

2016 ANNUAL REPORT

**CONCUSSION**  
↑ Legacy Foundation



**LEADING TO  
A SAFER  
FUTURE**

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In 2016, we welcomed our first high school student intern for the Concussion Legacy Foundation. But she wasn't a summer intern; Esther had been forced by her school to take the semester off because her post-concussion syndrome (PCS) didn't allow her to take a full course load. (Learn more about Esther's story on pages 16-17.)

Esther's presence was a daily reminder that concussions can derail a life, and that every case of post-concussion syndrome that we can prevent saves a child from what some consider to be the most painful period of their life. It's a period I know well from my own experience, and that my co-founder Dr. Robert Cantu helped me to persevere through.

To prevent future cases of PCS, this year we launched Team Up Speak Up Day. Team Up asks coaches to give a speech to their team before every season that tells their athletes they are expected to Speak Up if they believe a teammate has a concussion, because good teammates look out for one another.

Over 150 youth sports organizations - representing 3 million youth athletes - signed on, including national governing bodies like the National Federation of High School Athletic Associations, USA Hockey, USA Football, and USA Rugby.

As far as we have come in changing the culture since 2007, we are reminded that millions of children begin playing sports for the first time each year, and we are committed to ensuring they have a safe experience. Through our research, education and policy programs, and with the help of all our supporters and advocates, we are leading to a safer future.

Sincerely,



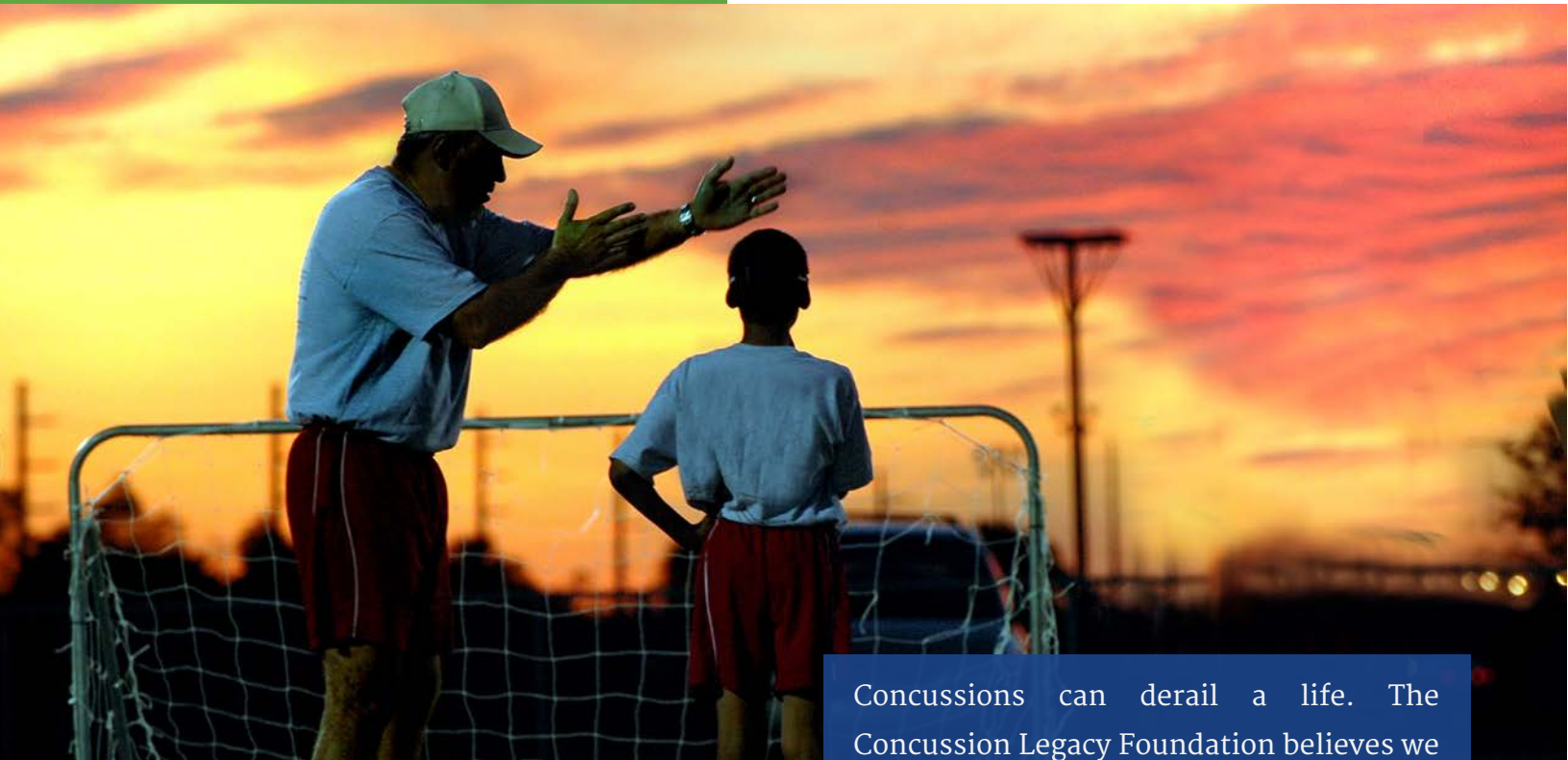
Christopher Nowinski

Co-Founder and CEO



John Corcoran

President, Board of Directors



Concussions can derail a life. The Concussion Legacy Foundation believes we all have a responsibility to ensure athletes can reach their full potential on and off the field. We are committed to protecting athletes and families through research, policy, and education.

## OUR MISSION STATEMENT

The Concussion Legacy Foundation is dedicated to advancing the study, treatment and prevention of the effects of brain trauma in athletes and other at-risk groups.

## OUR VISION STATEMENT

Our vision is a world without CTE, and concussion safety without compromise.





## CREATING CHANGE FROM THE BOTTOM UP THROUGH OUR COMMUNITY PROGRAMS

The Concussion Legacy Foundation held 64 Advanced Concussion Training programs in 2016, reaching over 20,000 coaches, parents, athletes, and doctors.

Concussion Legacy Foundation staff also held over 60 Team Up Against Concussions youth education programs, which reached over 10,000 children this year.

### OUR TEAM UP CHAPTERS:





## TEAM UP SPEAK UP DAY

In 2016, we launched our first annual Team Up Speak Up Day, a national concussion awareness day designed to improve concussion reporting among youth athletes.

Currently, most young athletes are taught to self-report concussions. The problem with this method is that athletes are often unaware when they've suffered a concussion, or they feel pressure to stay in the game. Using the bystander intervention model popular in anti-bullying campaigns, **Team Up Speak Up has coaches and captains tell athletes it's their responsibility to report concussion symptoms in their teammate.**

On September 13, we asked coaches and captains across the country to give the Team Up Speak Up speech. We want to reach every child playing youth sports with this important message.

### THE MAKINGS OF A SPEECH

This is the message we asked team leaders to deliver to their athletes:

- We're a team, and we look out for each other.
- A teammate with a concussion is a teammate that needs your help.
- I expect you to speak up if you think your teammate might have a concussion.



## TEAM UP SPEAK UP ACCOMPLISHMENTS



PARTICIPATION FROM **150+ ORGANIZATIONS**

REPRESENTING OVER **3 MILLION ATHLETES**



**4** national governing bodies

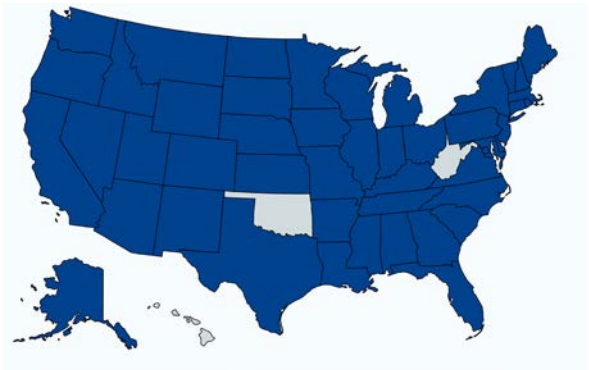


**9** state high school associations



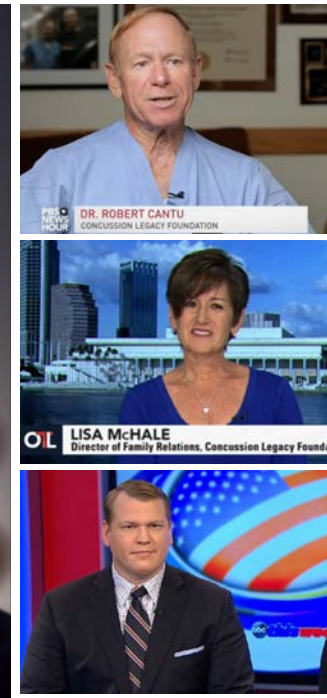
Confirmed participation in

**47 OF 50 STATES**



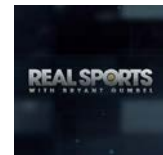


**CHRIS NOWINSKI**  
Concussion Legacy Foundation Co-Founder & CEO



## RAISING AWARENESS BY DRIVING A GLOBAL CONVERSATION















The Concussion Legacy Foundation leadership and researchers appeared in over 75 television, documentary and radio appearances and nearly 600 print articles, making them the most frequently quoted experts on concussions and CTE, and keeping these important issues at the forefront of public discussion.





## FOOTBALL CTE DIAGNOSES BY COLLEGE






Players from over 100 college football programs have now been diagnosed with chronic traumatic encephalopathy (CTE) at the VA-BU-CLF Brain Bank. Fifteen schools, highlighted below, have had three or more players diagnosed with CTE. Only players whose families have given permission for their names to be released are listed below.

<b>7</b>	 Earl Morrall Dick Proebstle Bubba Smith	<b>4</b>	 Lew Carpenter	 Forrest Blue	 Ron Perryman
<b>6</b>	 Paul Oliver	 Ralph Wenzel	 Eric Scoggins Jeff Winans		
<b>3</b>	 Ken Stabler	 Keli McGregor	 Shane Dronett Jim Hudson Greg Ploetz	 Dennis Wirgowski	 Rob Lytle
					



The **15 UNIVERSITIES** with three or more CTE cases have combined for **64 NATIONAL CHAMPIONSHIPS**

## POWER 5 TOTAL CTE DIAGNOSES BY CONFERENCE

Conference					
Conference Member Colleges <small>With 1 or more CTE diagnoses</small>	11 of 14	9 of 12	9 of 14	6 of 14	4 of 10
Percent	79%	75%	64%	43%	40%
CTE Cases	28	20	22	10	8

Note: This data is not a reflection of the level of risk in playing in any individual program or conference. The data better illustrates the level of commitment by alumni and families of these players to support CTE research by participating in brain donation.

In October we launched a campaign to educate the public on CTE in college football. We packaged data from the VA-BU-CLF Brain Bank into an exciting infographic illustrating where the first 100 CTE victims played college football, connecting with alumni and fans of some of the most prestigious and successful universities and football programs.

Fifteen schools had had three or more players diagnosed with CTE. Every conference within the college football Power 5 conferences (Atlantic Coast Conference (ACC), Big Ten, Big 12, Pac 12 and Southeastern Conference (SEC)) had at least one of its schools represented among the 15 college football programs with three or more confirmed cases of CTE. The 15 programs which have three or more confirmed cases have combined for 64 national championships.

The College CTE story was covered by:



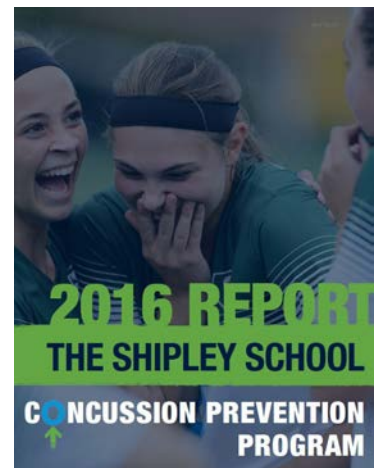


## CONSULTING SERVICES

The Concussion Legacy Foundation offers professional concussion consulting services to assist organizations with applying best practice guidelines, educational programs, and tools to improve player safety. Concussion consulting is available to all types of organizations, from professional sports leagues to private educational institutions, to help put them on the cutting edge of concussion safety.

The consulting model is a three-step process involving an audit of existing policies, program review, and implementation support. **The goal is to improve the five key areas of any organizational concussion prevention and management program: Education, Prevention, Policy, Infrastructure, and Coordination (EPPIC).**

In 2016, the Concussion Legacy Foundation consulted with:





## JOHN & SYLVIA MACKEY: MY LEGACY

John Mackey made a difference – in football, in business, and in life.

As a star tight end at Syracuse University, he quietly and peacefully made inroads into the discrimination that permeated society, building lifelong friendships that transcended ethnicity and socioeconomic backgrounds.

With the Baltimore Colts, John revolutionized the tight end position and was selected to the Pro Bowl five times, accomplishments that earned him a place in the Pro Football Hall of Fame and praise from Mike Ditka as “the greatest tight end to ever play the game”.

As the first president of the National Football League Players Association following the merger of the NFL and AFL, he fought for better pension and disability benefits for players, and gained the right to free agency that today’s NFL players still enjoy.

John’s advocacy efforts – his determination to give back – didn’t stop with the NFLPA or end with his NFL career.

He partnered with Jack Kemp to launch a non-profit that gave educational assistance to disadvantaged children. He actively supported the civil rights movement that changed

the course of history. He reached out to others, whether it was to offer guidance on career choices or to advocate for recognition of an under-appreciated teammate.

That’s the kind of person John Mackey was.

Sylvia Mackey is a member of the Concussion Legacy Foundation’s Board of Directors. She led a fundraising campaign in John’s memory in 2016.

Although dementia robbed John of his powerful voice, his private battle with the disease became the public face of the link between head trauma and chronic traumatic encephalopathy (CTE). He was the catalyst for the 88 Plan that provides financial assistance for those affected, for the advocacy and fundraising efforts of his Baltimore Colt teammates that helped so many former NFL players, and for my own involvement in the Concussion Legacy Foundation. When John died on July 6, 2011, the widespread media coverage focused as much on these later-in-life accomplishments as on any of his achievements earlier in life. Even in illness and in death, he changed the world.

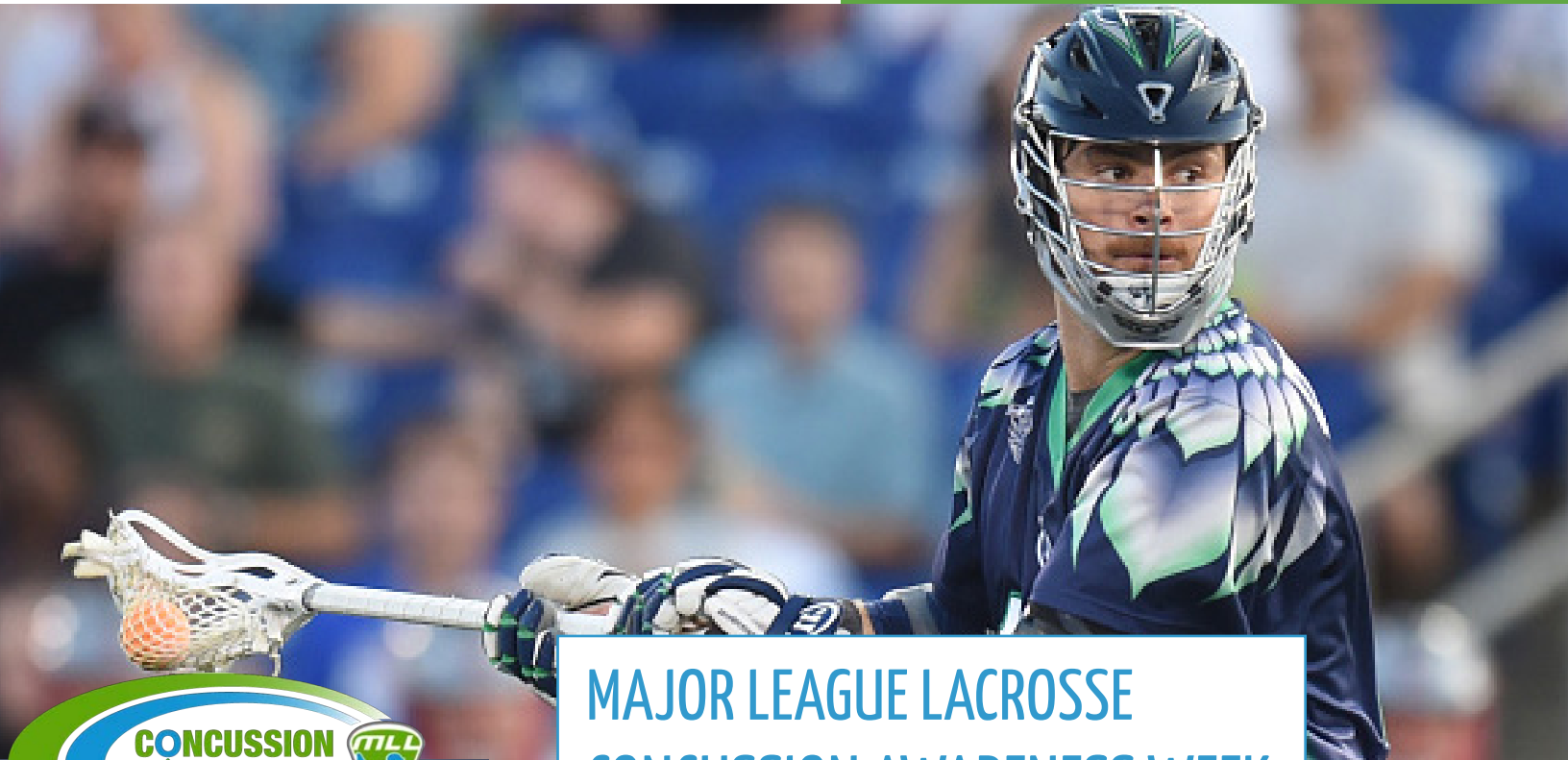
That, I believe, is John Mackey’s greatest legacy.



## ADVISORY ROLES: INFLUENCING GLOBAL CHANGE FROM THE TOP DOWN

Concussion Legacy Foundation co-founders Dr. Robert Cantu and Chris Nowinski are proud to serve as volunteer advisors to more professional and collegiate sports organizations than any concussion-focused nonprofit in the world. **When professional sports change, youth sports follow.**





## MAJOR LEAGUE LACROSSE CONCUSSION AWARENESS WEEK



In June of 2016, Major League Lacrosse (MLL) and the Concussion Legacy Foundation partnered to host the first ever MLL Concussion Awareness Week. The league, teams and players engaged fans and the lacrosse community through social media and events to educate on the seriousness of concussions. Concussion Awareness Week games were hosted in five cities, including Boston, home of the Boston Cannons.

During Concussion Awareness Week, 13 MLL players pledged to donate their brains to the Concussion Legacy Foundation, comprising the largest group of active pro athletes in a single sport to make the pledge.

During the 2016 season, the Foundation provided an Advanced Concussion Training for every MLL team. The goal was not only to provide education for the players, but also to train them to speak about concussions appropriately so that they can be leaders in changing the culture in the youth lacrosse community.



## SOMERSAFE SPORTS: A PARTNERSHIP WITH THE CITY OF SOMERVILLE, MA

In October, Concussion Legacy Foundation co-founder and CEO Chris Nowinski and Somerville, Massachusetts Mayor Joseph Curtatone announced a 3-year partnership to develop Somerville into a model city for concussion education, policy, and prevention for its youth athletes. **The goal is to develop a simple, scalable blueprint for other cities to independently implement to protect their children.**

The Foundation is working with the Mayor's Office, the Somerville Department of Health and Human Services, the Somerville Department of Parks and Recreation, and Somerville Public Schools to educate stakeholders including coaches, parents, and athletes. The partnership will also develop and expand cutting-edge policies for concussion management and prevention for the city, recreation department, and schools. The Foundation has already begun to bring its Team Up Against Concussions education program to each of the public schools in Somerville.

A November episode of HBO Real Sports focused on the dangers of youth and high school football and featured Nowinski and Dr. Ann McKee, director of the VA-BU-CLF Brain Bank. The episode also spotlighted Mayor Curtatone, a former football player and coach, who would like to eliminate tackle football for children before high school on Somerville's city fields.



## POST-CONCUSSION RESOURCES

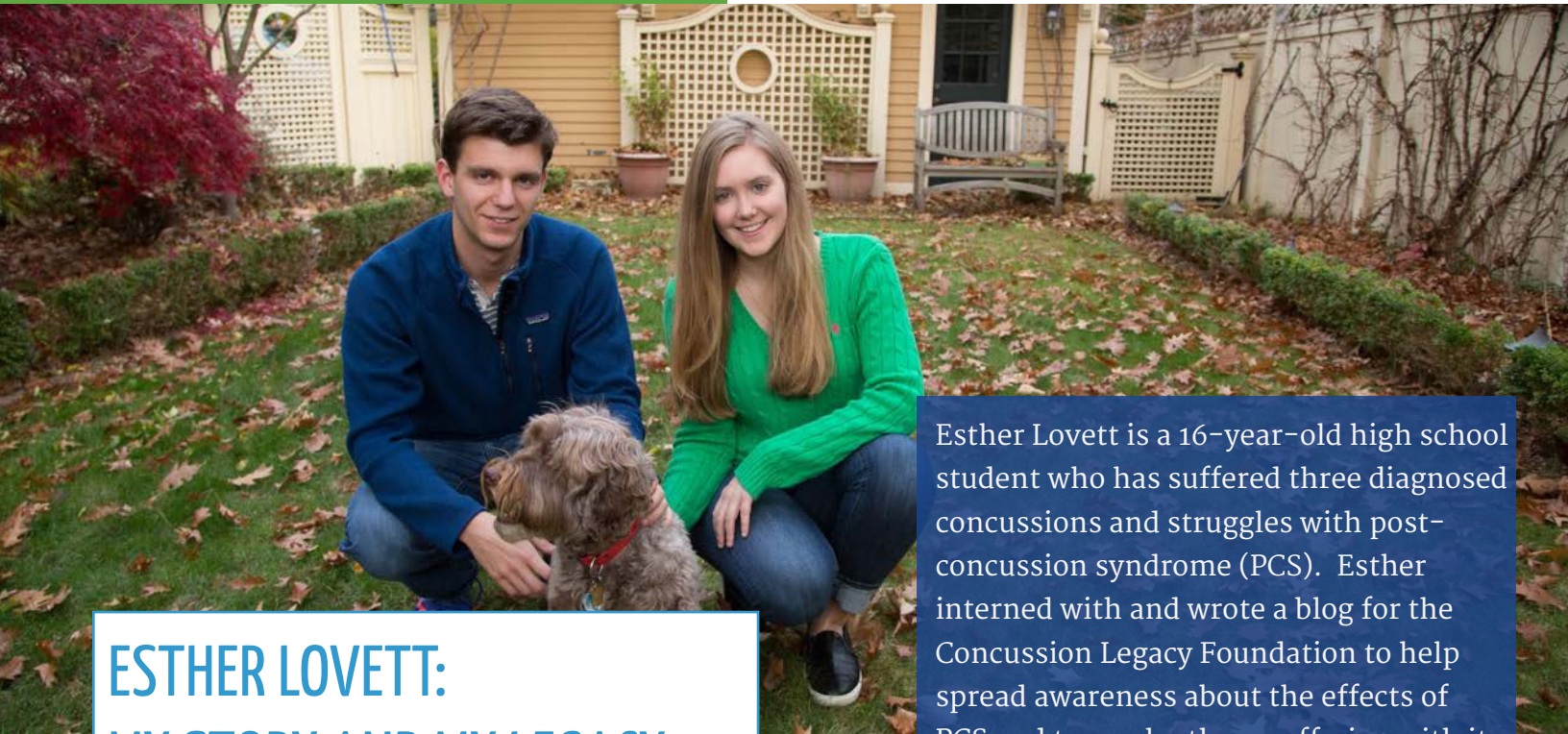
Patients and families are finally beginning to recognize that concussions are serious – but when a concussion happens to them, they often don’t know what to do next. The Concussion Legacy Foundation is proud to have created a growing resource so that athletes, veterans and families can access the right information when they need it the most.

The Foundation’s free search engine ConcussionClinics.org is the only service of its kind. It connects users to a concussion specialist near them. Since 2014, it has helped nearly 20,000 people find a specialist to help treat their injury.

**In 2016, the Foundation unveiled new help guides for athletes and families to consult when they are most in need.** They cover topics like “What to Do After a Concussion,” “5 Tips for Choosing a Concussion Clinic,” and “How to Put Together Your Concussion History.”

In 2017, the Foundation plans to build out post-concussion syndrome services for patients and families focused on education, recovery and providing hope to teenagers who have forgotten that brighter days are ahead.





## ESTHER LOVETT: MY STORY AND MY LEGACY

Esther Lovett is a 16-year-old high school student who has suffered three diagnosed concussions and struggles with post-concussion syndrome (PCS). Esther interned with and wrote a blog for the Concussion Legacy Foundation to help spread awareness about the effects of PCS and to reach others suffering with its challenging symptoms.

I suffered my first serious concussion in eighth grade. I struggled with post-concussion syndrome (PCS) for about two and a half years and then suffered another serious concussion right before my junior year of high school.

Before my concussion in eighth grade, I played soccer, hockey, and tennis, I was a dedicated student, and life was good. I experienced the concussion during a soccer game, and did not know enough to take myself out of the game despite dizziness, nausea, blurry vision, and confusion. It took me a long time to realize that this was serious. I had no idea that this seemingly harmless hit would turn my life upside down.

Initially, all I wanted to do was play soccer. I wanted to get back to my team and continue playing, but this concussion was something that I could not hide. For the rest of eighth grade, a little over a month, I don't think I was able to sit through a full class. I spent so much time in the nurse's office drinking ginger ale and eating saltines.

It was bizarre to be sitting in math class and have all of the numbers on the board blur and get a headache so intense I had to leave class. Normally, I would have been a step ahead,

solving homework problems during the lesson.

I just never stopped having symptoms and have been struggling with post-concussion syndrome (PCS) ever since.

Almost a year after this concussion, it fully hit me that I could not play contact sports anymore. I was crushed. Sports were a huge piece of who I was. I defined myself as an athlete. I remember texting with my soccer coach, finally telling him that I definitely could never play again. He said "we all become fans at some point. You just became one a little earlier." This was so comforting to me. He made it seem so normal and natural, like one door closes and another opens. This conversation gave me closure with soccer and the ability to move on and tackle new things.

'I'm an athlete, and I can't play contact sports, and I can't run. What do I do?' I remember thinking. My doctor suggested a low impact, non-contact sport; golf fit the bill. I had taken one golf lesson in my life (and I was terrible), but many people in my family were passionate golfers so I decided to try, banking on hereditary natural talent. I remember my first golf lesson. I barely made solid contact with the ball during that hour. Being a beginner at a sport was something I had not experienced since I was four. I was so frustrated. But, it was golf or the chess club so I started



working hard. I got better and my competitive spirit was back. Now, I'm not giving hard hits and sliding in mud on the soccer field, but rather hacking my way out of sandpits in polos at the golf course. A change in sport, but once an athlete, always an athlete.

I started writing for my school newspaper, which I would never have had time to do had I been putting so much time into sports. I was appointed as an editor. I became a member of my school's Disciplinary Committee, and I decided to row crew. I totally reinvented myself.

One of my doctors at Boston Children's Hospital called me in April of tenth grade, asking me if I would do a live NESN interview with him about concussions and Children's Brain Injury Center. I immediately said yes, not expecting it to manifest in anything. I quickly realized that I could help and that there are a lot of people out there silently soldiering on with PCS who go under the radar for medical care, with friends and family, and at school. I wanted to reach them because I guessed that they had all felt the same losses, disappointment, fear, and isolation that I had.

I had noticed a lack of education about concussions and PCS since eighth grade and decided that I needed to help change that. I did the interview as well as a few other events with Children's and grew passionate.

Everything seemed to have fallen into place. I had developed new passions including concussion advocacy, I was still a strong student, and I was dealing with my symptoms. I felt like the 'comeback kid' and it felt amazing.

Then, two weeks before school, I fell down a flight of stairs and suffered another bad concussion.

I ended up having to take a medical leave from the school I had attended since age four. It seemed like yet again, my whole world had crumbled. I couldn't participate in my school extracurriculars and my symptoms were worse than ever. The task of reinventing myself again seemed impossible.

But, I had my concussion advocacy, and that is what I have dedicated my year to, via an internship with the Concussion Legacy Foundation and continued work with Boston Children's Hospital.

I want my legacy to be in educating the public – especially teenagers – about concussions and their long-term effects. Every person who plays sports deserves to know the risks – I certainly didn't. I had no idea when signing up for middle

school sports that I would be signing up for three years of headaches and symptoms. There is such a lack of education, even amongst athletes, and this needs to change. Concussion is a pervasive injury and can affect so many aspects of your life.

There are also rule changes that need to be made. Sports need to be safer. Do five year olds need to be tackling? Do six year olds need to be heading or checking into the boards?

**“I want my legacy to be in educating the public – especially teenagers – about concussions and their long-term effects.”**

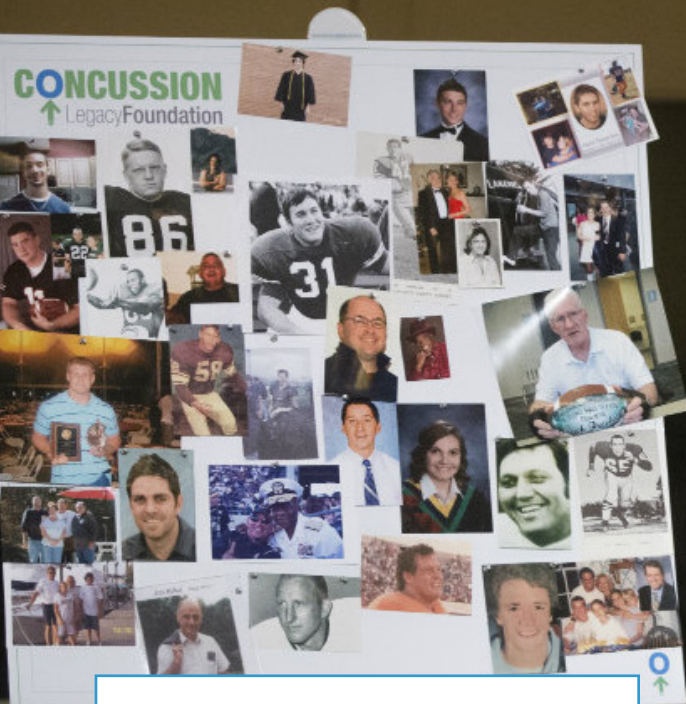
I also just want to reach other people with PCS. It is hard to struggle through on your own, never having anyone who truly understands. Knowing that you aren't alone and that your litany of misunderstood symptoms are a result of your injury is comforting.

I want to reach schools. Many schools do not understand PCS or know how to help students suffering with these symptoms. Many schools attribute PCS symptoms to other diagnosis, which severely disadvantages students with PCS.

Though taking a medical leave was not ideal and this injury has totally changed my life and mostly not for the better, it's made me stronger and I've realized that I have a cause that I care about more than anything else. I'm all in with concussions. I've found a passion and it might be a tad out of the ordinary. I've been through a lot and I don't want other kids to go through what I've gone through.

At this point, as a teenager without medical credentials, I can't cure concussions. So I'm going to do what I can do. I can share my story and my experiences.

I feel like I have an insight that only someone in the throes of PCS has and I want to use that. I want to be a cautionary tale of what happens when you don't take minor hits seriously, but also as an inspiring story of getting back on your own two feet and getting back in the game even if it's a new game. I hope that my story is one that other kids suffering with PCS can connect with, and I hope that I can reach schools and sports leagues. I'm all in.



## 2016 FAMILY HUDDLE



The Concussion Legacy Foundation hosted its second Legacy Family Huddle in November in conjunction with the 9th Annual Impact Awards in Boston. **Over 65 family members of our Legacy Donors (brain donors) attended the three-day conference with researchers and advocates to learn how their donation has advanced science and will help protect athletes for generations to come.** Without the selfless contributions of these families, we would have never made progress toward discovery.

The conference also allowed the Concussion Legacy Foundation team to better understand what it is like to be the wife, mother, father, sister, brother, or child of someone who lived with CTE or the effects of concussions so that we may continue to improve our services to families.

The tireless dedication of the Family Advisory Board is a daily inspiration, and is the foundation for any successes the Concussion Legacy Foundation finds through its research, education and policy work.



## VA-BU-CLF BRAIN BANK

### BRAIN BANK BY THE NUMBERS

- ➔ 246 confirmed CTE cases
- ➔ 385 brains (344 completed, 41 results pending)
- ➔ 97 military veterans
- ➔ Tissue has been shared for use in over 50 original research studies around the world
- ➔ First to identify CTE in athletes whose primary exposure was soccer, rugby, baseball, ice hockey, college football and high school football.

2016 was a record-breaking year for the VA-BU-CLF Brain Bank, with 91 brains donated, an 82% increase vs. 2015, boosted by the launch of the My Legacy campaign.

**The VA-BU-CLF Brain Bank remains the single greatest CTE research resource in the world, housing 70% of global CTE cases.** In 2016, our BU and VA research collaborators produced 13 medical journal articles, and we shared tissue with eight outside research groups for their independent research.

The best is yet to come. Now that we have a critical mass of cases, we anticipate future articles exploring risk factors, genetics, and other discoveries that can only be made thanks to nine years of hard work made possible by the support of CLF donors.

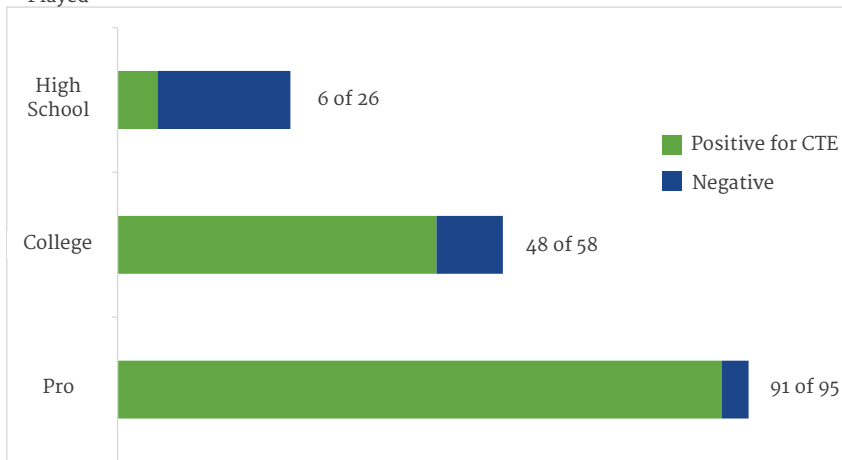


## BRAIN BANK RESEARCH ON FOOTBALL

The VA-BU-CLF Brain Bank holds 385 brains, 277 of which have come from football players. CTE has been diagnosed in football players as young as 17 years old.

### CTE RESULTS OF COMPLETED CASES

Highest Level Played



### A REMARKABLE 2016 CASE



Control

Kevin Turner



Former NFL player Kevin Turner, who died at 46 in March of 2016 from complications of ALS, was diagnosed with CTE by doctors from the VA-BU-CLF Brain Bank. Dr. Ann McKee revealed that Turner's ALS symptoms were likely caused by his CTE. Turner played tackle football for 25 years, beginning at age 5.

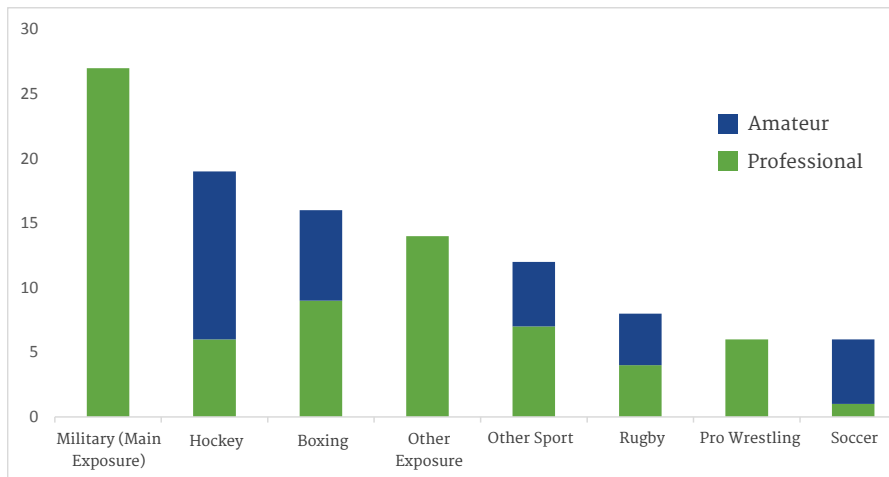


## BRAIN BANK RESEARCH ON OTHER SPORTS

Seventeen-year-old Rowan Stringer died on Mother’s Day in 2014. Her parents, Kathleen and Gordon, donated her brain to the VA-BU-CLF Brain Bank, where doctors confirmed she died of second-impact syndrome. This means Rowan continued to play with a concussion because she didn’t know the consequences could be lethal. It happens to high school athletes every year, and despite our increased awareness, it continues to occur.

Kathleen and Gordon decided something positive would come from this, and they spent the last

### BRAIN DONATIONS BY SPORT (FOOTBALL EXCLUDED)



two years fighting for Ontario to pass a law that requires athletes with a concussion to be cleared by a doctor, and concussion education for coaches and athletes. **Rowan’s story was an inspiration for Team Up Speak Up, and we honored Kathleen and Gordon with the Legacy Award at the 2016 Impact Awards.**

# RESEARCH



“As you progress toward retirement, you start to think more about making a contribution back. This is part of my legacy and my contribution back.”

Gary Fencik, Super Bowl Champion

“If contributing to this research can just help move the needle some, then I will leave the game better than I found it. I really believe that.”

Eric Winston, Cincinnati Bengals Player & NFLPA President

“Everybody who’s had experience in sports should feel compelled to participate in helping make their sport better.”

Brandi Chastain, U.S. Soccer Legend

We launched the My Legacy campaign in December 2015 to recognize individuals who have made a lasting contribution to research and awareness of concussions and CTE, and encourage others to pitch in and create their own legacies.

The signature gesture of My Legacy is individuals pledging to donate their brain to the VA-BU-CLF Brain Bank. More pledges mean greater public awareness of the critical role of brain donation in CTE research, more engagement by our supporters, and ensures a long-term pipeline of donors for this critical research program.

NFL player Ted Johnson was the first athlete to pledge his brain to the VA-BU-CLF Brain Bank in 2008; through the end of 2015, 820 athletes followed, or roughly 9 per month. Since CLF took over the registry, moved the pledge process online, and launched My Legacy, we have received 40 pledges per month, with 478 new pledges in 2016 alone, including some of the biggest names in sports. How does such growth take place? View the following page for more.



## MY LEGACY: A TIMELINE OF 2016



My Legacy launches with brain pledges from current NFL player Eric Winston and Super Bowl Champion Gary Fencik.



Stabler's CTE diagnosis leads former Raiders teammates George Atkinson, George Buehler and Art Thoms to pledge their brains to the Concussion Legacy Foundation in honor of Stabler.



U.S. Secretary of the VA Robert McDonald, Olympian Nancy Hogshead Makar, and Raiders legend Phil Villapiano pledge their brains to the Foundation as part of My Legacy.



Inspired by Dale Earnhardt Jr., NASCAR legend Fred Lorenzen, 81, amidst a battle with dementia, pledges through his family to donate his brain to CLF.



Sylvia Mackey launches a My Legacy fundraising campaign in honor of her late husband, Hall of Famer John Mackey, who was diagnosed with CTE.



13 Major League Lacrosse players pledge their brains to the Foundation, comprising the largest group of active professional athletes in a single sport to make the pledge.

DEC.

JAN.

FEB.

MARCH

APRIL

MAY

JUNE

JULY

AUG.

SEPT.

OCT.

NOV.

DEC.



Raiders legend Ken Stabler is diagnosed with CTE, prompting major media coverage from the New York Times, ESPN and more.



U.S. Soccer icon Brandi Chastain, already a spokesperson for the Foundation's Safer Soccer initiative, pledges her brain to My Legacy.



Inspired by the former Raiders players, NASCAR superstar Dale Earnhardt Jr. pledges to donate his brain to the Concussion Legacy Foundation.



The friends of Owen Thomas, the UPenn football player who died at 21 with CTE, wrap up their My Legacy campaign in his honor.

Thanks to prominent pledges, media coverage and a growing base of people eager to support CTE research, the final tally showed a record-breaking 478 brain pledges in 2016.

## L.E.G.E.N.D. STUDY

The Concussion Legacy Foundation is proud to continue to be the sole underwriter of the L.E.G.E.N.D. study. **Led by Dr. Robert Stern at the BU CTE Center, this longitudinal study seeks to understand the risk factors for CTE in the living.**

Nearly 800 current and former athletes participate in the study, making L.E.G.E.N.D. the largest study of its kind to

examine the effects of repetitive brain trauma in sports. Every year, participants across the country complete online and telephone-based assessments evaluating their mood, behavior, and cognition.

**In 2016, L.E.G.E.N.D. published its most important paper to date, answering a critical question: How can we quantify brain trauma in athletes who played years before we started keeping track of head impacts?** Using data from over 90 former high school and college football players, researchers developed an algorithm based on the positions an athlete played throughout their career and published data on how many head impacts players at each position typically suffer. They found that the more hits an athlete suffered throughout their career (not the number of concussions they suffered), the greater their risk of suffering problems with mood, cognition, and behavior, providing further evidence of the danger of sub-concussive impacts.

Most notably, the study continues to grow – in 2016 over 150 new athletes joined the program, and hundreds more completed their fifth assessment. We are very excited about the discoveries LEGEND will produce in the future.

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DOI: 10.1089/neu.2016.4413

### Cumulative Head Impact Exposure Predicts Later-Life Depression, Apathy, Executive Dysfunction, and Cognitive Impairment in Former High School and College Football Players

Philip H. Montenegro,<sup>1,2</sup> Michael L. Alisco,<sup>1</sup> Brett M. Marin,<sup>3</sup> Daniel H. Daneshvar,<sup>1,4</sup> Jesse Mez,<sup>1,4</sup> Christine E. Chaisson,<sup>1,5,6</sup> Christopher J. Nowinski,<sup>6</sup> Rhoda Au,<sup>1,7</sup> Ann C. McKee,<sup>1,4,8,9</sup> Robert C. Cantu,<sup>1,6,10,11</sup> Michael D. McClean,<sup>12</sup> Robert A. Stern,<sup>1,3,4,10,11</sup> and Yorghos Tripodis,<sup>1,5,\*</sup>

#### Abstract

The term "repetitive head impacts" (RHI) refers to the cumulative exposure to concussive and subconcussive events. Although RHI are believed to increase risk for later-life neurological consequences (including chronic traumatic encephalopathy), quantitative analysis of this relationship has not yet been examined because of the lack of validated tools to quantify lifetime RHI exposure. The objectives of this study were: 1) to develop a metric to quantify cumulative RHI exposure from football, which we term the "cumulative head impact index" (CHII); 2) to use the CHII to examine the association between RHI exposure and long-term clinical outcomes; and 3) to evaluate its predictive properties relative to other exposure metrics (i.e., duration of play, age of first exposure, concussion history). Participants included 93 former high school and collegiate football players who completed objective cognitive and self-reported behavioral/mood tests as part of a larger ongoing longitudinal study. Using established cutoff scores, we transformed continuous outcomes into dichotomous variables (normal vs. impaired). The CHII was computed for each participant and derived from a combination of self-reported athletic history (i.e., number of seasons, position[s], levels played), and impact frequencies reported in helmet accelerometer studies. A bivariate probit, instrumental variable model revealed a threshold dose-response relationship between the CHII and risk for later-life cognitive impairment ( $p < 0.0001$ ), self-reported executive dysfunction ( $p < 0.0001$ ), depression ( $p < 0.0001$ ), apathy ( $p = 0.0161$ ), and behavioral dysregulation ( $p < 0.0001$ ). Ultimately, the CHII demonstrated greater predictive validity than other individual exposure metrics.

**Key words:** behavior; cognition; concussion; football; long-term impairment; subconcussive impacts



# 2016 EVENTS



CLF Board Member and WWE Executive Vice President, Live Events & Creative Paul "Triple H" Levesque and U.S. Secretary of Veterans Affairs Robert A. McDonald exchange #TeamUpSpeakUp wristbands at the 9th Annual Impact Awards Dinner.



The 2016 Chicago Honors panel discussion featured (L-R) Tregg Duerson, son of Chicago Bears legend Dave Duerson; Super Bowl Champion and Bears legend Gary Fencik; Illinois Senate Democrats Finance Director Liz Nicholson; CLF Co-Founder and CEO Chris Nowinski; Smashing Pumpkins Lead Singer Billy Corgan; and CLF Board Member and CBS Chicago Anchor Rob Johnson.



Chris Nowinski addresses the crowd at the Congress of Future Medical Leaders in August.



L-R: U.S. Secretary of Veterans Affairs Robert A. McDonald, Olympic Gold Medalist Nancy Hogshead-Makar, BU CTE Center Director Dr. Ann McKee, Oakland Raiders Legend Phil Villapiano, and Chris Nowinski at the 2016 BrainTrust conference hosted by the V.A.




At the 2016 Boston Investment Breakfast, panelists included, L-R: Chris Nowinski, Boston Globe columnist Dan Shaughnessy, 7-year NFL veteran and former CLF Board Member Isaiah Kacyvenski, and CLF Co-Founder and Medical Director Dr. Robert Cantu.



Washington Redskins wide receiver Pierre Garcon (left) with Family Advisory Board Members Ollie Matson (son of NFL Hall of Famer Ollie Matson) and Stephanie Matson at the 2016 Tom McHale Memorial in Washington, D.C.

# SOCIAL



 TRIPLE H

Heading back from the 2016 #CLF Impact Awards. Thanks to @ChrisNowinski1 and everyone at @ConcussionLF for their continued work in the field.



DALE EARNHARDT JR.

*On whether brain donation is a "big commitment"*

Why? What use is it to you at that point?  
I'm gonna donate mine.



SMASHING PUMPKINS

4 VIP packages left to private pre-show & Q&A with Billy. Supports @ConcussionLF

#1

Chris Nowinski is the most influential person on Twitter when it comes to concussions, per Right Relevance.

1.7M

Facebook post reach in 2016

6.9M

Twitter impressions in 2016

75%

Facebook growth rate increased by 75% in 2016 vs. 2015



USA HOCKEY

USA Hockey is proud to support #TeamUpSpeakUp on September 13!



MAJOR LEAGUE LACROSSE

A huge thank you to @ConcussionLF for raising awareness of concussion safety during MLL Concussion Awareness Week.



@CONCUSSIONLF



BREAKING: US Soccer legend Brandi Chastain pledges brain to #MyLegacy



ERIC LINDROS

Today is Team Up Day. Take the pledge to #TeamUpSpeakUp to fight #concussions & change the culture.

## STATEMENT OF ACTIVITIES

## Public Support and Other Revenue

Contributions	\$1,780,148
Program Services Revenue	\$104,444
Investment Income	\$822
Other Revenue	\$42,395
<b>Total Revenue</b>	<b>\$1,927,809</b>

## STATEMENT OF FINANCIAL POSITION

Cash, Cash Equivalents & Investments	\$1,289,727
Property & Equipment	\$29,583
Other Assets	\$8,991
Pledges & Accounts Receivable	\$766,500
<b>Total Assets</b>	<b>\$2,094,801</b>

## EXPENSES

Program Expenses	\$998,091
Program Services	\$785,318
Research Grants	\$212,773
Management and General	\$188,616
Fundraising	\$233,109
<b>Total Expenses</b>	<b>\$1,419,817</b>

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