE NUMBERS

Emergency Medical Services
Name:
Phone:

Health Care Professional
Name:
Phone:

School Staff Available During Practice
Name:
Phone:

School Staff Available During Games
Name:
Phone:

WHEN IN DOUBT, SIT THEM OUT

Created by the CDC for USA Football, this information was placed on a clipboard sticker and distributed at more than 35 full-day USA Football Coaching Schools in 25 states in 2010. This image can be downloaded at no cost at *usafootball.com*.

WHEN A CONCUSSION OCCURS

If you suspect that an athlete has a concussion, implement your 4-step action plan:

1. **Remove the athlete from play.**
Look for signs and symptoms of a concussion if your athlete has experienced a bump or blow to the head or body. When in doubt, keep them out.

2. **Ensure that the athlete is evaluated by a health care professional experienced in evaluating for concussion.**
Do not try to judge the severity of the injury yourself. Health care professionals have a number of methods that they can use to assess the severity of concussions. As a coach, recording the following information can help health care professionals in assessing the athlete after the injury:

- Cause of the injury and force of the hit or blow to the head or body
- Any loss of consciousness (passed out/knocked out) and if so, for how long
- Any memory loss immediately following the injury
- Any seizures immediately following the injury
- Number of previous concussions (if any)

3. **Inform the athlete's parents or guardians about the possible concussion and give them information on concussion.**
Make sure they know that the athlete should be seen by a health care professional experienced in evaluating for concussion.

4. **Keep the athlete out of play.**
No play the day of the injury and until a health care professional, experienced in evaluating for concussion, says they are symptom-free and it's OK to return to play.

If you think your athlete has sustained a concussion…
take him/her out of play, and seek the advice of a health care professional experienced in evaluating for concussion.

For more detailed information on concussion and traumatic brain injury, visit:
www.cdc.gov/TraumaticBrainInjury.

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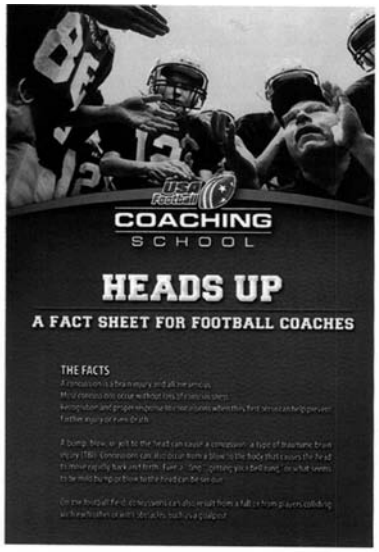

RECOGNIZING A POSSIBLE CONCUSSION

To help recognize a concussion, you should watch for the following two things among your athletes:

1. A forceful bump, blow, or jolt to the head or body that results in rapid movement of the head.
2. Any change in the athlete's behavior, thinking, or physical functioning.

Athletes who experience any of the signs and symptoms listed below after a bump, blow, or jolt to the head or body should be kept out of play the day of the injury and until a health care professional, experienced in evaluating for concussion, says they are symptom-free and it's OK to return to play. When in doubt, keep them out.

Remember, you can't see a concussion and some athletes may not experience and/or report symptoms until hours or days after the injury. Most people with a concussion will recover quickly and fully. But for some people, signs and symptoms of concussion can last for days, weeks, or longer.

SIGNS OBSERVED BY COACHING STAFF	SYMPTOMS REPORTED BY ATHLETE
Appears dazed or stunned	Headache or "pressure" in head
Is confused about assignment or position	Nausea or vomiting
Forgets an instruction or play	Balance problems or dizziness
Is unsure of score or opponent	Double or blurry vision
Moves clumsily	Sensitivity to light
Answers questions slowly	Sensitivity to noise
Loses consciousness (even briefly)	Feeling sluggish, hazy, foggy, or groggy
Shows mood, behavior, or personality changes	Concentration or memory problems
Can't recall events prior to hit or fall	Confusion
Can't recall events after hit or fall	Does not "feel right" or is "feeling down"

PREVENTION AND PREPARATION

As a coach, you can play a key role in preventing concussions and responding properly when they occur. Here are some steps you can take:

Check with your league or school about concussion policies. Concussion policy statements can be developed to include the league or school's commitment to safety, a brief description about concussion, and information on when athletes can safely return to play. Parents and athletes should sign the concussion policy statement at the beginning of the season.

Learn about Concussion. Take the free "Heads Up" training course for coaches online at: www.cdc.gov/TraumaticBrainInjury. Review the signs and symptoms of concussion and keep the four-step action plan with you at games and practices.

Educate athletes, parents, and other coaches about concussion. Before the first practice, talk to athletes and parents, and other coaches and school officials about the dangers of concussion and potential long-term consequences of concussion. Explain your concerns about concussion and your expectations of safe play. Show the videos, available online at: www.cdc.gov/TraumaticBrainInjury, and pass out the concussion fact sheets for athletes and for parents at the beginning of the season and again if a concussion occurs. Remind athletes to tell coaching staff right away if they suspect they have a concussion or that a teammate has a concussion.

Insist that safety comes first. Encourage athletes to:
Teach athletes "Heads Up" football and other safe playing techniques.
Follow the rules of play and practice good sportsmanship at all times.
Make sure they wear the right protective equipment (such as helmets, padding, shin guards, and eye and mouth guards). Protective equipment should fit properly, be well maintained, and be worn consistently and correctly.

Prevent long-term problems. If one of your athletes has a concussion, their brain needs time to heal. Don't let them return to play the day of the injury and until a health care professional, experienced in evaluating for concussion, says they are symptom-free and it's OK to return to play. A repeat concussion that occurs before the brain recovers from the first—usually within a short time period (hours, days, weeks)—can slow recovery or increase the chances for long-term problems.

Teach your athletes it's not smart to play with a concussion. Rest is key after a concussion. Sometimes athletes, parents, and others wrongly believe that it shows strength and courage to play injured. Discourage others from pressuring injured athletes to play. Don't let your athlete convince you that they're "just fine."

The above four-page Concussion Education brochure with content from the CDC was distributed at single-day USA Football Coaching Schools in 2011.

PREPARED STATEMENT OF STANLEY HERRING, MD, CLINICAL PROFESSOR DEPARTMENTS OF REHABILITATION MEDICINE, ORTHOPEDICS AND SPORTS MEDICINE, AND NEUROLOGICAL SURGERY UNIVERSITY OF WASHINGTON; CO-MEDICAL DIRECTOR SEATTLE SPORTS CONCUSSION PROGRAM; TEAM PHYSICIAN SEATTLE SEAHAWKS AND SEATTLE MARINERS; AND MEMBER, NATIONAL FOOTBALL LEAGUE'S HEAD, NECK AND SPINE COMMITTEE

Chairman Rockefeller, Ranking Member Hutchison, and members of the Committee:

My name is Dr. Stan Herring. I am the Co-Medical Director of the Seattle Sports Concussion Program and a Clinical Professor at the University of Washington. In addition, I serve as a Team Physician for the Seattle Seahawks and the Seattle Mariners. I submit this statement to you today as a Member of the National Foot-

ball League's Head, Neck and Spine Committee and the Chairman of the Subcommittee on Education and Advocacy.

Mr. Chairman, thank you for calling this hearing to bring greater awareness to the important topic of concussion in sports. As a medical advisor to the NFL, I believe that the NFL values its leadership role on the issue of concussions, not only for professional football players, but for all sports at all levels. I appreciate the opportunity to submit a statement summarizing some of the NFL's work on this important matter.

As a physician who has worked on the sidelines of Seattle Seahawks games for many years, I know there is nothing more important to the NFL than the health of its players. Effective safety equipment is one important component in protecting the health of athletes. Among the many equipment related initiatives pursued by the League was a recent study into the effectiveness of the helmets worn by NFL players. The results of this study were shared not only with the players, but also the equipment manufacturers and made available to the public. The more information people have about equipment safety, especially as it relates to head injuries, the safer sports will be.

Additionally, last December the NFL hosted a symposium in New York to discuss the performance of safety equipment, including helmets. Invited stakeholders included helmet and accelerometer manufacturers, the Department of Defense, the National Operating Committee on Standards for Athletic Equipment, the NFL Players Association, and researchers, among others. The daylong meeting allowed the most informed and knowledgeable individuals working on helmet safety to share ideas and learn from each other's work. All of those invited shared the same goal—making the game as safe as possible for those who play it.

There currently are no products on the market that can make an athlete concussion-proof. Equipment technology will continue to evolve over time. The NFL is encouraging the pace of this change. In the meanwhile, we cannot look to equipment to replace the critical role of medical evaluation and treatment.

We need not wait for the development of new technology to protect children from the dangers of concussions. Greater awareness and education can protect athletes of all ages, in all sports. The NFL promotes broader education about concussion in all levels of sport. Through collaboration with the CDC, educational posters now hang in NFL training rooms. I was personally involved in developing a similar poster to be used by youth athletes and made available through the CDC. Additionally, with support from the NFL, I have been involved in developing educational materials for coaches and clinicians so they can be better informed in treating athletes who have suffered a concussion. All of these materials are available, for free, on the CDC's website at *www.cdc.gov/concussion*.

The NFL invests in research, and our medical committee works to examine the latest developments in technology. In the NFL's most recent collective bargaining agreement with the NFL Players Association, there is an agreement to dedicate $100 million over the next ten years to medical research, the majority of which will go toward brain injury research.

Youth athletes who have suffered a concussion will routinely recover and return to play eventually if properly treated. For this reason, it is important that appropriate protocol is followed when children suffer concussions. One way to ensure that parents, coaches and others involved in youth sports are aware of the best possible way to treat concussions is through the adoption of laws with internationally accepted guidelines for how to treat youth concussions. A year ago, the NFL announced a campaign to advocate for the passage of youth concussion laws across the country. The laws all contain at least these three key principles:

1. Student athletes and a parent or guardian must sign an education sheet that provides them with information about the signs and symptoms of concussion;
2. Any youth athlete who appears to have suffered a concussion in any sport is removed from play or practice at that time; and
3. That athlete must be cleared by a licensed healthcare provider trained in the diagnosis and management of concussions before returning to play or practice.

Laws containing these provisions have been enacted in thirty states, as well as the District of Columbia. Twenty-two have become law in the last year alone. The NFL has pledged to continue its advocacy until every state has adopted a way to protect youth athletes.

The importance of these laws is personal for me. In October 2006, Zackery Lystedt was a 13-year-old star football player who suffered an undiagnosed concussion with a few minutes left in the first half. An injury time-out was called. After resting during halftime, Zackery returned to play in the second half while still having symp-

toms from his injury. He sustained further head blows during the second half of the game, and at the end of the game collapsed in his father's arms. He lapsed into a coma suffering from life-threatening injuries. Zackery survived, but continues to face a long road of rehabilitation. In the meanwhile, a coalition in Washington State began work on a law designed to prevent the next child and the next family from suffering the way Zackery and his family did. The adoption of the Zackery Lystedt law in Washington is already making a difference in our state. Thanks to the fine work of advocates across the country to promote this law, many more kids will play sports safer.

I am proud that the NFL is a leader to the benefit of athletes at all levels of sport. As more is learned about concussions, I believe that the NFL will continue to make the necessary changes to best protect its players and to lead and serve as a model for all sports.

Thank you again for this opportunity today.

RALPH & JOY CONRADT
Bend, OR, October 29, 2011

Chairman JAY ROCKEFELLER,
Senate Committee on Commerce, Science, and Transportation,
Washington, DC.

RE: FOOTBALL HELMET SAFETY

Dear Senator Rockefeller,

Having viewed the October 19th Senate Hearing, I have a number of comments regarding the statements made by equipment-industry-representative Oliver. First though it is ironic that the 10/19/11 hearing occurred on the ten-year anniversary of my son Max's catastrophic brain injury while wearing a twenty year-old football helmet.

1. At the time of Max's injury, we had no reason to question the reconditioning process. We just assumed *all* helmets were *tested every year* and reconditioning consisted of more than deodorizing, painting and checking for cracks. Mr. Oliver stated that an old helmet, properly reconditioned, offers the same protection as a state-of-the-art helmet. Our experience is that this is *not* the case. Max's helmet was drop-tested at the NOCSAE lab and *failed* over 50 percent of the standards of the year 2000. Oliver says a helmet should not necessarily have an established shelf life since it may sit unused for several seasons. Clearly Mr. Oliver clearly has never owned a product made of polycarbonate, commonly known as *plastic.* If he did he would recall that while exposed to air, polycarbonate becomes brittle and no longer effectively absorbs shock.

2. Oliver further stated an older helmet would meet current standards if 'new parts were installed'. This position is ridiculous, as the primary component of a helmet is the *shell*. Since helmet shape has changed over the years the older shells will not accommodate new padding, bladders, head-sizers etc. Only parts made exactly to fit the old technology will work. Thus, even in the best-case scenario, such a helmet could only meet old standards, not recent standards.

3. It troubles to me that children are allowed to play with these older products once newer standards are established. Why then have new standards? A reporter asked Max's principal, Von Taylor of Waldport High School in Oregon, how Max, the quarterback of his team and arguably the most valuable player, be assigned a 20-year-old helmet?? Taylor replied that Max's was not the only helmet of that vintage.

This sort of justification explains why young players continue to suffer life-altering injuries and death—the most recent death just a week ago in New York. In 2008 I attended a coaches' conference where a coach questioned why he should be so concerned about examining and fitting helmets and sitting out players that felt a little dizzy when in fifteen years he had never had a player suffer a major injury. I was happy to explain to him that Max's coach tearfully expressed similar sentiments to me in the ICU while we stood over my son's comatose body.

4. Max assured me that in his junior year he was using a "new" helmet. Had I known that in his senior year he would be issued a 20-year-old helmet, which was three years older than he was, I would not have let him step onto the field. Max and I used to race our track car. It was mandatory, in that sport, that helmets be replaced every ten years, *even if they were never worn in an accident.* Helmets that had been dropped or which showed signs of minor impact also required replacement.

5. Oliver stated that a helmet's age could be readily determined from a stamp in the shell. There are three problems with that statement. (A) Most schools do not allow players to take helmets home for parents' inspection; (B) the date stamp is

usually disguised in a code and (C) the code is usually obscured by padding, which only coaches may remove.

6. Coaches have only recently begun to take the issue of head protection seriously. Les Totten is CEO of SportsSoft, a company that offers teams a product to track all the conditioning and parts replacement for equipment. Les stated to me on-camera that he has never been in a school's equipment room and *not* found a helmet that was clearly ineffective by date of manufacture or reconditioning.

Lastly, shortly after my 3.95 GPA son slipped into a four-month coma I was contacted by Riddell representative Mark Elmblade. He was concerned that one of his helmets might have been worn by Max. I assured him that it was a Bike helmet made by Schutt. Elmblade was relieved, but said he had recently visited Waldport coach Donald Kordosky. During their conversation Elmblade picked up one of the helmets in Waldport's stock and exclaimed "These are a brain injury waiting to happen!" Kordosky justified the use of out-dated helmets because he had no budget to replace them. Parents were not notified of this dangerous situation and had I known of the dire budgetary situation I would have gladly bought new helmets for the starting players.

Lincoln County School District saved a few dollars and my son paid with his life. He will never work, never again join me in car racing. He will not provide me with grandchildren or contribute to our society with his once-exceptional brain power.

Had Max's antiquated helmet been relegated to the trash heap there is every reason to believe that I would still have a whole son. Hopefully in your next Hearing, Mr. Oliver will be asked to respond to the issues raised here.

Lastly as a filmmaker I have on tape almost every game Max played in. This footage became a major source of visuals for my film "What Happened, Dad?"

RALPH & JOY CONRADT

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. FRANK R. LAUTENBERG TO ALEXIS BALL

Question. Parents normally associate concussions with football, but the CDC reports that soccer has the second highest incidence and rate of concussions. Do you believe that parents and coaches are aware of the concussion risks related to sports like soccer?

Answer. I do not think that parents/athletes tend to associate concussions with sports like soccer. Much of the attention generated about concussions in sports is centered on football and thus I believe that other sports get overlooked. With the high number of young kids playing sports like soccer, it is essential to educate coaches, parents, and athletes about frequency of concussions occurring in sports other than football such as soccer.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. FRANK R. LAUTENBERG TO STEVEN THREET

Question. Do you have advice for young athletes who may have suffered a concussion?

Answer. My advice for young athletes who believe they have suffered a brain injury is to report it. It is better to speak to a trainer or a doctor and have them be able to rule out the possibility that a brain injury has occurred rather than the worst-case scenario where an athlete would stay quiet because they don't think their injury is significant enough to be reported and subsequently return to play before their brain is ready. This reporting process is significant because the brain is at a much greater risk for serious or permanent injury as a result of a second impact, known as Second Impact Syndrome.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. JOHN THUNE TO STEVEN THREET

Improper Tackling Technique and Concussions

Question 1. I'm aware that NFL and college football teams today have significantly reduced the amount of time devoted during practice to proper tackling and other football fundamentals. I recognize that coaches are limiting some of the physical contact during practice to prevent injuries. However, my concern is that less time devoted to teaching proper tackling technique may be contributing to an increase in concussions during games. Specifically, players these days seem to lead with their head rather than wrapping a player up with one's arms and body, and

keeping their head up. Do you see any connection, at all levels of football, to improper tackling technique and an increase in concussions?

Answer. I do believe that there is a connection between tackling technique and concussion. I believe that this is an issue being addressed by the NFL as well as in the college game. There has been a concentrated effort to lower the strike zone and to enforce it with penalties and in the NFL with fines as well. There is difficultly in this area because the speed of the game. Often times it appears that a player will tackle with proper technique but then the offensive player will make a last second adjustment in his body position in anticipation of the impact and subsequently bring their head lower and back into the striking zone for the defensive player.

Question 2. Do you think this improper tackling technique is caused by less time being devoted to teaching good technique in practice?

Answer. I believe that as players get older less time is spent teaching proper technique. At elite levels of the game coaches either assume it is known or do not feel they can spend the time focusing on technique. I think this is because there are such strict rules by the NCAA about the time that coaches can spend with their players. The off-season would be a great time for position players to teach their players but contact between coach and player in this way is currently not allowed. Because of time constraints the emphasis of practice is learning the defensive scheme in the spring and the preseason and preparing for the opponents during the season.

Question 3. As part of the campaign to highlight concussion awareness, how much emphasis is being placed on educating coaches and players about using proper tackling technique to reduce concussions?

Answer. I believe that there is some emphasis being placed on how proper technique can help reduce the frequency of brain injury. However the greatest emphasis on the awareness front is getting athletes to appreciate the seriousness of brain injury. I believe that as more people begin to recognize the problem, it will be possible to switch the focus of the awareness effort to include partial-solutions like a greater emphasis on tackling technique.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. FRANK R. LAUTENBERG TO JEFFREY KUTCHER, MD

Question 1. Concussions and other traumatic brain injuries pose a serious and increasing risk for our youth. In 2009, emergency rooms treated an estimated 248,418 sports and recreation-related concussions and other brain injuries among children and adolescents. These injuries have increased by 60 percent over the last decade even though school sports participation has fallen. What more can be done to prevent these injuries? How can we ensure that kids who experience concussions don't suffer long-term consequences?

Answer. The increase in emergency room visits for sport and recreation related brain injury is very likely multi-factorial. First, although school sports participation may be trending down, the overall exposure to activities with an inherent risk of brain injury is more difficult to quantify. It may be, for example, that overall exposure is up, once we factor in those activities that are not school organized. Second, increased awareness of head injury has almost certainly led to a higher percentage of head injuries presenting to an emergency room. Thus, the 60 percent increase in ER visits over the last decade may not necessarily represent an increase in the absolute number of injuries.

That being said, there is no question that a serious problem exists and injury prevention is key. A significant number of injuries could be prevented through proper education and awareness campaigns that address known high-risk activities. These efforts should stress the use of well-fitted and certified equipment, proper technique, and adherence to the rules of whatever sport or activity is being considered. As is the nature of the concussion issue, what we don't know puts a limit on our ability to make a difference. To truly prevent concussion, we need to understand much more about the injury itself, how a traumatic force acts to insight the injury, how the brain responds to the injury, and what additional factors may influence the clinical outcome.

Currently, we do not know enough about concussion or traumatic brain injury to ensure that any individual can be free of long-term consequences. The simple answer is that long-term problems likely come from a combination of intrinsic (genetic) and extrinsic (environmental) factors, including the total lifetime dose of biomechanical forces. Thus, the only way to truly ensure that long-term problems do not develop is to avoid exposure to biomechanical forces completely. This is clearly not a

realistic goal. Given what we know, I stress the need to let every concussion heal prior to returning to a contact risk environment. I also suggest that the overall exposure to contact risk be considered. For example, I advise my patients who play a contact sport to avoid other contact sports, giving their brains time to recover in the off-season. Finally, I believe that it is critical for any contact sport participant to undergo periodic neurological evaluation and screening for any signs of brain dysfunction that might be related to head trauma.

Question 2. Rates of concussion and other brain injury have dramatically risen over the last decade as have sales of equipment that is supposed to protect our kids from these injuries. Are these products really protective?

Answer. Equipment plays a critical role in injury prevention. The very nature of contact sports, such as football and ice hockey, is determined, in no small part, by the presence of protective equipment such as helmets. To this end, equipment being an integral part of the game means that it is both preventive and causative. Obviously, any football player who for some reason participates without a helmet is at a significantly higher risk of injury. The protective nature of helmets is limited, however. They are very good at preventing bone fracture and superficial injury, but are not very good at preventing concussion. Concussion can occur from direct blows to the head or as the result of a blow to the body causing a whiplash event. No helmet could ever prevent the latter. The amount of biomechanical force that is absorbed by helmets, in my opinion, is not enough to expect that they could ever significantly alter concussion risk. With that in mind, I tell my patients to make sure all of their equipment is properly fitted and certified. I also advise them that while newer generation helmets might not be able to greatly reduce concussion risk, they may lower the absolute amount of force that their brain will experience.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. TOM UDALL TO JEFFREY KUTCHER, MD

Question 1. Helmet requirements for high school football. The National Federation of State High School Associations (NFHS) sets football playing rules and equipment guidelines that are adopted by many state athletic associations. The 2010 NFHS Football Rules book requires players to wear a football "helmet and face mask which met the NOCSAE test standard at the times of manufacture" (see page 17). However, these NFHS rules allow a football helmet that is no longer in compliance with NOCSAE standards to be worn by a high school player as long as the helmet met NOCSAE standards when it was originally made. NFHS also does not require that an older helmet be reconditioned and recertified to NOCSAE standards. Should high school football players wear helmets that meet current NOCSAE requirements when they are actually being worn—and not just on the day their helmets were manufactured?

Answer. Absolutely. I believe it is critical that high school football players wear helmets that meet current NOCSAE standards while they are in use. Every reasonable effort should be made to ensure that this is the case. Allowing helmets to be worn that no longer meet standards defeats the purpose of having standards in the first place.

Question 2. NOCSAE drop test and helmet quality. My understanding is that the NOCSAE safety standard for football helmets is primarily a drop test method that requires helmets to score less than a 1200 severity index (SI) level. Is there a difference in the level of protection offered by a helmet that tests at a 1199 SI level and a helmet that tests at a 300 SI level?

Answer. Theoretically, yes. The difficulty resides in trying to quantify the level of protection that any helmet offers. When speaking about injuries that are easy to document objectively, such as skull fractures or bleeding events inside the skull, one can make a reasonable estimate of risk. When speaking about concussion, however, as well as possible long-term effects of brain trauma such as chronic traumatic encephalopathy, it is much more difficult, if not impossible, to quantify the risk in a way that's precise enough to allow for comparisons between helmet types. First, we need to advance the science of concussion to a point that we have a consistent and well-defined clinical outcome to study, and one with an objective confirmatory test. Then, helmet types could be studied to see how they differ in preventing these outcomes. As it stands now, our estimates of risk, and therefore the amount of protection that any helmet can provide, is little more than guesswork.

That being said, it certainly makes sense from a neuropathological perspective that brains would rather experience less force than more, especially over the course of a lifetime. For that reason, it would seem to be an axiom that a helmet with an SI level of 300 would be preferable to one with an SI of 1199. Although we cannot

expect this difference to significantly mitigate the risk of experiencing a clinical concussion, it is more plausible that it could account for some amount of decreased risk of developing long-term neurological effects. If this effect does exist, however, it likely represents a very small proportion of the overall risk, and, therefore, we should not expect advancing helmet technology alone to solve the problem.

Question 3. Concussions tests. Dr. Kutcher, we hear more and more in the media about "concussion tests" used to diagnose athletes and determine if they are fit to return to play. Yet we also hear reports that some athletes may intentionally fail or "sandbag" their baseline neuro-cognitive tests in order to reduce the chance of being removed from play following a concussion later in the season. How effective are computerized neuro-cognitive tests in diagnosing concussed athletes and determining when it is safe for them to return to playing sports?

Answer. Computerized neuro-cognitive tests cannot diagnose concussion. Actually, there is no test currently available that can do so. Concussion is a diagnosis that is made clinically. Computerized neuro-cognitive tests provide information on brain function that an experienced physician can use, together with other pieces of information, to help make the diagnosis of concussion and help determine when the injury is over. I am very concerned with the degree to which computerized neuro-cognitive tests are being used inappropriately in our country. The problem stems from the fact that an abnormal result on these tests is not specific for concussion. An athlete who is in pain for any reason, or one who is sleep deprived, distracted, or unmotivated can produce abnormal results, whether they are concussed or not.

Furthermore, having a result on one of these tests that falls within a population-based norm does not mean that the person in question is not concussed. The best use of these tests comes when there is a pre-injury baseline result for comparison. The trick is that producing a baseline neuro-cognitive study truly representative of that individual's ability is more difficult than it sounds. Environmental and motivational factors frequently act to set a "false baseline" that is then used for comparison later.

Computerized neuro-cognitive testing is, potentially, a very useful concept. Used incorrectly, however, it can be misleading at best and dangerous at worst. I strongly encourage any clinician who uses this modality in their practice to understand the strengths and weaknesses of the individual tests and to use them as extensions of their physical examination, and never as a diagnostic test. In the end, diagnosing concussion and making a return to play decision not only involves clinical decision-making, but is very much a medical decision that should only be made by a physician.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. JOHN BOOZMAN TO JEFFREY KUTCHER, MD

Concussion Education

Question. Are educational campaigns, such as the CDC's Heads Up campaign, effectively reaching parents and coaches across the country? Do you feel they are reducing the number of concussions that occur and/or changing the way people react when someone sustains one? Should anything be done to make these education campaigns more effective?

Answer. The publicly available concussion education programs, such as the CDC's Heads Up campaign, are helping, but only to a degree. They are part of the larger changing landscape of increased concussion awareness and, as such, do have some impact on moving the issue forward. I do not believe they are significantly reducing the number of concussions, nor do I see a significant change in how concussed athletes are being treated. We can, and certainly should, do better. There are four main reasons that I see for this overall lack of effectiveness:

First, I have found that the value of any educational resource depends on how specifically the material is designed for a particular audience. Most available concussion resources take a generic approach that appeals to the public at large. Granted, this may be a result of the need to produce materials that cover a wide audience with limited resources. Concussion education, however, needs to address every stakeholder in the issue. We need programs that are designed for each population specifically, speaking to their concerns, using their language, and engaging them in the learning process. We need to have programs that are created for athletes of different age groups, coaches of all levels of sport, parents, administrators, officials, and medical staff.

Second, most concussion education materials I have seen are fairly average in quality. They provide superficial content in a non-stimulating way. Successful edu-

cation programs use creative instructional design and an interactive format that motivates and challenges the learner.

Third, there is a significant issue with lack of quality control and consistency between programs. In some cases, information is outdated, incorrect, or contradictory. Much of this may be due to the fact that our understanding of concussion is evolving quickly. I'm afraid, however, that in an age when anybody can produce an educational tool using electronic media, that many programs are designed for the purpose of marketing a product or service. The public is thirsty for knowledge and deserves information that is accurate, current, and not driven by ulterior motives.

Finally, while having these materials available to those who are actively seeking knowledge is a wonderful start, I believe the majority of athletes, parents, and coaches would not seek these programs out voluntarily. Whenever possible, we need to make concussion education a mandatory activity prior to playing, coaching, or consenting for a child to participate in contact sports.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. FRANK R. LAUTENBERG TO ANN C. MCKEE, MD

Question 1. Concussions and other traumatic brain injuries pose a serious and increasing risk for our youth. In 2009, emergency rooms treated an estimated 248,418 sports and recreation-related concussions and other brain injuries among children and adolescents. These injuries have increased by 60 percent over the last decade even though school sports participation has fallen. What more can be done to prevent these injuries? How can we ensure that kids who experience concussions don't suffer long term consequences?

Answer. The primary way to reduce the number of concussions suffered by children and adolescents is to raise awareness and educate the public—coaches, parents, medical doctors, psychologists and kids—about what a concussion is, what kind of activities increase the risk of concussion, and how to properly manage a concussion after it occurs. A concussion properly recognized and medically managed is the best protection against the long-term consequences. Ensuring that the child or adolescent rests sufficiently (including cognitive rest) after a concussion and not allowing the resumption of play of the sport or other activities until fully recovered is the best way to reduce complications down the road. Other prevention measures include wearing proper protective gear when bicycling, skiing, skateboarding, etc and avoiding activities that are associated with repetitive brain trauma, *e.g.,* leading with your head or tacking with your head in football and other sports.

Question 2. Rates of concussion and other brain injury have dramatically risen over the last decade as have sales of equipment that is supposed to protect our kids from these injuries. Are these products really protective?

Answer. There is no product marketed today that prevents concussion, including helmets, although helmets make sports safer by reducing catastrophic injuries. Reducing the incidence of sports-related concussion will require changing the way many of our popular sports, including football, soccer and hockey, are played.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. JOHN BOOZMAN TO ANN C. MCKEE, MD

Risks in Concussions/Death

Question 1. Last month, a 16-year-old high school football player died from a head injury after collapsing during a game. I understand the possibility of further injury due to multiple concussions, yet according to the news report, there was no evidence of any pre-existing injury or condition that would have contributed to his death. How can a seemingly healthy 16-year-old with no previous head injury history die after what appeared to be an ordinary football play?

Answer. While I'm not certain I know what specific case you are referring to, it sounds as though it may be a case of second impact syndrome or SIS. SIS occurs when a young athlete sustains an initial head injury and then suffers a second head injury before the symptoms associated with the first impact have cleared. There are many times when the athlete does not report the initial injury—he may not realize that he had a concussion, he may be minimizing the symptoms or his desire to return to the playing field may cloud his judgment. Before the first injury completely resolves, which may take days or weeks, the athlete returns to competition and receives a second blow to the head—which may be remarkably minor—as in an ordinary football play. Yet the second impact produces sudden brain swelling, high intracranial pressure, and results in death or severe neurological disability. The

pathophysiology of the SIS is believed to be dyregulation of the cerebrovasculature, which young brains are more susceptible to. SIS occurs only in young athletes and has never been reported in an athlete over the age of 24 years.

Another possible cause of sudden collapse and death on the football field is bleeding into the brain, such as a subdural or an epidural hemorrhage. Although these are very rare events and would not be expected to occur after an ordinary football play.

Question 2. Are injuries such as this one preventable?

Answer. Not playing while recovering from a concussion, even a seemingly minor concussion, is the best prevention against this injury.

Question 3. How does an injury like this differ from a concussion?

Answer. A concussion is a temporary state of neurological dysfunction accompanied by microscopic evidence of multifocal axonal injury and disordered cerebral metabolism. SIS occurs when there is a second concussive impact on a brain that has not fully recovered from the first one. The second injury produces sudden brain swelling that leads to brain herniation and death or severe neurological injury.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. FRANK R. LAUTENBERG TO MIKE OLIVER

Question 1. Why has NOCSAE not substantially updated helmet standards in nearly 40 years?

Answer. This is a common and persistent misconception or misunderstanding. NOCSAE helmet standards including football helmet standards have been updated, revised, expanded, and strengthened regularly over the past 40 years. Changes to the NOCSAE standard over time have included revisions and modifications to the pass fail criteria, and at other times the revisions, although appearing to be small simple changes in test methodology and procedures, in fact proved to be substantial and demanding changes that forced helmets to become more robust, more protective, and more durable.

As a result of improvements and updates to the NOCSAE football helmet standard and advances in materials technology and engineering and design innovation, the average pass fail test scores for new helmets has dropped from 600 SI in 1998 to just under 500 SI in 2010. Although there is no way to quantify what this reduction means in terms of injury protection and prevention, it is evidence of improvement. It also must be kept in mind that even though the pass fail threshold is 1200 SI which threshold is based on the science behind the Gadd Severity Index ("SI"), in order to meet the Quality Assurance and Quality Control requirements of the NOCSAE standards, helmets must average 500–600 SI in certification testing.

Football helmets certified to the NOCSAE standard and used in high school and collegiate play are involved in over 600,000,000 practice and game impacts during the course of a single football season, and sometimes they must perform across two and three seasons of continuous use before they are submitted for reconditioning and recertification. Tests performed on these helmets before they are reconditioned establishes that, unless padding has been removed or altered, these helmets will have test results that are nearly the same as when the helmet was new. Under the circumstances, changes to a standard which already provides an extremely high level of protection and performance can only be undertaken and adopted when there is solid and consensus scientific support for those changes. NOCSAE is one of the leading research funding sources for the advancement of that kind of scientific knowledge, in the hope that additional revisions and updates can be made to the standards to further enhance protection and performance.

Some examples of changes and updates to the NOCSAE standard are listed below.

- 1990—A random location impact requirement was added to the six predetermined impact locations contained in the standard. As a result of this change, helmets would not be required to be tested in locations in as many as 58 different locations not previously evaluated. This simple change prevented a helmet from being designed to meet the standard only at designated impact locations, and ensured that football helmets would meet the standard which struck at any location on the helmet shell and within defined limits of the edges of the shell.
- 1992—Implementation of a scientifically proven calibration method of the NOCSAE headform using the three inch MEP is introduced. Required calibration performed before testing, produced increased repeatability between laboratories. This change was mandatory for all NOCSAE licensees. The NOCSAE carriage assembly was made more rigid and the air craft cable guide wires were

replaced with smoother music wire. This decreased friction in the drop system and increased stability of the carriage assembly throughout the drop impact. A tapered bolt for locating the different impact sites was introduced. The test MEP was hardened from a 36 Shore A hardness natural rubber surface to a 43 Shore A hardness urethane to produce a more consistent impact surface. These changes resulted in significantly higher impact velocities and increased impact energies to the helmet, a more demanding test than in the previous standard. The impact energies and the velocities were increased to the point that sophisticated testing headforms were being broken and had to be redesigned and replaced at a cost of $350,000.

- 1996—The pass/fail threshold was toughened by 20 percent, by changing the pass/fail threshold value from 1500 SI to 1200 SI. The SI value of 1200 corresponds almost directly with the Federal Motor Vehicle Safety Standard head injury criteria (HIC) value of 1000.
- 1999—The new anthropometrically correct size medium headform was introduced. This change produced a more robust head model to prevent the excessive breaking of headforms that had resulted from the earlier changes made to the drop system that increased drop velocities and energies. This change created a head model that is less likely to break under normal use and resulted in a more demanding helmet test particularly for impact sites located along the rear portion of the headform. After extensive tests were carried out on the new medium head model, the size small and large headforms were introduced in 2002.
- In 1994, NOCSAE introduced a proprietary data acquisition and analysis computer and software program and mandated its implementation by all licensed helmet recertification entities. This system has been refined multiple times over the intervening years, and in 2003, the entire system was replaced with a second-generation data acquisition system. One of the strengths of this test and data acquisition system is to prevent invalid helmet test results from being recorded.

In the last five years, NOCSAE has clarified the zero defect or zero AQL quality assurance requirements of the standards, has added a third low-level impact requirement with a separate lower pass fail threshold, and has required that helmet impact velocities during the test be directly measured with a light activated velocity gate instead of utilizing mathematical calculations based upon acceleration of gravity.

As a result of the revisions, modifications, and updates made by NOCSAE to its standards, football helmets certified to the NOCSAE standard outperform helmets certified to any other standard, whether in energy management, head coverage, durability, weight, low-energy and high energy impact performance.

Question 2. Given the misleading claims by many manufacturers based on little or no scientific evidence, why has NOCSAE not developed marketing guidelines for products that meet its standards?

Answer. NOCSAE is a standards development organization. The scope of our authority is limited to matters regarding compliance with the NOCSAE standards by licensed manufacturers and reconditioners who certified products to the NOCSAE standards. NOCSAE does exercise control over advertising content with regard to the appropriate and proper use of all registered and trademarked names, marks, and properties used in connection with certification to the NOCSAE standards. Unless the licensee improperly and impermissibly uses those registered properties as part of the objectionable content in advertising, NOCSAE has no authority to address or provide guidelines beyond that scope. The license agreement NOCSAE has with each manufacturer or reconditioner covers a licensee obligations with regard to certification and compliance with the standards is a unique and powerful control over the integrity and validity of the NOCSAE standards, but it cannot provide a legal basis for the regulation of advertising content unrelated to the proper use of registered and trademarked properties in compliance with the NOCSAE standards.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. TOM UDALL TO MIKE OLIVER

Question 1. NOCSAE's standard development process. Mr. Oliver, many standards development organizations follow a code of good practice embodied in the American National Standards Institute's Essential Requirements: Due process requirements for American National Standards.

These ANSI Essential Requirements include provisions for balance, openness and lack of dominance by any single interest category, individual or organization. De-

spite your description of NOCSAE's membership and mission, your organization falls short of the ANSI Essential Requirements for standards development in several important respects. Will NOCSAE commit to becoming fully compliant with the ANSI Essential Requirements for standards development? If so, by what date?

Answer. NOCSAE voted in June 2011, to seek accreditation as an ANSI Standards Developer, and is in the process of preparing an application for that purpose. It is anticipated that such accreditation will be straightforward, given the fact that existing NOCSAE procedures and board membership already comply with the essential due process requirements contained in the ANSI procedures.

Being an ANSI Accredited Standards Developer signifies that standards are developed using a fair, open process that ensures a level playing field and will meet the needs of materially affected interests, and NOCSAE written policies and by-laws address those core concepts and values.

According to published ANSI 2010 Essential Due Process provisions, the hallmarks of the ANSI due process are openness, consensus by a balance of materially-affected interests, consideration of views and objections, lack of dominance by any affected interest, transparency of the process, and provisions to provide fundamental fairness. The NOCSAE By-Laws define the membership of the board of directors to create a balanced and diverse consensus body representing materially affected interests from a variety of national organizations which represent those diverse interests on a broad national scale. These interest categories include medical, consumer/athlete end-user, scientific, and manufacturing interests. Membership number limits each category precludes any single interest group from having a controlling vote or veto. This defined membership structure of the NOCSAE board also satisfies the ANSI definition of a consensus body.

Additionally, ANSI requirements for specific written procedures to be followed in adopting and publishing standards that provide for public notice and comment periods, periodic review and reaffirmation, and the use of standardized nomenclature have been a part of the NOCSAE procedures for many years.

The application for ANSI accreditation will be submitted before January 30, 2012, but it cannot be known when the application will be approved by ANSI.

Question 2a. NOCSAE's market surveillance. Mr. Oliver, you state in your testimony that NOCSAE performs market surveillance. This seems to contradict what is written in the NOCSAE drop impact test method used for football helmets, which clearly states that:

"NOCSAE publishes standards but does not conduct surveillance to assure compliance to standards. It is the sole responsibility of firms that manufacture or recertify protective products to certify that all requirements of these standards are met, including ongoing statistically relevant QC protocols." Can you explain this discrepancy between your statement and what is written in the NOCSAE standard?

Answer. The reference in the standards that NOCSAE ". . . *does not conduct surveillance to assure compliance to standards"* refers to market surveillance that is typically performed by certifying bodies, such as CE Notified Bodies in Europe, and certifying bodies in the United States such as Underwriters Laboratories and the Snell Foundation as part of their product certification duties. NOCSAE is not a certifying body and so does not conduct formal market surveillance as part of the standards development process, and the referenced paragraph is intended to make that fact clear to consumers, manufacturers, and licensees.

The purpose of a market surveillance program utilized by certifying bodies is to protect the integrity of the certification mark, to prevent counterfeit and non-conforming products from reaching the consumer market, and as a check on the manufacturer who is placing the certifying body's mark on the product. "Market surveillance" as commonly used in this context involves the certifying body supplementing its own product certification testing on limited samples provided by a manufacturer with tests on a sample of unused certified products purchased in the market after the certified product has been distributed by the original manufacturer.

But many of the policies and duties imposed by the NOCSAE standards and the license agreement between a manufacturer and NOCSAE involve activities that would fit the definition of market surveillance, and which accomplish the same goals as with a certifying body, although on a much more demanding and far reaching scope than any traditional market surveillance program maintained by a certifying body.

Formal and traditional market surveillance programs test only new products purchased at retail to verify the accuracy of the certification mark, but no surveillance program tests used products as part of that process. The NOCSAE recertification standards involve testing and evaluating previously certified equipment for as long as the equipment is being used and submitted for recertification. To make an analogy, the NOCSAE product surveillance program would be the equivalent of Under-

writers Laboratories going into homes and re-testing toasters that have been in use for years, and verifying that the toasters still comply with the original UL mark.

Testing used helmets for the purpose of recertification is also an affirmation and validation of the integrity of the new helmet certification. If the helmet meets the standard after it has been used for several seasons, it is a given that it met the standard when it was newly certified. That fact alone obviates the need to purchase new, unused helmets at retail in order to verify the accuracy of the original certification.

Each year, NOCSAE licensed recertifiers re-test tens of thousands of randomly selected helmets of varying brand, model, age and condition based on time elapsed since last reconditioned. This recertification process is regulated by NOCSAE standard, and controlled by proprietary testing and data acquisition software developed by and for NOCSAE. The re-testing process is randomized sample based, and involves testing a helmet both in the exact condition it was in when it last came off a player's head, without any repair or modification, and then testing the very same helmet again after it has completed the reconditioning process. For each helmet tested, the program collects 28 separate data points, including brand, model, model year, size, test headform model and size, test laboratory temperature, date and time of testing, the name of the test technician and the laboratory name and location, and the performance test scores for 8 separate impacts across 4 different impact locations.

In the 2009–2010 reconditioning season, there were 50,508 different football helmets tested representing over 50 different models spanning more than 10 model years. Additionally there were 880 lacrosse helmets tested, and over 1,500 batters helmets tested.

The NOCSAE data acquisition computer and software used by each recertification facility forces an internal and external system function and calibration check before and after each batch of helmet testing. If the pre-test calibration check test fails, the system prohibits testing until the calibration failure is resolved. If the system and calibration check test fails after a batch of helmets is tested, the test results for those helmets is voided and dumped into a special file, and all the helmets tested in that batch must be re-tested. If the pre-and post-test calibration and system checks pass, the helmet test results are stored in an encrypted file which is accessible only by the NOCSAE Technical Director for review and analysis.

This dataset provides market and product surveillance information for certified helmets new and old, as well as information on team and school reconditioning frequency across the country, and on the quality controls of each licensed recertifier. From this data an extremely detailed historical record of the performance over time of helmet models by year, age, and years since last reconditioned has been developed. As an example, in the 2009–2010 dataset, the before and after performance of several models can be compared over 15 model years to determine whether there is a decline in the performance of the helmet, and to what extent the reconditioning process has restored or even improved the helmet's original performance levels. There is no other market surveillance program in the world for personal protective equipment that comes close to evaluating the continuing validity of the equipment certification.

A combined dataset that includes testing done from 2005 through 2011 contains 7,728,000 separate data points on 276,000 individual helmets, and includes 2,208,000 helmet impact performance data points.

This product surveillance process is supplemented by a mandate that each certification and recertification facility participate in round-robin system equipment calibration programs directed by an A2LA accredited laboratory at least once a year, and more often if indicated.

As with many international product certification programs, the NOCSAE standards mandate that licensees submit certified products for testing and validation annually to a third party testing laboratory certified to ISO 17025 standards, and that new products or models must be submitted for third party laboratory validation in advance of distribution. In order to receive a license agreement an applicant must first submit a report from an appropriately accredited third party laboratory confirming that the products they intend to certify to the NOCSAE standard actually meet the standard. Those validation tests and reports are a check on the accuracy and validity of the original certification of that product consistent with the goals and intent of a formal market surveillance program. NOCSAE follows almost the identical third-party laboratory validation protocol requirements mandated by the CPSC for bicycle helmets certified to the CPSC standard.

Additionally, if NOCSAE is made aware of a potential invalid or incorrect certification, NOCSAE does engage in a focused investigation in the form of direct helmet purchase at retail, and testing to determine whether the manufacturer's certification

is void or valid. We will also demand the production of all certification testing data and results, including all QA and QC that the licensee uses to support its certification of helmets, both as an independent check on the certification process, and as part of an investigation as to a specific product.

NOCSAE does not conduct formal market surveillance as part of a product certification program, but the requirements in the NOCSAE equipment performance standards result in a product surveillance and validation function which far exceeds traditional certifying body market surveillance programs both in scope and performance demands as it validates and verifies helmet standard compliance certification for new and used helmets.

Question 2b. Did NOCSAE "market surveillance" efforts, if any, discover problems related to compliance with NOCSAE standards at any helmet manufacturer or reconditioner? My understanding is that NOCSAE did not learn of problems at a New Jersey reconditioning company, for example, until after they were exposed by a Federal criminal probe.

Answer. The only reconditioner that was the subject of a Federal investigation was Circle System in Easton, Pennsylvania, and that investigation did not involve failed helmets or a failure to properly test helmets. The breach in that case was the fraudulent underreporting of the number of helmets recertified. There was never a finding by the FBI or NOCSAE, following its own separate investigation, that the recertified helmets from Circle System failed the recertification tests, or that the helmets were poorly reconditioned. From what little has been revealed by the investigators and in the press, the owners of Circle System apparently defrauded their insurance company and NOCSAE by intentionally underreporting the total number of helmets recertified, thereby saving significant premium expenses and license fees, while at the same time double billing school districts and customers.

Market surveillance testing would not have discovered this type of fraud. Reconditioned helmets are not sold at retail, and the helmets reconditioned and recertified by Circle System had been reconditioned several times before the fraud was discovered, and there was no data to support any conclusion that he helmets had been improperly reconditioned or incorrectly recertified.

Although no incidents of product failures have been discovered, NOCSAE has discovered several situations which required a licensee to revise and supplement its QA and QC programs, and provide supplemental testing of larger samples to meet those requirements.

Question 3. No NOCSAE requirement for maximum helmet lifespan. Mr. Oliver, you stated during the hearing that NOCSAE relies on manufacturers regarding the recommended lifespan of football helmets. However, NOCSAE's own technical director, Dave Halstead, told The *New York Times* he "would never let [his] kid wear a helmet that is more than 10 years old." Another NOCSAE expert, Dr. Robert Cantu, wrote in review comments for the 2006 Neurosurgery study of Riddell Revolution football helmets that:

> "As Vice President of the National Operating Committee on Standards for Athletic Equipment (NOCSAE), the organization that makes the certification standards for football helmets and other athletic equipment, I am aware . . . that new helmets test to a higher severity index level than older helmets. New helmets out of the box before receiving the thousands of hits that they will incur on ensuing seasons often test significantly below the 1200 severity index that they must pass. Then, with each year's passage of time, their abilities to attenuate acceleration forces decline."

Dr. Cantu is also quoted in the book Head Games: Football's Concussion Crisis from the NFL to Youth Leagues (page 109) as follows: "The brand new helmets that come right off the shelf are about 800 [SI], way better than the letter of the rule. Over the course of a season, or seasons, they get worse. . . ."

Given that NOCSAE's own experts believe newer helmets are safer than older ones, will NOCSAE commit to revising its football helmet standards to include a maximum lifespan for football helmets?

Answer. Questions regarding the proper life span of a helmet, sometimes referred to as the useful safe life, involve considerations unique to each manufacturer such as design function, product liability exposure, proper care and treatment, and materials performance characteristics that are outside the authority and function of an independent standards setting body such as NOCSAE. Helmet performance standards developed by NOCSAE are intentionally design neutral so that engineers and designers are not restricted in their approach to helmet function and design. That freedom has resulted in the development of at least three unique engineered approaches to protecting the heads of athletes that involve different materials, dif-

ferent mechanical properties, and even different physics principles. Because of these differences, life span issues that might be relevant to one type of system may not be relevant to the others. Because a standard, by definition, must apply equally to all products within its scope, any provision that imposes a limit on how long a helmet can be used will be an arbitrary decision which can unduly harm one brand while giving an advantage to another. The creation of a maximum life for a helmet through a standard also creates a risk that players and parents will assume that a helmet is safe and needs no attention as long as it is still within the defined "useful safe life." Notwithstanding these concerns, what NOCSAE can do, and what it does, is continuously evaluate the performance of helmets over time to see if there are data that might indicate the need to further investigate this issue.

I am personally familiar with each individual quoted, and based that and the actual helmet performance test data that NOCSAE has collected over the past 15 years, I am confident that Dr. Cantu and Mr. Halstead were referring to older helmets that have not been properly and regularly reconditioned when they were commenting on helmets of a particular age. Recertification test data covering hundreds of thousands of helmets document a helmet's performance over time and under various reconditioning frequencies, and the data does not support a conclusion that a helmet's age, standing alone, is related to that helmet's performance abilities. There is very little, if any, decline in the performance of a football helmet over the course of a season, absent significant abuse or intentional alteration of the padding system. Football helmets are designed to handle repeated impacts in quick succession over thousands of impacts. Current literature involving the *in vivo* collection of football helmet impacts over more than 7 seasons by researchers at upper division colleges and at the high school level has shown that a player's helmet will likely be hit more than a thousand times per season. In 2009–2010, new 2009 helmet models tested after just a single football season and before any reconditioning, averaged in the 500 to 600 SI range on the impact location which is most likely to have the highest SI values. That value is almost identical to the average SI values scores as new unused helmets, and in many cases that number is actually lower than when the helmet model was tested for certification as a new helmet.

For a 10 year old helmet that has been properly reconditioned and has had the padding system replaced with new padding that meets or exceeds the original padding performance levels, the only 10 year old part of that helmet is the shell, and unless the shell is cracked, which would prevent its recertification, that helmet should perform as good if not better, than when it was new. And the recertification testing data shows that such is true.

Tragically, catastrophic and even fatal head injuries have occurred to players wearing *brand new* helmets, which speaks more to the fact that there are some serious and even fatal head injuries which cannot be prevented by any helmet. The rapid and usually fatal brain swelling and auto-regulatory dysfunction that is seen in second-impact syndrome, which seems consistent with facts describing the injury to Max Conradt, can occur from very slight hits to the head and even without head contact through whiplash type accelerations of the head if that player has been returned to play too soon following a concussion. In those cases, the injury risk likely is unrelated to the age or performance of the helmet being worn.

Question 4. Helmet requirements for high school football. The National Federation of State High School Associations (NFHS) sets football playing rules and equipment guidelines that are adopted by many state athletic associations. The 2010 NFHS Football Rules book requires players to wear a football helmet and face mask that "met the NOCSAE test standard at the times of manufacture" (see page 17). However, NFHS rules allow a football helmet that is no longer in compliance with NOCSAE standards to be worn by high school player as long as the helmet met NOCSAE standards when it was originally made. NFHS also does not require that an older helmet be reconditioned and recertified to NOCSAE standards. Should high school football equipment rules require that any helmet used by a player meet current NOCSAE requirements when it is actually being worn—and not just on the day it was manufactured?

Answer. As with any equipment or product certified as compliant with a standard at the time the new product was manufactured, once placed in use, the continued validity of that certification is dependent not only upon proper use and care, but also on the designed durability of all component parts, and the margin between the standard's pass-fail threshold requirements and the actual helmet test performance when certified. From years of post-use recertification testing of all brands and models and ages of helmets, 99.86 percent of the helmets tested from the field *after one or more seasons of use and before reconditioning* will perform far below the threshold and still meet the standard by a significant margin. This extremely high percentage includes all helmet models, all ages, and all conditions, and it includes hel-

mets which may have had altered or damaged padding, since the BEFORE reconditioning test of these randomly selected helmets does not permit repair before the helmet is tested. When tested after reconditioning, the percentage that passes is 99.95 percent, and the 0.05 percent that doesn't pass is not returned to the school or club. So the persistence of the validity of a helmet's certification to the NOCSAE standard over time and use is extremely high when helmets are regularly reconditioned. That means that it is extremely rare for a helmet to be used by a player that doesn't meet the standard, even after significant use over several seasons.

An important reason for such extremely high certification validity persistence is the Quality Control and Quality Assurance levels that are imposed upon NOCSAE licensees who certify their equipment to NOCSAE standards. In order to reach the zero defect or 0 AQL levels, the average passing SI value for every new helmet impact location must be substantially below the pass-fail threshold of 1200 SI. For all new 2010 adult and varsity helmets in size medium certified to the NOCSAE standard, the average certification SI value was 497 on the front location, which historically has the highest SI values. This same general margin has existed for many years.

With the levels of Quality Assurance and Quality Control mandated by the NOCSAE standard, all organizations, including high schools, should have the highest level of confidence that the helmets meet the NOCSAE standard.

Question 5. Football helmet reconditioning. The NOCSAE website FAQ page states that "There is nothing in the NOCSAE standard that requires any helmet to be recertified on any regular basis." Ralph Conradt states that his son Max was injured while wearing a twenty year old helmet that, when tested after Max's injury, was found to not meet NOCSAE's safety standards. Given that some high school football players could be wearing unsafe helmets that are twenty years old and that no longer meet NOCSAE standards, will NOCSAE commit to updating its football helmet standards to require reconditioning on a regular basis?

Answer. How frequently a particular helmet should be reconditioned and recertified is dependent upon many uncontrollable variables, including the level and intensity of usage and condition at the end of a season. The reconditioning and recertification process is a significant budget item for most high schools, and a standard arbitrarily mandates annual reconditioning where the data does not support the conclusion that annual recertification is necessary at every school or with every helmet simply adds additional budget and expense burdens to school districts already facing severe pressures. NOCSAE is committed to exploring options in this regard, and currently strongly recommends reconditioning and recertification every year. When a school or club cannot afford annual recertification of all their helmets, NOCSAE strongly recommends the adoption of a two-year or three-year cycle of regular reconditioning and recertification such that each year one third to one half of the helmets in the program are submitted for reconditioning and recertification, and the remainder are evaluated pursuant to a written inspection and assessment program to identify helmets with obvious damage, missing pads or components, or other signs that indicate the need for reconditioning and recertification, even if that helmet is not scheduled for reconditioning.

Data available to NOCSAE from the recertification test datasets establishes that, with the exception of helmets which are missing pads or which have been altered or may have broken shells, there is no statistically difference in the average SI values of helmets submitted every year for reconditioning/recertification and those submitted every other year, or even every three years. As a general rule, the primary benefit of annual reconditioning and recertification is that it inserts an experienced third party into the helmet inspection and assessment process, and increases the likelihood that hidden problems or unrecognized damage will be discovered and addressed, and it probably would limit the swapping of pads and padding systems among different helmet brands and models.

Max Conradt

When the helmet used by Max Conradt was made and certified to the NOCSAE standard in 1983, the pass/fail threshold in the standard was 1500 SI. Helmets can only be recertified to the standard applicable to the original certification. The testing data presented to the court in the Conradt case by an accredited laboratory acceptable to the court and to each side, established that the helmet in question, when tested to the NOCSAE standard after Max Conradt was injured passed all impact test locations below the 1500 SI threshold, and even passed all impact location tests to the 1200 SI threshold, with one location exception, and that location was not a location where it was suspected that Max had been hit. The Conradt helmet was manufactured in 1983, just 3 years after the NFHS made compliance with the NOCSAE standard mandatory for high school play. As recently as 2009–2010, of the

48,000 randomly selected helmet sample set tested for recertification, there were 28 helmets in the sample set made before 1991, and all tested below the 1200 threshold BEFORE (meaning as they were in use and on the field) reconditioning on every test impact location, even though the applicable threshold for those helmets was 1500.

The type of severe and life changing head injury sustained by Max Conradt, although very rare, has no specific association with the age or SI values of a particular football helmet. Almost identical non-fatal and fatal injuries have occurred to players wearing brand new 2009 and 2010 helmet models, and some epidemiological data suggest that the rate of occurrence of these types of injuries has remained relatively steady over time, unaffected by improvements in helmet technology, SI values or helmet age.

Certainly the best level of protection any helmet can provide is a function of proper maintenance, regular reconditioning and recertification, and following warnings and instructions. No standard can guarantee an outcome or even a performance level, but compliance with the NOCSAE standard will provide the player, coach and parent with the highest level of protection available today, and as much assurance as is possible that the helmet will continue to meet that standard as long as it is properly maintained.

Question 6. Football helmets in use at high school and younger level. USA Football estimates that there are 3 million youth football players. In addition, there are an estimated 1.4 million high school football players. Of this group of about 4.4 million football players, how many are wearing:

(1) new helmets

(2) helmets manufactured or reconditioned in the last year

(3) helmets manufactured or reconditioned in the last two years

(4) helmets that have not been reconditioned in more than two years

(5) helmets older than two years that have never been reconditioned?

Answer. It is impossible to know the answers with definite certainty because many of those players are outside the control and supervision of any national governing body. We do know that on average there are approximately 800,000 new helmets sold each year, and approximately 52 percent of those are categorized as "youth models" which could include models intended for use at the middle school level. We also know that there are youth players who must wear adult or varsity helmets because the youth models are too small for them.

(1) *new helmets:* approximately 800,000 are wearing new helmets

(2) *helmets manufactured or reconditioned in the last year:* 2.5 million

(3) *helmets manufactured or reconditioned in the last two years:* 3 million

(4) *helmets that have not been reconditioned in more than two years:* it is impossible to know this number exactly. We know that each year there are approximately 250,000 helmets sent for reconditioning and recertification that have not been reconditioned for more than 2 years, but we currently have no way to know whether that number is statistically representative of the helmets in the field.

(5) *helmets older than two years that have never been reconditioned:* unless the helmets are sent for reconditioning, there is no way to answer to this question.

Question 7. NOCSAE drop test and helmet quality. My understanding is that the NOCSAE safety standard for football helmets is primarily a drop test method that requires helmets to score less than a 1200 severity index (SI) level. Is there a difference in the level of protection offered by a helmet that tests at an 1199 SI level and a helmet that tests at a 300 SI level?

Answer. The answer depends on which type of injury is being analyzed. The 1200 SI threshold is premised upon a risk analysis curve, very much the same as HIC values used in Federal Motor Vehicle Safety Standards. The HIC and SI plotted curves are logarithmic and as the values pass downward through 1200 the curve flattens such that measurable differences between 1200, 1100, 1000, and on down become very small. As to those injuries for which the 1200 SI threshold is intended to address, no quantitative or qualitative comparisons can be made between SI values of 300 and 1100 as to which will prevent more injuries. Certainly lower (all other helmet attributes like mass and shape being the same) would be better in general, but there is no linear relationship or scale than can state with any confidence how much more protective a lower value is over a higher value. This is particularly true with regard to the kinds of engineering and design changes that might be nec-

essary to obtain lower values, and whether the impact being tested is a high energy impact or a low energy impact.

An SI score of 1200 is essentially equivalent to a HIC score of 1000, which represents the "safe" limit of human injury tolerance, above which the risk of a fatal or catastrophic head injury is clear, and the probability of that type of injury rapidly increases with higher SI values. But because of the logarithmic characteristic of the scale, the converse is not true as the values decrease below 1200. The 1200 SI threshold is like a doorway, once you are through it you can go further into the room, but outside is still outside. An SI value lower than 1200 represents some reduction in risk, although very minor (negligible), but going higher represents a near exponential increase in risk. The importance and validity of HIC or SI as weighted impulse criteria is frequently debated but the criterion remains extensively used because no better formulations or thresholds have demonstrated reduced injury risk. For example, in the USA, Europe and elsewhere, government mandated performance requirements for automotive seatbelts, airbags and other safety devices are specified in terms of a 'not to exceed' HIC score, with no specified benefits for being under that limit by any percentage.

Question 8. Clearly visible labels. Mr. Oliver, you stated during the hearing that NOCSAE does require clearly visible "date of manufacture" and "date of last reconditioning" labels for football helmets. However, the primary NOCSAE technical standard for football helmets, NOCSAE DOC (ND) 001–08m10, in section 9.4, states that helmets must have:

> "A permanent and legible label or mark that denotes the month and year of manufacture that can be easily read without removing any permanent component. If this mark or label requires a 'code' to determine month and year, such code shall be made available upon request."

This contrasts with the standard's requirements that other labels are "not obscured in any manner."

- Will NOCSAE commit to revising its standard to include a requirement for clearly visible date of manufacture and date of last reconditioning labels that are not obscured in any manner?
- Will NOCSAE commit to revising its standard to require that the date of manufacture and date of last reconditioning be easily read and understood by players, coaches and parents? In other words, will NOCSAE require that such labels are not written in "code" which can only be interpreted by the manufacturer or reconditioner

Answer. *New Helmets*. NOCSAE is committed to evaluating the existing standard requirements for the placement and visibility of a manufacturing and recertification date for helmets certified or recertified to the NOCSAE standard. The NOCSAE standards incorporate the considerations contained in ANSI Z535.4, and NOCSAE is committed to continued compliance for all helmet labeling and warning requirements. We are currently exploring several options for improvement, and we are committed to that process as we always are in maintaining NOCSAE standards. Deciding whether and how a specific piece of information is located and identified on the helmet also involves human factors consideration as to whether such information may dilute the effect of, or divert visual attention from, other specific hazard warnings and signal words already on the external portions of the helmet.

ANSI warning label requirements distinguish between warning labels that address hazards and those which convey information that may be related to hazards and indicate matters such as location and visibility. The age of the helmet shell, which is all the manufactured date will reliably indicate for a used helmet, is not related to any identified hazard or risk of injury, nor is it a piece of information reasonably necessary to be accessed under emergent circumstances. There is also no common agreement or understanding with regard to whether the more important date for a consumer or user is the date the helmet was first used and not the date the shell was made. A helmet with a manufactured date of 2009 may not first be used by a player until the fall of 2011. Is the manufactured date for that helmet more representative of its quality and ability to perform than a helmet with a manufactured date of 2010, but which has been used for part of the 2009–2010 season and all of the 2010–2011 season?

To complicate matters more, there are helmets which may have their component parts manufactured on different dates and not actually assembled for a year or more. Which date is the one which should be provided to the consumer in those cases? If the shell was manufactured in 2009, the various protective energy attenuating system components manufactured in 2008, 2009, and 2010, and final assembly of that helmet did not occur until 2012, which of those dates is provides material

and useful information for the consumer to know with regard to the ability of that helmet to perform? The issue of a manufactured date is not a simple one, and NOCSAE is committed to investigate and address the matter to determine if there's a better or more functional way to present the model year information.

Reconditioned Helmets

NOCSAE recertification standards have required for many years that the reconditioning and recertification date be plainly visible and placed on the helmet. The recertification date and the identity of the entity that performed the reconditioning and recertification are required. All licensed recertifying companies follow the same format and actually use the same company to print the labels for each season. If the manufacturer's original certification logo is no longer visible on the outside of the helmet, then a recertification label must be placed on the outside. An example of the outside information mandated by the NOCSAE standard is:

Every recertified helmet must also have a label on the inside, underneath the padding, which includes a statement verifying recertification and indicating the year and name of the company which performed the recertification. Placement of this information on the inside of the helmet shell and underneath removable padding makes it easily accessible, while also protecting the label and information from damage and removal during usage. As with the manufacturing date of a helmet or helmet shell, the recertification date and identity of the recertifying entity is not information that would need to be accessed quickly under emergency circumstances, but should be easily accessible without having to remove permanent component parts.

Question 9. NOCSAE licensing agreement and advertisements with NOCSAE seal. Mr. Oliver, your written testimony states that NOCSAE's licensing agreement with helmet makers "obligates each licensee to obtain prior approval of proposed advertising which uses the NOCSAE name or references NOCSAE as part of its advertising."

A Riddell brochure titled "Revolution Helmet Research Findings" (available at: http://www.lohud.com/assets/pdf/BH1661391028.PDF, accessed Oct. 19, 2011) references NOCSAE in three separate places and includes the NOCSAE seal in two places. This advertisement prominently features Riddell's claim that research shows a "31 percent reduction of the relative risk of sustaining a concussion when wearing a Revolution vs. a traditional helmet."

- Did Riddell obtain approval from NOCSAE to use the NOCSAE seal and name in this brochure?
- If so, why did NOCSAE approve the use of its seal and name in an advertisement featuring a concussion reduction claim that NOCSAE technical director

Dave Halstead and NOCSAE board member Dr. Robert Cantu have publicly criticized?

Answer. The authority of NOCSAE under the license agreement to review licensee advertising is limited to ensuring compliance with permitted uses of the name, phrases and certification marks which are trademarked and registered properties of NOCSAE. The license agreement does not provide NOCSAE with a blanket right or duty to review and approve all advertising content, nor to impose its own opinions as to the accuracy of claims that do not involve actual or potential misuse of the registered and trademarked properties. The NOCSAE seal, mark and name were properly used in the referenced advertising, and were not a part of or suggested as support for the other claims in the advertising. NOCSAE does not endorse recommend or indicate the use of any particular helmet, other than to state that the helmet meet the standard.

NOCSAE board members and independent contractors, such as Mr. Halstead, are free to comment on matters of interest to them, including the references described in this question.

Question 10. Independent Testing and Certification. Mr. Oliver, your testimony states that "NOCSAE also maintains an ongoing independent contract with an A2LA accredited and ISO 17025 certified testing laboratory."

- Is this testing laboratory also accredited to ISO Guide 65, "General Requirements for Bodies Operating Product Certification Systems"?
- Does NOCSAE's testing laboratory have any commercial ties to helmet manufacturers or reconditioners that could potentially create a conflict of interest when certifying helmets to NOCSAE standards? If so, please clearly describe any such potential conflict of interest.

Answer. It should be kept in mind that neither NOCSAE nor the laboratory in question certifies products or equipment to the NOCSAE standards. ISO Guide 65 pertains only to entities which actually certify products or equipment. Certification of compliance with NOCSAE standards is done by the manufacturer pursuant to a license agreement, and annual proof of compliance with the standards through third-party laboratory validation testing. The procedure tracks very closely to the self-certification made by manufacturers under the CPSC rules for bicycle helmets, except that the authority of NOCSAE over the manufacturer is based on the license agreement, not Federal laws and regulations.

The laboratory with which NOCSAE contracts for technical advice and testing is the Southern Impact Research Center, ("SIRC"). SIRC is A2LA accredited and certified as compliant with ISO 17025 standards for independent testing laboratories to perform testing to all NOCSAE standards, and is also an approved and accredited testing laboratory under the CPSC Bicycle helmet standard, and is directly approved by the CPSC for independent testing under 16 CFR Part 1203 and Part 1501. SIRC is also A2LA accredited to perform testing under FMVSS 218 VESC–8, Sec 8 for motorcycle helmets eye protection and many other helmets. The lab is under contract with the military for independent testing of military related items.

SIRC is not certified under ISO Guide 65, at least for NOCSAE purposes, as they do not perform product certification to the NOCSAE standards, but SIRC is involved with product certifications with the Safety Equipment Institute which is a Guide 65 entity.

The only commercial relationships which SIRC has with manufacturers who may also be NOCSAE licensees would be on a job by job basis where a licensee may contract with SIRC laboratory to conduct validation testing, or to submit products for evaluative testing. All board members and contractors are required to submit conflict of interest disclosure statements.

Question 11. NOCSAE not keeping football helmet standard up to date. Mr. Oliver, several NOCSAE members have publicly criticized your organization for not doing enough when it comes to keeping helmet standards up to date. In an October 20, 2010 *New York Times* article, reporter Alan Schwarz quotes Dr. Robert Cantu as saying that NOCSAE has been "asleep at the switch" and that Cantu has been "calling for a new standard to be written for football helmets for years, and NOCSAE has been sitting on their duffs."

The *New York Times* article further notes that: "Dr. Cantu. . .said that the board has become as concerned about legal liability as about child safety. If [NOCSAE] were to supplement its helmet standard in an attempt to address concussions, it could open itself to lawsuits brought by players saying that their helmet did not prevent the injury. . . ."

Dr. Blaine Hoshizaki, from the University of Ottawa, told the *The New York Times* that he lobbied NOCSAE to strengthen its standard five or six years ago but

he says, "It was like punching a balloon; they, yes, understand, and then do nothing." In the article, he goes on to say of NOCSAE: "They say they don't know what the thresholds are; OK, but I can tell you that less angular acceleration is better than more . . . To suggest we have no idea so we'll do nothing is not an excuse to me. This has become a serious impediment to making a safer football environment."

- Given this level of criticism from NOCSAE's own experts, why should coaches and parents of young football players rely on NOCSAE to maintain up-to-date voluntary safety standards for football helmets?
- What steps will NOCSAE take to update and maintain its helmet standards given new medical understanding of concussion risk and the latest state of the art in helmet technology?

Answer. I have attached copies of the written responses from each gentleman addressing *The New York Times* assertions with regard to NOCSAE. I cannot explain why the quotes in the article differ markedly from what the quoted speakers have said in response, nor can I explain why the article contains assertions that differ from the documented and uncontested facts

The quotes from *The New York Times* do not accurately reflect the comments and opinions of those who were quoted. In a letter he prepared and sent to Mr. Schwarz, (attached as Appendix A) Dr. Cantu took issue with the quotes attributed to him:

> "Since 2000, NOCSAE has provided approximately $2.4 million to fund research grants looking at all aspects of concussion in sports, including validation of the new linear impactor. In January 2010, by motion I fully supported, NOCSAE created a special ad hoc committee to examine any other possible avenues to more rapidly advance science and research in the area of concussion. The NOCSAE Multi-Disciplinary Expert Task Force which met on October 23 on Cape Cod was one of those avenues identified by the ad hoc committee. This meeting was being planned and developed long before your investigation and is a process which NOCSAE has followed in the past.
>
> These activities are not those of a group that is "asleep at the switch" or that has been "sitting on its duff," quotes you attributed to me. Every NOCSAE Board member is frustrated that there is yet no answer as to how concussions might be more effectively addressed in our helmet standards, but the frustration is not with NOCSAE, it is that despite our own internal efforts and substantial research funding to outside experts, science has yet to find an answer that we can incorporate into our helmet standards to specifically improve concussion protection."

As general counsel I can state with certainty that no decision regarding new standards or changes to existing standards was based or premised upon potential legal liability that might arise because of the differences between helmets certified under older standards and ones certified to the newer standards. Such a decision was in fact made when the first NOCSAE football helmet standard was published in 1973. That new standard rendered almost 80 percent of existing helmets noncompliant. And the same decision was made when the pass/fail threshold was revised from 1500 SI to 1200 SI.

To the extent any legal liability might exist at all, it would arise from acting arbitrarily in adopting or revising a standard without the valid scientific data necessary to support a conclusion that the change would be effective, and that it would not create an increased risk of other injuries. NOCSAE has a responsibility to the public and to players and parents to premise its standards on science and valid data, and it will not abandon that responsibility to cater to the pressures and demands of nonscientists. In order for the public to have the confidence that the NOCSAE standard has meaning and validity, it must be premised upon sound and consensus scientific data.

Regarding the quotes attributed to Dr. Hoshizaki, I asked him for clarification following the printing of the article in question. The quotes attributed to him were personally puzzling because I knew he had never contacted me to discuss any of the issues identified in the article. I also knew that he had not attended any board meetings since I became Executive Director in 1995, and I was unable to find any correspondence or other e-mail contacts from him on those subjects. Dr. Hoshizaki was kind enough to respond in writing (attached as Appendix B to these responses), and he explained to me:

> "As for the comments recorded in *The New York Times* article they were the author's interpretation of what I felt is a disconnect between NOCSAE and the broader scientific community. My previous discussions with David Hallstead

> [sic] revolved around understanding the process for the [sic] making decisions regarding the development of the NOCSAE test standards and resulting implications."

Dr. Hoshizaki is certainly a well-respected scientist and biomechanical engineer, and has published some excellent work regarding helmet performance and biomechanics of head injury. It appears that he was frustrated with *his understanding* of the NOCSAE process, and perhaps his interactions with Mr. Halstead on other standards related issues with other organizations. Mr. Halstead and Dr. Hoshizaki have worked together on many non-NOCSAE activities and are in fact at this time working together on a research project in this very area. There was never any lobbying effort by Dr. Hoshizaki as the reporter described, and the board meeting minutes do not contain any references to such attempts. Any such requests by Dr. Hoshizaki would certainly have been seriously considered and discussed, simply because of his reputation. In fact, the NOCSAE board had contacted Dr. Hoshizaki in the year prior to the printing of *The New York Times* article to request that he serve on a NOCSAE sponsored Concussion Task Force expert panel that was convened in October 2010 to help NOCSAE map out a plan for focusing research efforts to better address concussions through helmet standards.

As for his quote regarding the injury threshold levels, all that can be said is that almost every peer reviewed article that has considered this question in the last 10 years has reached a different conclusion. The consensus scientific opinion on this issue is clearly expressed by Dr. Kevin Guskiewicz in a 2011 article describing the elusive injury threshold for concussions and mTBI:

> "What is the relationship between clinical outcome measures from our earlier work and biomechanical factors? The literature has not adequately addressed this question. We hypothesize that within the spectrum of concussion or mTBI, the biomechanical threshold for sustaining the injury is not only elusive, but impact severity (measured in acceleration/deceleration) may be clinically irrelevant." Guskiewicz, K. M. and J. P. Mihalik (2011). "Biomechanics of sport concussion: quest for the elusive injury threshold." Exerc Sport Sci Rev 39(1): 4–11.

The Task Force Committee, with significant input from Dr. Hoshizaki and Dr. Guskiewicz, agreed there was no present threshold which could be incorporated into a helmet standard that could effectively reduce the frequency and or severity of concussions. The Task Force committee identified specific research and work that would be necessary to reach a point where revisions could be made to the NOCSAE standards that could effectively address concussion issues. Dr. Hoshizaki is currently doing some of that very work at the present time under a focused research grant from NOCSAE.

There is no helmet standard in the world which more effectively or aggressively addresses head injuries than does the NOCSAE standard. Apart from the Federal government, there is no other organization that has invested more research dollars over the past 10 years to address concussion protection through helmet performance standards than has NOCSAE. As explained by Dr. Cantu and his written response to the inaccurate quotes in *The New York Times* article, these are the actions of a group that is leading the way for the development of helmet standards to address concussions effectively, not an entity sitting on the sidelines waiting on someone else to do the work.

To the extent there is a "new medical understanding of concussion risk and the latest state of the art in helmet technology" referenced in the question, such advances exist in very large part due to the financial support from NOCSAE research grants, and the NOCSAE board, staff, and its Scientific Advisory Committee are intimately familiar with such developments, but this "new understanding" has not answered the specific questions necessary to support a change to the NOCSAE standards to address concussions.

You ask ". . .*why should coaches and parents of young football players rely on NOCSAE to maintain up-to-date voluntary safety standards for football helmets?*"

In comparative testing performed on almost every type of protective helmet, whether sports, or otherwise, football helmets certified to the NOCSAE standard consistently and markedly outperform every helmet in all impact categories, whether in protecting from low-level impacts, high velocity impacts, head coverage, or durability. There is no other helmet standard in the world which demands the same level of quality control and quality assurance in the manufacturing and production process as that which is mandated by the NOCSAE standards. And although millions of research dollars have been and are being invested by NOCSAE to improve the standards and reduce the frequency and severity of all head injuries including

concussions, football helmets certified to the NOCSAE standard perform at the highest levels. Helmet testing data, including the testing of bare head forms without helmets, show that a helmet certified to the NOCSAE standard will reduce the resultant head accelerations in large and small impacts by almost 70 percent. Between high school and collegiate football players, there are more than 600,000,000 helmet impacts during the course of a single season which result in head accelerations exceeding 15 g's *after the helmet has done its work*. It is arguable, that without a helmet certified to the NOCSAE standard, each of those blows to the head would have been hard enough to result in a concussion or worse.

NOCSAE is committed to improving helmet performance standards to effectively address concussions, and when there is reliable consensus scientific support for a specific change to accomplish that goal, NOCSAE will undoubtedly be the first to incorporate those changes. Until then, coaches and parents can count on NOCSAE not to experiment with their children's safety by making changes to the standard simply on the hope that a scientifically unsupported change might work.

APPENDIX A—LETTER FROM DR. ROBERT CANTU

ROBERT C. CANTU, M.A., M.D., F.A.C.S., F.A.C.S.M.
NEUROLOGICAL SURGERY, INC.

Chief, Neurosurgery Service
Chairman, Department of Surgery
Director, Service of Sports Medicine
Emerson Hospital, Concord, MA 01742
Board Certified in Neurosurgery

Clinical Professor of Neurosurgery Boston University School of Medicine
Co-Chair
Center for the Study of Traumatic Encephalopathy (CSTE)
Boston University Medical Center

Senior Advisor NFL's Head, Neck and Spine Committee

Co founder and Chairman Medical Advisory Board Sports Legacy Institute

Co-Director
Neurological Sports Injury Center At Brigham and Women's Hospital Boston, MA

Adjunct Professor
Exercise and Sport Science, University North Carolina, Chapel Hill, NC
Medical Director
National Center for Catastrophic Sports
Injury Research, Chapel Hill, NC

Neurosurgery Consultant
Boston College Eagles Football 2002 – Neurosurgery Consultant
Boston Cannons Lacrosse 2003 -

Medical Advisory Board MA Boxing Commission 2007-
Fellow:
American College of Surgeon
International College of Surgeons
American College of Sports Medicine
American College Sports Medicine
Board of Trustees 1984-1994, 1996-1999
Ambassador 1989-
President 1992-1993
Treasurer 1996-1999
Vice President
National Operating Committee on Standards for Athletic Equipment (NOCSAE)

Founding Member Sports Legacy Institute (SLI)
Advisory Committee for Injury Prevention Centers for Disease Control
Consultant, United States of America Amateur Boxing Federation, Inc.

Principal Editor:
Neurosurgery 2003 -
Associate Editor *Medicine and Science in Sports and Exercise*
Associate Editor *Exercise and Sports Science Reviews*
Editorial Board *The Physician and Sports Medicine, Clinical Journal of Sports Medicine, Journal of Athletic Training, American Journal of Medicine and Sports*

November 10, 2010

Alan Schwarz
New York Times
620 8th Avenue
New York, NY 10018

Dear Mr. Schwarz,

I am writing in response to your October 20, 2010 article in the New York Times regarding the issue of helmet standards and concussion prevention. As an active participant in the work done by the National Operating Committee on Standards for Athletic Equipment (NOCSAE) I recognize that NOCSAE is fully committed to its sole purpose of protecting the millions of athletes who choose to play sports. I seriously doubt whether any other non-governmental organization has done more in the last 10 years to advance the science of concussion in sport than has NOCSAE through its own internal work and research grant funding. It is an incorrect and inaccurate statement to write that NOCSAE has done nothing to address concussions in football or any other sport.

As a representative for the American College of Sports Medicine on the NOCSAE Board, and as NOCSAE vice-president, I have been directly involved in our efforts to revise football standards to better protect athletes. The board began working on this issue even before 2004 when NOCSAE published a proposed revision to its football helmet testing standard for the specific purpose of adding special impact testing protocol that we believed would be necessary to address concussion protection as soon as the science was developed to allow those changes to be made. NOCSAE actually funded the creation of the first five prototype linear impactors for the specific purpose of being ready to test helmets to a concussion standard as soon as science could tell us what that standard should include.

Since 2000, NOCSAE has provided approximately $2.4 million dollars to fund research grants looking at all aspects of concussion in sports, including validation of the new linear impactor. In January 2010, by motion I fully supported, NOCSAE created a special ad hoc committee to examine any other possible avenues to more rapidly advance science and research in the area of concussion. The NOCSAE Multi-Disciplinary Expert Task Force which met on October 23 on Cape Cod was one of those avenues identified by the ad hoc committee. This meeting was being planned and developed long before your investigation and is a process which NOCSAE has followed in the past.

These activities are not those of a group that is "asleep at the switch" or that has been "sitting on its duff", quotes you attributed to me. Every NOCSAE Board member is frustrated that there is yet no answer as to how concussions might be more effectively addressed in our helmet standards, but the frustration is not with NOCSAE, it is that despite our own internal efforts and substantial research funding to outside experts, science has yet to find an

ROBERT C. CANTU, M.A., M.D., F.A.C.S., F.A.C.S.M.
NEUROLOGICAL SURGERY, INC.

answer that we can incorporate into our helmet standards to specifically improve concussion protection .

As I have consistently said, it is impossible to revise the football helmet standard without reliable scientific data to support a change. To change the standard to address concussions absent scientific data would be irresponsible, and could potentially jeopardize the safety of athletes. I am confident the recent Multi-Disciplinary Expert Task Force convened by NCOSAE will be submitting focused and goal specific research proposals intended to provide the answers which can be incorporated into our standards to better protect against concussions. As it has always been, NOCSAE is dedicated to this goal.

Sincerely,

Robert Cantu. MD, FACS, FACSM

APPENDIX B—LETTER FROM DR. BLAINE HOSHIZAKI

uOttawa

Université d'Ottawa
Faculté des sciences de la santé
École des sciences de l'activité physique

University of Ottawa
Faculty of Health Sciences
School of Human Kinetics

613 562-5852
613 562-5149
125 Université / University
Ottawa ON K1N 6N5 Canada
www.uOttawa.ca

December 20, 2010

Michael Oliver
Executive Director
NOCSAE11020 King Street, Suite 215
Overland Park KS 66210
USA

Dear Michael,

I appreciate you taking the time to respond to concerns expressed during the discussions at the NOCSAE Multidisciplinary Task Force panel this past October. The meeting was interesting and certainly provided an opportunity for me to gain a bit of an understanding and appreciation on how NOCSAE works. As for the comments recorded in the New York Times article they were the author's interpretation of what I felt is a disconnect between NOCSAE and the broader scientific community. My previous discussions with David Hallstead revolved around understanding the process for the making decisions regarding the development of the NOCSAE test standards and resulting implications. At the time the only individual that had any contact with the scientific community involving test protocol and dependent variables to my knowledge was David Hallstead. My concern revolved around the balance between the broader scientific research that is ongoing in the areas of innovative testing protocols, new measurement variables and validation of existing methods and the inherent risk of limiting the discussion of these issues within the NOCSAE board. There are all sorts of limitations concerning unbiased vetting of scientific research by a single board that is made up of members with a variety of corporate and financial interests in the decisions. The use of research testing from contracted test houses even third party test houses to provide information does not replace peer reviewed published scientific research. The expertise required in evaluating scientific research and contracted testing to support decisions is substantial.

As you probably know research in three dimensional test protocols, dynamic head response and brain tissue stress/strain to predict brain injuries including the risk of concussion is of special interest to me. The scientific literature clearly supports employing a 3 dimensional test protocol with both linear and angular acceleration as dependent variables. While our lab has published a number of peer reviewed papers in this area I have never felt that NOCSAE would be interested in supporting a new test protocol that was not developed either in house or by contracted testing. I must admit I am biased as I have spent a great deal of time undertaking research in this specific area and feel strongly that test standards, not only NOCSAE, are not keeping pace with

existing research. As I pointed out at the last meeting it is clear that valid protocols for eliciting angular accelerations independent of linear accelerations can be reliable and valid. There has also been a great deal of progress in developing valid testing measurements for angular acceleration. If NOCSAE expects to make any progress in decreasing the risk of concussions in football or any sport it is absolutely necessary that a valid test protocol designed to elicit dynamic responses that are not the result of linear biased impacts be adopted. I understand there have been recent discussions to support the necessary research in this area and I am very interested in participating in these discussions as well as contributing to the development of protocols that decrease the risk of concussive injury.

I think the resurrection of the Technical Advisory Committee is an important step in the right direction and I look forward to being a participant in those discussions. I also appreciate you taking the time to ask me to provide clarity concerning the comments written in the newspaper.

Sincerely,

Blaine Hoshizaki PhD
Director
Neurotrauma Impact Science Lab.
Vice Dean
Faculty Health Sciences
University of Ottawa
Ottawa, ON

CC: Robert Cantu

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. JOHN THUNE TO MIKE OLIVER

Question 1. Improper Tackling Technique and Concussions. I'm aware that NFL and college football teams today have significantly reduced the amount of time devoted during practice to proper tackling and other football fundamentals. I recognize that coaches are limiting some of the physical contact during practice to prevent injuries. However, my concern is that less time devoted to teaching proper tackling technique may be contributing to an increase in concussions during games. Specifically, players these days seem to lead with their head rather than wrapping a player up with one's arms and body, and keeping their head up. Do you see any connection, at all levels of football, to improper tackling technique and an increase in concussions?

Answer. In the course of a football game players will receive high energy hits to the head that are unavoidable and unintentional, and it is not likely those kinds of hits can be eliminated from the game of football. But the use of tackling techniques in which the player initiates contact with the head or targets the head of the other offensive player are dangerous, unnecessary, and avoidable. Not only do they increase the risk of sustaining a concussion or causing a concussion in the opposing player, or both, those techniques also place the tackling player at an increased risk of spinal cord injury and even death.

Debate exists among experts in concussion epidemiology whether there is really an increase in the number of concussions, or whether the increase in diagnosis is a function of greater awareness and attention to the importance of addressing concussions. I think most believe that the actual rate is essentially unchanged, but recognition and diagnosis is much greater. But even if the rate is not higher today than it has been historically, the number of concussions can be significantly reduced simply by eliminating the intentional use of the head to initiate contact, and the vast majority of those events happen through poor tackling techniques.

Sometimes those incorrect techniques are taught, but in many cases they develop from a lack of teaching and player correction at early ages. Dr. Kevin Guskiewicz at the University of North Carolina has been monitoring the players on the football team at UNC through the use of an in-helmet impact monitoring and telemetry system that records the magnitude and location of every impact to a player's helmet in practices and games. One of the information gleaned from this data is that they are able to identify those players who record far more impacts to the top of the helmet than other players on the team. Dr. Guskiewicz and his staff are able to meet with these players and undertake behavior modification to try and eliminate those avoidable hits to the top of the head. Clearly the issue of leading with the head is very important in the efforts to reduce the frequency and severity of concussions, even with elite athletes at the collegiate level.

Question 2. Do you think this improper tackling technique is caused by less time being devoted to teaching good technique in practice?

Answer. As players mature and develop, it is natural for most coaches to focus more on the subtle aspects and complicated skills of the game, and spend less time on the fundamentals. If players don't develop the reaction and muscle memory to effectively "see what you hit" when tackling and blocking as youth players, it is unlikely they will suddenly develop those skills in high school, and even less likely in college. The time to spend the time is when players have not yet developed the bad habits.

Question 3. As part of the campaign to highlight concussion awareness, how much emphasis is being placed on educating coaches and players about using proper tackling technique to reduce concussions?

Answer. The emphasis on concussion prevention and recognition is extensive and growing monthly.

NOCSAE in partnership with the CDCP is creating a parent targeted concussion awareness and prevention program called "Heads Up to Parents" which designed and created to reach all parents of football players and provide access to an extensive online resource to address all aspects of concussion prevention, including proper tackling and blocking techniques.

There are coaching education programs at all levels which provide the necessary instruction and teaching tools to help coaches instruct their players. The American Football Coaches Association provides such training and educational programs for high school through collegiate levels, and has teamed with the National Athletic Trainers Association to make education and training videos that address head and neck injury prevention, which can be accessed at *http://www.afca.com/article/article.php?id=968*. The National Federation of State High School Associations ("NFHS") provides online coaching education and certification in the areas of con-

cussion prevention as well. For youth football, USA Football in partnership with the NFL provides a wealth of coaching and player education programs in person and online that address concussion prevention through proper playing and tackling techniques. These resources can be accessed at *http://www.usafootball.com/health-safety/prevention-preparation.*

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