



The Gillian Reny
STEPPING STRONG
 Center for Trauma Innovation

Annual Stewardship Report: 2018–2019

BRIGHAM HEALTH
 BRIGHAM AND
 WOMEN'S HOSPITAL

**Life. Giving.
 Breakthroughs.**

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A MESSAGE FROM BRIGHAM HEALTH PRESIDENT BETSY NABEL, MD



Dear friends and colleagues,

Five years ago, the Reny and Epstein families established the Gillian Reny Stepping Strong Fund at Brigham and Women's Hospital to honor the medical team that saved their dear Gillian's life and limbs in the aftermath of the 2013 Boston Marathon bombings. On that tragic day, the people of Boston came together and showed remarkable resilience. I am proud to say that many physicians and nurses at the Brigham also came together and worked across specialties to save lives, a true reflection of the collaborative nature of our hospital, which is also the defining spirit of the Stepping Strong community.

Five years later, the fund has evolved into The Gillian Reny Stepping Strong Center for Trauma Innovation, with dedicated, state-of-the-art laboratory space for our researchers and medical directors. Our momentum continues to accelerate, and this past year has been particularly exciting. We welcomed our fourth fellow, honored four award-winning research teams, and launched the Stepping Strong Injury Prevention and Intervention program. To show my devotion to the Stepping Strong Center and its mission, I recently committed the Brigham Boston Marathon team to support the Stepping Strong Center through 2022.

As you read through the updates that follow, I hope you take great pride in all that has been accomplished by our talented medical leaders, devoted community members, passionate runners, and generous donors. I am grateful for your dedication to the Stepping Strong Center and our mission to transform outcomes for civilian and military trauma survivors and their families. Thank you for helping us reach this five-year milestone, and I look forward to keeping you updated as we continue this transformative work.

With gratitude,

A handwritten signature in black ink that reads "Betsy". The signature is fluid and cursive, with a large, stylized "y" at the end.

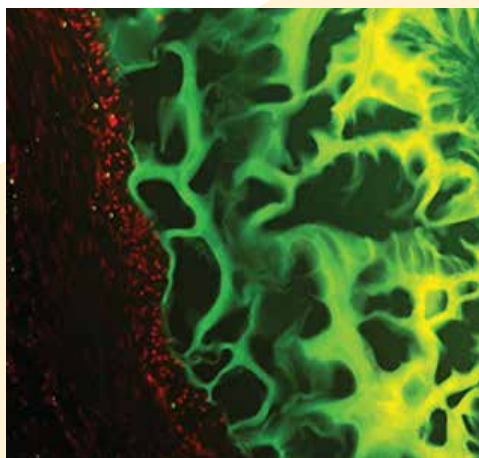
Elizabeth G. Nabel, MD
President
Brigham and Women's Hospital
Brigham Health

THE GILLIAN RENY STEPPING STRONG CENTER FOR TRAUMA INNOVATION

TURNING TRAGEDY INTO HOPE



Stepping Strong Innovator Dr. George Dyer



"Smart" tissue developed by Stepping Strong Innovator Dr. Natalie Artzi



Members of the 2018 Stepping Strong Marathon Team

Traumatic injuries can happen to anyone, anywhere, at any time—in military combat, on athletic fields, in motor vehicle accidents, and, sadly, in terror attacks. Each year in the United States, trauma incidents account for 200,000 deaths and leave 500,000 survivors with permanent mental and physical disabilities. Trauma injuries comprise 40 percent of visits to emergency departments and result in approximately \$700 billion in lost productivity. Despite these staggering statistics, trauma research and care remain under-recognized and underfunded. Because of this, advancements in the field have long been at a standstill.

Thanks to the generous support of donors like you, a growing community of medical professionals is committed to addressing this widespread problem.

The mission of The Gillian Reny Stepping Strong Center for Trauma Innovation is to catalyze multidisciplinary collaborations that inspire groundbreaking innovation, effective prevention, and compassionate intervention to transform care for civilians and military heroes who endure traumatic injuries and events.

With your support, The Gillian Reny Stepping Strong Center for Trauma Innovation at Brigham and Women's Hospital is making groundbreaking progress in areas spanning soft tissue, bone, and muscle regeneration; next-generation prostheses; wound healing; limb preservation; bioengineering; and emergency preparedness, all with the goal of transforming outcomes for survivors of trauma in Boston and beyond.



\$3.3M

distributed to innovators and scholars

18,000+

community supporters

53

publications in medical
journals

2

endowed programs

15

Ewing Amputation
patients

1,500+

runners

21

Innovator Award research teams

110

Stepping Strong
Center-affiliated faculty

\$14.6M

in outside grants secured by
Innovator Award winners

4

Stepping Strong
fellows

5,600+

social media followers

2,500+

trained in emergency response

C

OLLABORATIVE EXPERTISE: HOW OUR LEADERSHIP IS ADVANCING THE FIELD



“It is remarkable to reflect on how far we have come since establishing Stepping Strong with a vision to transform trauma research and care. In just five years, a fund has given rise to a physical center, seed money has been leveraged into larger federal funding, and a small group of family and friends dedicated to changing outcomes for trauma patients has grown into a global community of physician-scientists, runners, and philanthropists.

This past year was defined by new collaborations and extraordinary results. With renowned medical directors at two of Boston’s most esteemed hospitals, talented Stepping Strong Innovator Award winners at multiple institutions across the city, and an expanded focus on injury prevention, we are poised to make significant impact on the lives of trauma survivors. We are grateful for your partnership and support as we embark upon the next five years of turning tragedy into hope.”

Audrey Epstein Reny, Co-founder and Advisory Board Chair



"I cared for Gillian when she came into the Brigham after the bombing with severe traumatic injuries to her legs. A moment that defines my commitment to leading the center was when Gillian and I participated in the B.A.A. 5K race five years later. Our goal is to fuel innovation and care programs that

lead to more happy endings like Gillian's."

Mitchel B. Harris, MD, Medical Co-director

As Stepping Strong completes its fifth year, our dedicated leadership team continues to grow the scope of the center's work and impact. Following the transition of the center's medical co-director, **Mitchel B. Harris, MD**, to chief of the Department of Orthopaedic Surgery at Massachusetts General Hospital (MGH), the opportunities for center expansion have increased exponentially, creating access to new expert faculty and critical resources. Dr. Harris, a key leader in the center since its founding, provides an important path for collaboration as the leadership team works to establish a Stepping Strong footprint at MGH and peer institutions across the city.

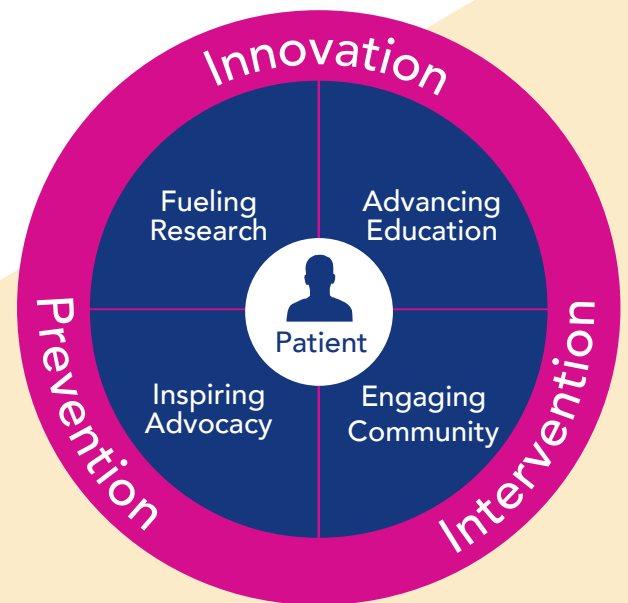


"I am proud to be leading the center as we launch our new Stepping Strong Injury Prevention and Intervention program at the Brigham. Traumatic injury is the leading cause of death for children and adults up to the age of 45 in the United States—a shocking statistic that affects

everyone, regardless of age, race, or economic status. By educating the community and inspiring advocacy, we aim to reduce the number and severity of traumatic injuries in Boston and across the country."

Ali Salim, MD, Medical Co-director

As chief of the Trauma, Burns, and Surgical Critical Care division at the Brigham, **Ali Salim, MD**, brings to the center decades of expertise in emergency surgery, surgical critical care, injury prevention, and trauma care.



What We Do at the Stepping Strong Center

TRAUMA INNOVATION

Through the Stepping Strong Innovator Awards program, our multi-institutional faculty continue to pursue groundbreaking research, accelerate innovation, and advance education for young clinician-researchers. In addition to training the next generation of leaders in advanced surgical techniques and funding leading-edge research projects, the center aims to provide further educational opportunities in the areas of raising capital, licensing, commercialization, and entrepreneurship.

TRAUMA PREVENTION AND INTERVENTION

Under Dr. Salim's leadership, the center is proud to introduce the new Stepping Strong Injury Prevention and Intervention program, which aims to prevent traumatic injuries resulting from distracted driving, gun violence, falls, and other situations before they occur. Our goal is to reduce the volume and severity of traumatic injuries through multiple in-hospital and community-based outreach and advocacy initiatives, in conjunction with research studies and training programs focused on best practices for intervention and prevention.

COLLABORATIVE EXPERTISE: HOW OUR LEADERSHIP IS ADVANCING THE FIELD



Two-time Innovator Award winner **Matthew J. Carty, MD**, also joined the center in 2018, in the newly created role of director of strategy and innovation. Dr. Carty brings a unique lens to short- and long-term strategic planning at the center with the goal of building on the center's five-year legacy and charting the course for the next five years and beyond. Dr. Carty is director of the Lower Extremity Transplant Program and a surgeon in the Division of Plastic Surgery at the Brigham. He is also an associate professor of surgery at Harvard Medical School and a research scientist at the Massachusetts Institute of Technology (MIT) Media Lab Center for Extreme Bionics.



How We Do It: The Cycle of Trauma Innovation

"Five years ago, the Stepping Strong Center provided me with the support and resources to develop an innovative amputation procedure that has already changed the lives of many. My new role as the director of strategy and innovation will allow me to return the favor by helping other physician-scientists pursue novel treatment strategies for patients affected by traumatic injuries."

Matthew J. Carty, MD
Director of Strategy and Innovation



This past year, Stepping Strong Center Program Director **Nish Acharya, MPA**, oversaw several key initiatives to build community and expand the center's research activities. In addition to managing the Stepping Strong Innovator Awards program, which provided \$400,000 to four new research teams from the Brigham, MGH, and MIT, Acharya organized the inaugural Stepping Strong Trauma and Research Symposium to showcase the center's innovative projects and to spark dialogue among experts in the field.

With your support, Drs. Harris, Salim, and Carty, alongside Epstein Reny and Acharya, the Stepping Strong Medical Executive Committee, and the Stepping Strong Advisory Board, will continue to work tirelessly to advance the Stepping Strong mission, improve patient outcomes, and forge exciting new strategic partnerships—both here in Boston and at civilian and military institutions around the world.



STEPPING STRONG MEDICAL EXECUTIVE COMMITTEE

The Stepping Strong Medical Executive Committee is comprised of expert physician-scientists from institutions throughout Boston, further demonstrating the center's collaborative nature. Led by the Stepping Strong Center leadership team, the committee consists of physician-scientists from each medical area the Stepping Strong Center represents, including orthopaedic, plastic, and trauma surgeons; emergency medicine physicians; bioengineers; and basic scientists. Committee members are leaders at Brigham and Women's Hospital (BWH), Massachusetts General Hospital (MGH), Beth Israel Deaconess Medical Center (BIDMC), Massachusetts Institute of Technology (MIT), Harvard Medical School (HMS), and Spaulding Rehabilitation Hospital (SRH). They provide strategic guidance to center leadership and faculty regarding grants and clinical and research projects. They also have the significant task of selecting the Stepping Strong Innovator Award winners each year, which continues to build the center's portfolio of investments and areas of impact.

COMMITTEE MEMBERS:

Ali Salim, MD (BWH, HMS)
Mitchel B. Harris, MD (MGH, HMS)
Natalie Artzi, PhD (BWH, HMS, MIT)
Matthew J. Carty, MD (BWH, HMS)
David Crandell, MD (HMS, SRH, MGH)

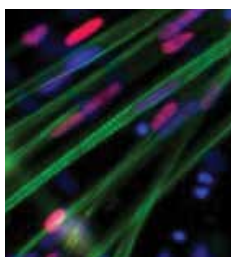
George Dyer, MD (BWH, HMS)
Omid Farokhzad, MD, MBA (BWH, HMS)
Eric Goralnick, MD, MS (BWH)
Jeff Karp, PhD (BWH, HMS, MIT)
James Lederer, PhD (BWH, HMS)
Bohdan Pomahac, MD (BWH, HMS)

Olivier Pourquie, PhD (BWH, HMS)
Christian Sampson, MD (BWH, HMS)
Indranil Sinha, MD (BWH, HMS)
Mike Weaver, MD (BWH, HMS)
Jack Wixted, MD (BIDMC, HMS)

BUILDING MOMENTUM: ACCELERATING TRAUMA RESEARCH AND DISCOVERY



2018 Stepping Strong Innovator Award winners Drs. Yi Lu, Jessica Lehoczy, Jenna Galloway, Natalie Artzi, and Mathias Kolle



Functional skeletal muscle from Dr. Indrahil Sinha's lab



Stepping Strong Research Scholars Drs. Dennis Orgill and Julie Glowacki

Through its Stepping Strong Innovator Awards program, the center aims to inspire and fund cutting-edge research that both tackles complex problems that must be solved to improve standards of care for trauma patients and leads to technological advances and clinical procedures that ultimately transform outcomes for recovering trauma patients. These competitive grants facilitate multidisciplinary collaborations and recognize high-impact projects that traditional funding sources will often not support in areas including limb preservation, muscle and bone regeneration, advanced stem cell technology, orthopaedic and plastic surgery, bioengineering, and emergency preparedness.

To date, **21 research teams** have received **\$3.3 million** from the Stepping Strong Center, resulting in an additional **\$14.6 million** of funding from the National Institutes of Health, the U.S. Department of Defense, and the Small Business Innovation Research program. We are proud to report that, with your support, one innovator achieved the ultimate goal of translating his research from the bench to the bedside, transforming the lives of **15 patients** (see page 14).

With generous lead support from the Jack Satter Foundation, the center was able to fully endow an annual \$100,000 Stepping Strong Innovator Award, which will enable the center to fuel leading-edge trauma innovation in perpetuity.

THE STEPPING STRONG INNOVATOR AWARDS

//2018

Using Gene Therapy and Antibiotic Delivery to Treat Bone Infections

Natalie Artzi, PhD (BWH)

In collaboration with Omid Farokhzad, MD, MBA (BWH), and Morteza Mahmoudi, PhD (BWH)

Identifying Drugs to Expedite the Healing of Orthopaedic Injuries

Jenna Galloway, PhD (MGH), and Jessica Lehoczy, PhD (BWH)

In collaboration with Xubo Niu, PhD (MGH), and Vikram Khedgikar, PhD (BWH)

Revealing Optimal Pressure in Compression Therapy Using Color-Changing Fibers

Mathias Kolle, PhD (MIT)

In collaboration with Matthew J. Carty, MD (BWH), and Joseph Sandt (MIT)

Locomotion Recovery After Spinal Cord Injury

Yi Lu, MD, PhD (BWH), and Zhigang He, PhD (BCH)

//2017

First-time funding:

Mitigating Damage to Injured Limbs After Tourniquet Application

Giorgio Giatsidis, MD (BWH)

Renewed funding:

The Ewing Amputation

Matthew J. Carty, MD (BWH)

In collaboration with the MIT Media Lab (MIT)

Multi-functional Scaffolds that Promote Bone Healing and Regeneration

Omid Farokhzad, MD, MBA (BWH), and Morteza Mahmoudi, PhD (BWH)

Developing Common Standards for Disaster Medicine

Eric Goralnick, MD, MS (BWH), and Edward J. Caterson, MD, PhD (BWH)

A Simple, Ultraportable Device for Rescuing Limbs

Bohdan Pomahac, MD (BWH)

Restoring Skeletal Muscle Mass and Function

Using 3D Bioprinting

Su-Ryon Shin, PhD (BWH), and Indranil Sinha, MD (BWH)

//2016

New Hope for Trauma Patients with Severe Burn Injuries

Reza Abdi, MD (BWH)

In collaboration with Ali Khademhosseini, PhD (BWH), and Dennis P. Orgill, MD, PhD (BWH)

21st Century Tools to Measure Bone Healing

Michael J. Weaver, MD (BWH)

In collaboration with Jack Wixted, MD (BIDMC), and Ara Nazarian, PhD (BIDMC)

Best Practices in Treating Mass Casualty

Eric Goralnick, MD, MS (BWH),

and Edward J. Caterson, MD, PhD (BWH)

//2015

Healing Bones with Nanodrones:

The Next Frontier in Orthopaedic Surgery

Omid Farokhzad, MD (BWH)

In collaboration with Mitchel B. Harris, MD (MGH), and Morteza Mahmoudi, PhD (BWH)

From Battlefield to Bedside:

A Portable Device for Rescuing Limbs

Bohdan Pomahac, MD (BWH)

Using 3D Bioprinting to Heal Muscle Trauma

Su-Ryon Shin, PhD (BWH)

//2014

A New Surgical Approach for the 21st Century

Matthew J. Carty, MD (BWH)

In collaboration with the MIT Media Lab (MIT)

Using Stem Cells to Regenerate Injured Muscle

Indranil Sinha, MD (BWH)

Using Silk-Based Implants to Promote Bone Healing

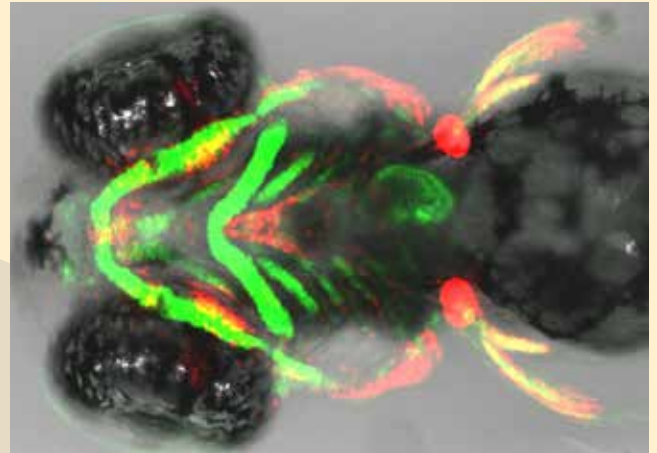
George S. Dyer, MD (BWH)

In collaboration with Ara Nazarian, PhD (BIDMC), and David Kaplan, PhD (Tufts)

BUILDING MOMENTUM: ACCELERATING TRAUMA RESEARCH AND DISCOVERY



Dr. Natalie Artzi invented an injectable adhesive hydrogel that can locally deliver therapeutics to help regenerate bones



In their investigation, Drs. Jenna Galloway and Jessica Lehoczky found that drugs help to promote musculoskeletal fates in zebrafish cells

2018 INNOVATOR AWARD WINNERS

//HEALING INFECTED BONES USING ANTIBIOTICS AND LOCALIZED GENE THERAPY

Bone is unique in its capacity to self-regenerate. However, despite this natural healing potential, bone is not always able to repair large-scale defects. This can result in permanent bone loss, infections, and other complications. In serious cases, it can lead to an inflammatory condition called chronic post-traumatic osteomyelitis, which threatens limb viability. **Natalie Artzi, PhD**, in collaboration with **Omid Farokhzad, MD, MBA**, and **Morteza Mahmoudi, PhD**, aim to develop a dual-therapy hydrogel that will stop the spread of infection by selectively delivering antibiotics only to cells at the wound site.

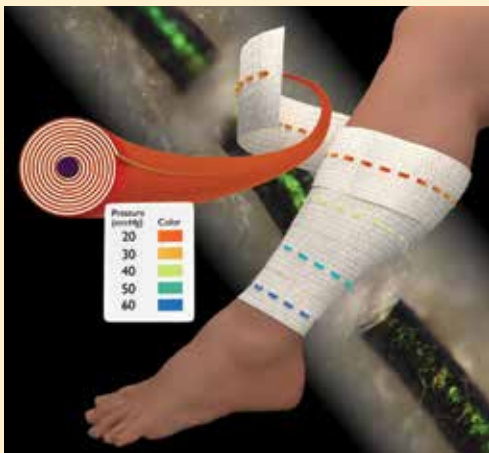
In addition to killing bacterial cells, the gel will accelerate the recovery of patients with traumatic bone injuries by simultaneously enhancing fracture healing in the surrounding bone tissue. Recognizing that both teams had common interests and complementary technologies, the Stepping Strong Center leadership facilitated this collaboration between Dr. Artzi and Drs. Farokhzad and Mahmoudi, to accelerate and advance both of their projects.

//IDENTIFYING DRUGS TO EXPEDITE THE HEALING OF ORTHOPAEDIC INJURIES

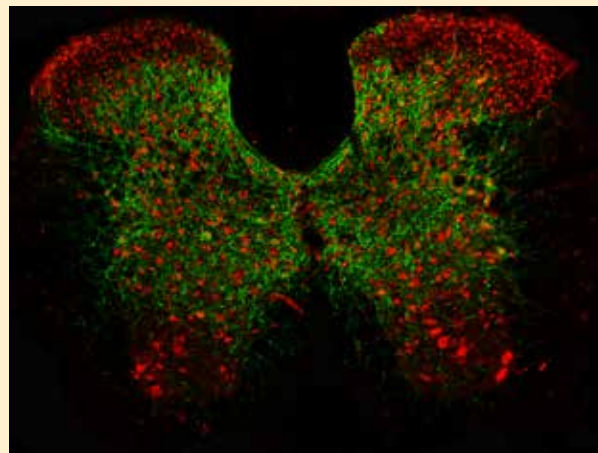
Doctors treating patients with traumatic injuries have long strived to rapidly heal bone and soft tissue damage to fully restore function. Although bone can regenerate, a substantial number of fractures do not fully heal. Injured tendons and ligaments do not regenerate but instead scar, resulting in an inferior tissue that is prone to reinjury.

To address these regeneration issues and accelerate healing, we are excited to welcome a partnership between investigators at Brigham and Women's Hospital and Massachusetts General Hospital that leverages the intellectual power of the two esteemed institutions.

Jenna Galloway, PhD, and **Jessica Lehoczky, PhD**, and their team aim to discover drugs that promote stem cells to form new bone and tendon tissues, which would make a significant clinical impact for patients recovering from orthopaedic trauma.



Dr. Mathias Kolle added bio-inspired fibers to bandages to correctly assess bandage pressure and enhance patient recovery



As seen in this cross-section of a mouse spinal cord, Drs. Yi Lu and Zhigang He found increased expression in neurons, which correlates to improved motor function

//REVEALING OPTIMAL PRESSURE IN COMPRESSION THERAPY USING COLOR-CHANGING FIBERS

Among the many challenges for patients with traumatic injuries are painful leg ulcers, hematoma, and burn-related scars. These conditions are frequently treated by applying pressure to affected tissue with bandages—an approach known as compression therapy. To enable optimal healing with this approach, the pressure exerted on the patient's body must be exact, but medical professionals struggle to correctly assess bandage pressure. To address this challenge, **Mathias Kolle, PhD**, and his team combined bandages with bio-inspired fibers that change color when damaged, thus indicating the correct pressure level. By eliminating ambiguity in adjusting bandages, the team hopes to shorten treatment duration, increase the therapy success rate, and decrease treatment costs.

//LOCOMOTION RECOVERY AFTER SPINAL CORD INJURY

Most patients with severe spinal cord injuries lose the ability to walk. However, new strategies that maximize the function of preserved neural tissues may provide urgently needed solutions. **Yi Lu, MD, PhD**, and **Zhigang He, PhD**, have identified a small molecule, CLP290, that effectively restores the activity of the spared interneurons and supports improvements in movement following severe spinal cord injury. This collaborative research project will shed light on the mechanisms of CLP290 in locomotion function restoration, with the ultimate goal of establishing the molecule's safety and efficacy so that it can be used to give spinal cord injury patients the ability to walk again.



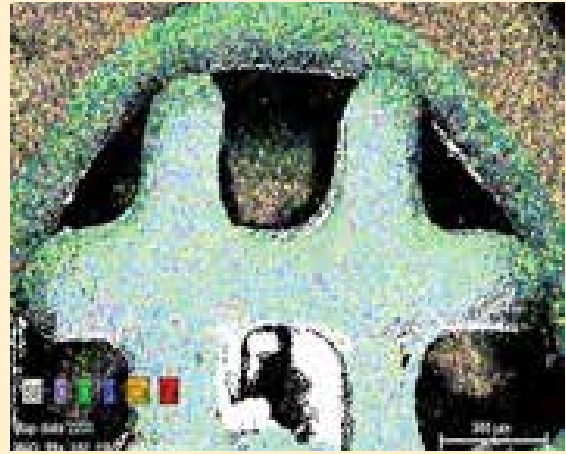
“Our interest in the Stepping Strong Center was both deepened and focused when our nephew suffered a traumatic spinal cord injury that rendered him paraplegic. The passion of the Stepping Strong research community and the spirit of collaboration at the center is the ideal environment to catalyze research in the area of restoring spinal cord function. We hope that the work enables future patients like our nephew to experience better outcomes.”

Barbara and Michael Eisenson, Stepping Strong Advisory Board members

BUILDING MOMENTUM: ACCELERATING TRAUMA RESEARCH AND DISCOVERY



Drs. Su-Ryon Shin and Indranil Sinha developed 3D-printed bio-scaffolds that have been successfully implanted in animal models with volumetric muscle loss injuries



Drs. Omid Farokhzad and Morteza Mahmoudi zoom in on an electron microscopy of a bone scaffold that includes antibacterial and therapeutic agents

EARLY-STAGE INNOVATION AND NEW FRONTIERS IN TRAUMA RESEARCH

//RESTORING SKELETAL MUSCLE MASS AND FUNCTION USING 3D PRINTING

Introduced through the Stepping Strong Center and using discoveries made through their initial Stepping Strong Innovator Award projects, **Su-Ryon Shin, PhD**, and **Indranil Sinha, MD**, formed a new collaboration and were awarded additional funding to explore skeletal muscle regeneration following volumetric muscle loss, a condition that often occurs after traumatic injuries and results in fibrosis—the thickening and scarring of connective tissue—causing impaired muscle function.

Drs. Shin and Sinha developed 3D-printed bio-scaffolds that were successfully implanted in animal models with volumetric muscle loss injuries. They are now in the first stage of creating a customized scaffold that mimics the properties of human muscle tissue, incorporates muscle growth factors, and delivers muscle stem cells to the injured area following volumetric muscle loss. This new material has the potential to revolutionize healing in patients with profound muscle injuries by improving muscle mass and function. The pair has parlayed their initial grants of \$200,000 into additional outside funding of \$3.8 million.

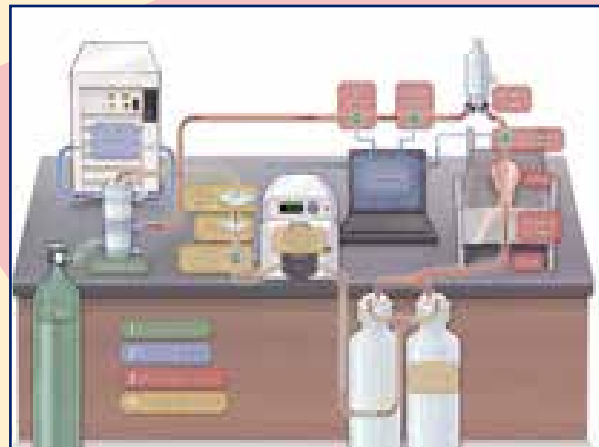
//MULTI-FUNCTIONAL SCAFFOLDS THAT PROMOTE BONE HEALING AND REGENERATION

Following orthopaedic surgery, patients with severe traumatic limb injuries can suffer from large open bone fractures that do not easily heal and are prone to high rates of infection. To minimize the need for follow-up surgeries, **Omid Farokhzad, MD, MBA**, and **Morteza Mahmoudi, PhD**, developed 3D-printed patches containing nanoparticles that can deliver antibiotics and other drugs to promote bone growth and wound healing in a safer, controlled, and more efficient way than current approaches.

With a second round of funding from the Stepping Strong Center, Drs. Farokhzad and Mahmoudi are finalizing the patches in animal models, which will facilitate the clinical translation of the patches for use in trauma patients with serious bone injuries.



Dr. Giorgio Giatsidis is developing a device that uses controlled, localized cooling to minimize ischemic damage in injured limbs after tourniquet application



Dr. Bohdan Pomahac, in collaboration with Drs. Valentin F. M. Haug and Brian Polizzotti, has developed a perfusion device that mimics normal blood flow to keep severed limbs alive. Illustration by Kai-Ou Tang.

MOVING IDEAS FROM LAB TO MARKET

//MITIGATING DAMAGE TO INJURED LIMBS AFTER TOURNIQUET APPLICATION

When faced with a traumatic injury, tourniquets can control bleeding, but because they restrict oxygenated blood flow to tissues, they can also cause ischemic damage and systemic injury. Amputated limbs are usually preserved using ice, but this is not the standard practice for limbs that are severely injured but still attached.

To address this issue, **Giorgio Giatsidis, MD, PhD**, is developing a sleeve-like device that uses a therapeutic method of controlled, localized cooling to minimize tissue damage. The device would be applied to injured limbs immediately after application of a tourniquet, then removed as blood flow is restored. In partnership with a Cambridge-based startup, Dr. Giatsidis recently received an additional \$150,000 in funding from the U.S. Department of Defense that will help bring the device closer to commercialization. The ultimate goal of this project is to reduce the amount of tourniquet-induced injuries and amputations.

//AN ULTRAPORTABLE DEVICE FOR RESCUING LIMBS

A twice-funded Stepping Strong Innovator Award winner, **Bohdan Pomahac, MD**, built a portable perfusion device that expands the window of time that an amputated limb can be safely reattached from up to 6 hours to up to 24 hours—a revolutionary development for patients and medical personnel faced with traumatic injuries. The perfusion device works by attaching the amputated limb to a pump that delivers a solution containing electrolytes, nutrients, and oxygen through the circulatory system, mimicking normal blood flow to keep the limb alive.

With the goal of creating an even simpler device for military personnel to utilize on the battlefield, Dr. Pomahac worked with colleagues at MIT and confirmed that a new ultraportable device would effectively preserve an amputated limb. Dr. Pomahac is currently in discussions with companies from Massachusetts to Ireland that are all interested in building the ultraportable device prototype so he can conduct clinical trials and accelerate the time it will take to bring this limb-saving device to civilian and military patients.

BUILDING MOMENTUM: ACCELERATING TRAUMA RESEARCH AND DISCOVERY



Audrey Epstein Reny, Ewing Amputation patient Tammy Jerome, Dr. Matthew Carty, Ewing Amputation patient Alicia Lakey, and Steven Reny



Ewing Amputation patient and veteran Brandon Korona shares his story at a Stepping Strong emergency preparedness event



Jim Ewing returns to the site of a devastating rock-climbing accident to climb once again with a new bionic limb

SCALING UP IMPACT

//REINVENTING AMPUTATION PROCEDURES

Matthew J. Carty, MD, the inaugural Stepping Strong Innovator Award winner and the new Stepping Strong Center director of strategy and innovation, collaborated with **Hugh Herr, PhD**, at MIT to reinvent the way the medical community views and performs lower limb amputations. The Ewing Amputation, named after Jim Ewing—the first Brigham and Women’s patient to undergo this revolutionary procedure—connects the leg’s front and back muscles in a loop, allowing them to continue working together to communicate with the brain despite the amputation.

For the Ewing Amputation patients, Drs. Carty and Herr designed a robotic prosthesis capable of acting like a natural limb in terms of feeling and movement. With a second round of funding from the Stepping Strong Center, Dr. Carty was able to put his innovative technique into practice and has now performed the Ewing Amputation on 15 patients, including two military veterans injured while serving overseas. Not only has this procedure drastically improved patients’ quality of life, **Dr. Carty was able to leverage his Stepping Strong funding of \$200,000 and turn it into more than \$10 million of outside grants**, paving the way for a robust new framework that integrates bionic systems with human physiology.

With an additional grant from The Soldiers Fund, which provides lifetime aid for American and British soldiers and their families, Dr. Carty traveled to five military bases across the country to meet with amputees and to exchange ideas with military doctors and educate them on how to perform this new technique.



“We have supported many important charities in the city; however, our gift to support a Stepping Strong Innovator has been one of our most meaningful and impactful. In five short years, we have seen our initial investment in a research idea evolve into a clinical procedure that has changed the lives of 15 patients. It has been a remarkable honor for us to be connected to Dr. Carty’s transformative work.”

Stephanie and John Connaughton, Stepping Strong Advisory Board members

//DEVELOPING COMMON STANDARDS FOR DISASTER MEDICINE

In the United States, it takes an average of seven minutes for emergency medical personnel to respond to a 911 call. To help trauma patients receive care more quickly, the U.S. government's "Stop the Bleed" campaign educates the general public about the basics of bleeding control and empowers them to intervene in life-threatening emergencies.

Two-time Stepping Strong Innovator Award winner **Eric Goralnick, MD, MS**, partnered with fellow Stepping Strong Innovator Award winner **Edward J. Caterson, MD, PhD**, to conduct novel research on epidemiology, education, implementation, and policy—all with a goal of reducing the number of preventable deaths due to bleeding to zero. Their research includes the largest trial to date comparing various education models, a roadmap for Stop the Bleed implementation at sports stadiums, and retrospective studies on potential lives saved with improved tourniquet accessibility. The team has trained more than 2,500 people.

"In many cases, bleeding is a preventable cause of death. Our team is laser-focused on improving injury prevention and empowering the public to save lives." Eric Goralnick, MD, MS

In February 2019, Stepping Strong, in partnership with the Brigham Center for Surgery and Public Health and the National Center for Disaster Medicine and Public Health, hosted the first annual National Stop the Bleed Research Consensus Conference. Over the course of two days, key stakeholders and subject matter experts from across the globe convened to define a national research agenda for use by clinicians, researchers, funding organizations, and policymakers, and to develop a list of top priorities to drive the future directions of Stop the Bleed research.

To further advance Dr. Goralnick's important work, the Stepping Strong Center has made an additional five-year investment in his research. Currently, there are no established guidelines for physicians and government agencies to share mass casualty incident (MCI) reports. Dr. Goralnick and his team will use the funding to compare multiple MCIs with a goal of building a database to improve trauma patient care.



Dr. Eric Goralnick



The Stepping Strong Center hosted the first-ever National Stop the Bleed Research Consensus Conference



Dr. Edward J. Caterson

BUILDING MOMENTUM: ACCELERATING TRAUMA RESEARCH AND DISCOVERY



TRAINING THE NEXT GENERATION OF TRAUMA SURGEONS

The Stepping Strong Plastic Surgery Trauma Fellowship is a unique, yearlong, multidisciplinary program designed for promising young surgeons to train with experts and learn advanced and innovative techniques for treating acute and complex traumatic injury. Under the leadership of **Christian Sampson, MD**, fellows acquire skills in surgical management, rehabilitation, limb construction, and scar management that they use throughout their Brigham careers and carry with them to peer institutions across the country, strengthening the growing Stepping Strong network.

Our 2018–2019 fellow, **Justin McCarty, DO**, is a general surgery resident at St. Elizabeth's Medical Center. Dr. McCarty, who grew up in Pittsburgh and attended medical school in Florida, is well known to the center for supporting Innovator Award winners Drs. Goralnick and Caterson's work around bleeding control for the past two years. While being the primary fellow dedicated to working on the Stop the Bleed initiative at the Brigham has been a large focus of Dr. McCarty's, he also collaborates extensively with other researchers evaluating trauma outcomes related to plastic surgery. This includes work on firearm-related injuries, which resulted in a publication in JAMA in September 2018. The time Dr. McCarty has spent learning valuable statistical methods, leading clinical trials, and becoming an expert in research methodology has uniquely positioned him as a surgeon-scientist, and this fellowship experience will serve Dr. McCarty well as he pursues a career in plastic surgery.



"It has been an honor to educate, guide, and mentor the first four Stepping Strong Plastic Surgery Trauma fellows. These talented individuals have taken what they have learned about the management of complex upper- and lower-extremity wounds and helped spread the Stepping Strong message to other institutions in Boston and across the country. One former fellow joined the faculty at the Brigham and even won a Stepping Strong Innovator Award last year."

Christian Sampson, MD, Director, Stepping Strong Fellowship

R

RAISING FUNDS AND AWARENESS: STEPPING STRONG IN THE COMMUNITY



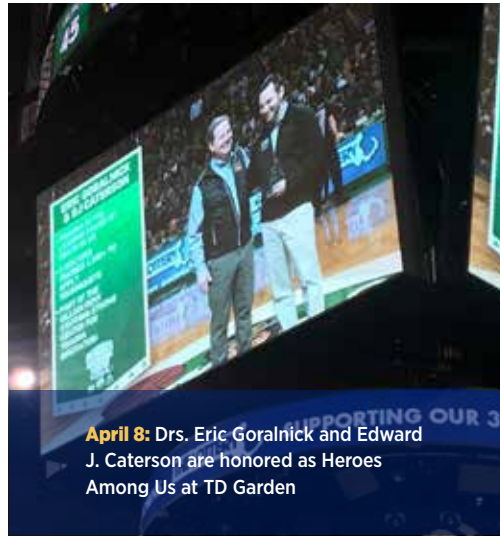
True to the Boston Strong spirit of kindness and collaboration, five years after the Stepping Strong Center was established, community members, runners, and donors are inspired to come together with a goal of transforming trauma research and care for countless patients and families around the world. The pages that follow capture a diverse array of fundraising events and community initiatives spearheaded by the extraordinary members of the Stepping Strong family.

RAISING FUNDS AND AWARENESS: STEPPING STRONG IN THE COMMUNITY

2018–19 EVENTS



March 1: Members of the Stepping Strong Advisory Board attend the Brigham Leadership Summit



April 8: Drs. Eric Goralnick and Edward J. Caterson are honored as Heroes Among Us at TD Garden

\$17.5M

given to the
Stepping Strong Center
since 2014



May 1: The revolutionary Ewing Amputation procedure is featured on the cover of Science Translational Medicine



May 29: Stepping Strong Innovator Dr. George Dyer explains his research at a BB&N Lower School gathering



June 1: The Stepping Strong Center welcomes Dr. Ali Salim as its new medical co-director

30,638

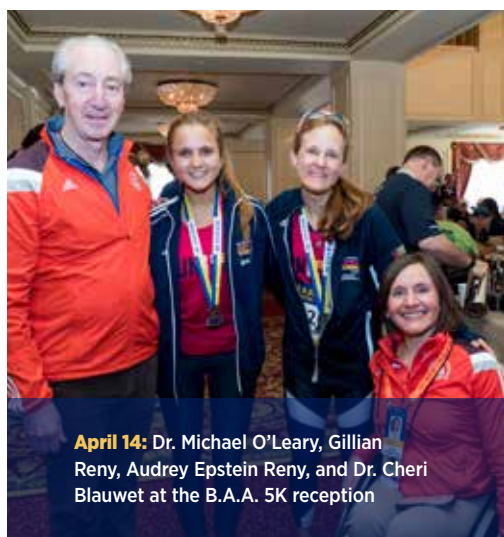
gifts
since 2014



October 18: Vincent Fischer and Dr. Robert Riviello were among the guests at the first annual trauma survivors dinner



November 1: Dr. Hugh Herr presents the keynote address at the inaugural Stepping Strong Trauma and Research Symposium



April 14: Dr. Michael O'Leary, Gillian Reny, Audrey Epstein Reny, and Dr. Cheri Blauwet at the B.A.A. 5K reception



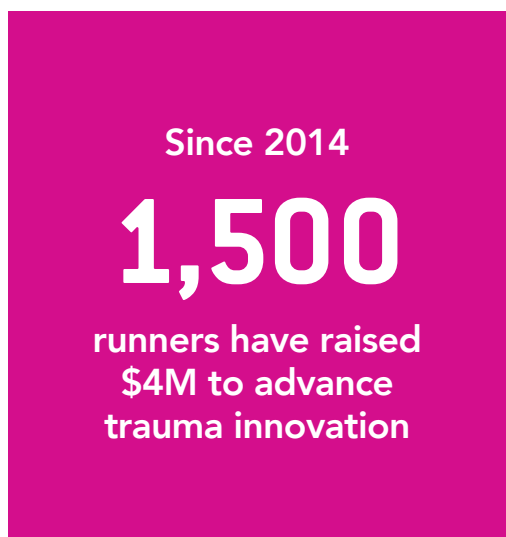
April 15: Shane O'Hara of Marathon Sports receives the 2018 Stepping Strong Heroes Award



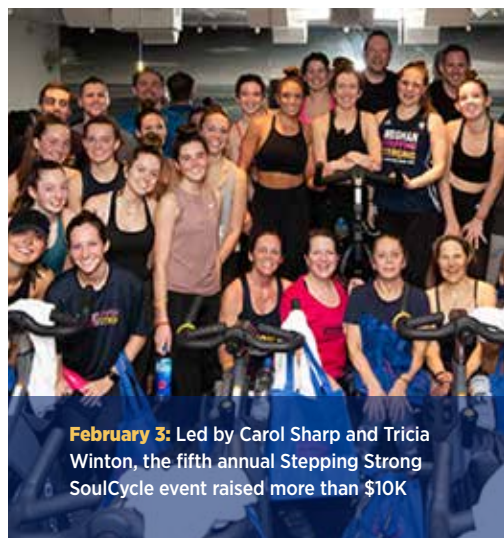
April 16: Marathon team captain Audrey Epstein Reny with Steven Reny at the finish line



August 18: 21 members of the Stepping Strong Falmouth Road Race team raised \$17,390



September 16: Ryan Enright runs the Berlin Marathon in support of trauma research and care



February 3: Led by Carol Sharp and Tricia Winton, the fifth annual Stepping Strong SoulCycle event raised more than \$10K



February 20: Fifth anniversary of The Gillian Reny Stepping Strong Center for Trauma Innovation



February 27-28: The Stepping Strong Center hosts the inaugural National Stop the Bleed Research Consensus Conference

RAISING FUNDS AND AWARENESS: STEPPING STRONG IN THE COMMUNITY

FIVE YEARS OF RUNNING STRONG

The Stepping Strong Center running program has grown into a passionate community of runners who dedicate months each year to training and fundraising for the center, fueled by their own personal experience, a loved one who has been affected by trauma, or their desire to be part of the critical work taking place at the center. Since the program's inception in 2014, more than 1,500 runners have participated in the Boston Athletic Association's 5K, 10K, and Half Marathon races, the Chilmark Road Race, the Falmouth Road Race, the Chicago Marathon, the Berlin Marathon, and the legendary Boston Marathon—regarded as the world's oldest and most challenging race.

The 2018 Stepping Strong Boston Marathon Team set a new program record by raising more than \$1.5 million for trauma research. Braving unprecedented conditions that The New York Times referred to as a “freezing deluge,” 140 runners from 20 states and four countries ran through driving rain with a 30-mile-per-hour headwind. Inspired by stories of trauma survivors' resilience, the team of devoted first-time runners, seasoned marathoners, doctors, nurses, and grateful patients made its way from Hopkinton to the finish line on the fifth anniversary of the bombings.

“I was in the army and was injured jumping out of a helicopter. After three years of limb reconstruction and salvage surgeries, I was in constant pain and felt my world becoming smaller. The Ewing Amputation changed my life. Six weeks after the surgery, I went out west and hiked a bunch of national parks. I got back into biking. I rode 40 miles the other day. I am excited to share that I was able to give back to Stepping Strong, which made this all possible, by running and raising money for the center.” **Rebecca Mann, U.S. Army veteran and Ewing Amputation patient**





20 states

4 countries



140 runners

24 repeat runners



13 BWH employees

In August 2018, Tammy Jerome, Brandon Korona, and Rebecca Mann, featured on the cover, participated in the Falmouth Road Race and crossed the finish line together. All three are among the first patients to undergo the novel Ewing Amputation, supported by the Stepping Strong Center, to relieve the chronic pain they had endured for years and allow them to experience all the benefits of an advanced prosthetic device.

Just one month after the Falmouth Road Race, Korona, an Army veteran who was injured while serving in Afghanistan, carried the Stepping Strong message overseas where he cheered on three Stepping Strong runners as they completed the Berlin Marathon, demonstrating the special bonds being forged among this unique community of advocates.

In addition to running, members of the Stepping Strong community organize their own fundraisers to spread awareness and benefit the center. In February, Stepping Strong advocates Carol Sharp and Patricia Winton hosted their fifth annual Stepping Strong SoulCycle Charity Ride. They have raised more than \$50,000 through the popular event.

“I was introduced to the Stepping Strong Center when my friend Jackie was injured in a horrific boating accident and tragically lost one of her legs. Less than a year later, she was back riding on a spin bike herself and hosting a fundraiser for the Stepping Strong Center. I ran to support Jackie and all others affected by trauma.” Joann O’Brien, 2018 marathon team member

The Stepping Strong Center is committed to engaging with other organizations in the community in the spirit of “Boston Strong” to support advances in trauma care. Each year, the Boston Celtics host Stepping Strong night at the TD Garden, generating funds and awareness for the center. This past year, the Boston Red Sox, Harpoon Brewery, Eataly, Buckingham Browne and Nichols Lower School, The Beehive, The Soldier’s Fund, and Marathon Sports all hosted events to support the center.

RAISING FUNDS AND AWARENESS: STEPPING STRONG IN THE COMMUNITY

STEP UP FOR STEPPING STRONG



Step Up for Stepping Strong is a corporate wellness program that encourages participants to stay active and “step strong” during a month-long steps challenge. Employees from companies across the country take steps while raising awareness and funds for trauma research.

In 2018, health insurance company Cigna sponsored the May Step Up for Stepping Strong challenge in observance of National Trauma Awareness Month. Cigna agreed to donate \$100,000 to the Stepping Strong Center if participants reached 100 million steps before the end of the month. This goal was reached two weeks ahead of schedule thanks to the tremendous participation and activity of all who registered.

By the end of May, more than 1,500 participants from 20 local companies took more than 200 million meaningful steps toward transforming care for patients impacted by trauma. Participants tracked their progress on a new app that pushed out content about the effects of trauma and included a chat feature that garnered messages of excitement, encouragement, and appreciation among the growing Stepping Strong community. The Cigna check presentation to Brigham President Betsy Nabel, MD, and Stepping Strong co-founder Audrey Epstein Reny was featured on news outlets across the region.

STEP UP FOR STEPPING STRONG

1,500+

participants

200M+

steps

20

companies

STEPPING STRONG IN THE NEWS

APRIL
15



She nearly lost her leg in the Boston Marathon bombing, then raised millions for research: Gillian Reny, center, was one of hundreds who were injured in the deadly marathon bombings. "This time of year can be challenging," Reny told NBC. "But my family has done a really good job of turning what happened into something positive."



MAY
9

The Boston Globe

Stopping a deadly bleed: It's more complicated than you think: A Stepping Strong-funded study at Gillette Stadium revealed that 9 out of 10 employees who took a training course correctly applied a tourniquet to mannequin legs. According to lead researcher and Stepping Strong innovator Eric Goralnick, MD, "In-person training is the best modality we have now."

MAY
30



STAT

Pioneering surgery makes a prosthetic foot feel like the real thing: After Jim Ewing fell 50 feet from a cliff he was scaling, he became the first patient to undergo an entirely new kind of amputation, pioneered by researchers at Stepping Strong and MIT. Since the operation, his pain has largely subsided, and he climbs "pretty much every weekend."

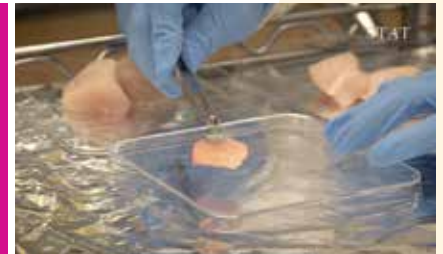


JUNE
30



Fundraiser at local hospital inspires community to take 204 million steps: After members of the Boston community tracked more than 200 million steps in the Step Up for Stepping Strong fitness challenge, Cigna followed through on its promise to donate \$100,000 to support trauma care and recovery.

JULY
13



STAT

Turning to nature for surgical innovations: For Jeff Karp, PhD, a scientist and member of the Stepping Strong Medical Executive Committee, nature is one big library, filled with volumes of evolution's best R&D secrets. Among his bio-inspired inventions: an adhesive inspired by a parasitic worm.

DEC
18



The Boston Globe

Training students to patch up classmates' gunshot wounds sends message: Kids, you're on your own: Gun violence is one of the largest public health issues facing this nation. In the next few months, Stepping Strong researchers will participate in a trial program to study whether school-aged children could perform lifesaving measures to reduce preventable deaths.

MESSAGE OF HOPE AND GRATITUDE FROM THE RENY FAMILY

Five years ago, in the aftermath of the 2013 Boston Marathon bombings, our family searched for a way to turn our personal tragedy into hope for others. We shared Gillian's story of resilience to raise funds and awareness for trauma research, an often-neglected medical area. We also aspired to support the ongoing work of her caregivers—our medical heroes at the Brigham who saved her life and limbs. At the time, we were nervous about opening our lives to the public, but here we are, five years later, and the Stepping Strong Center has evolved into more than we could ever have imagined.

The accomplishments of the center's physician-scientists, patients, community fundraisers, and volunteer leaders are truly inspiring, and the path forward seems equally exciting, as we delve into untapped opportunities to accelerate trauma research and care.

The collaborative spirit of "Boston Strong" lives on in The Gillian Reny Stepping Strong Center for Trauma Innovation, and we are so grateful to each and every one of you for making it all possible. On behalf of the countless trauma survivors and families who benefit from your support, please accept our heartfelt thanks.

With love,

Audrey, Steven, Danielle + Gillian



Thank you

The Gillian Reny
STEPPING STRONG
Center for Trauma Innovation

THANK YOU TO ALL WHO HAVE CONTRIBUTED TO THE GILLIAN RENY STEPPING STRONG CENTER FOR TRAUMA INNOVATION. WITH YOUR GENEROSITY, WE HAVE RAISED \$17.5 MILLION.

LEADERSHIP CIRCLE



Members of the Stepping Strong Leadership Circle

We acknowledge the generous donors who have cumulatively given \$25,000 or more to The Gillian Reny Stepping Strong Center for Trauma Innovation as of February 28, 2019.

\$1,000,000+

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ANNUAL HONOR ROLL (AS OF FEBRUARY 28, 2019)

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Thank you to the individuals, families, foundations, and organizations who have given \$1,000 or more between March 1, 2018, and February 28, 2019.

\$100,000+

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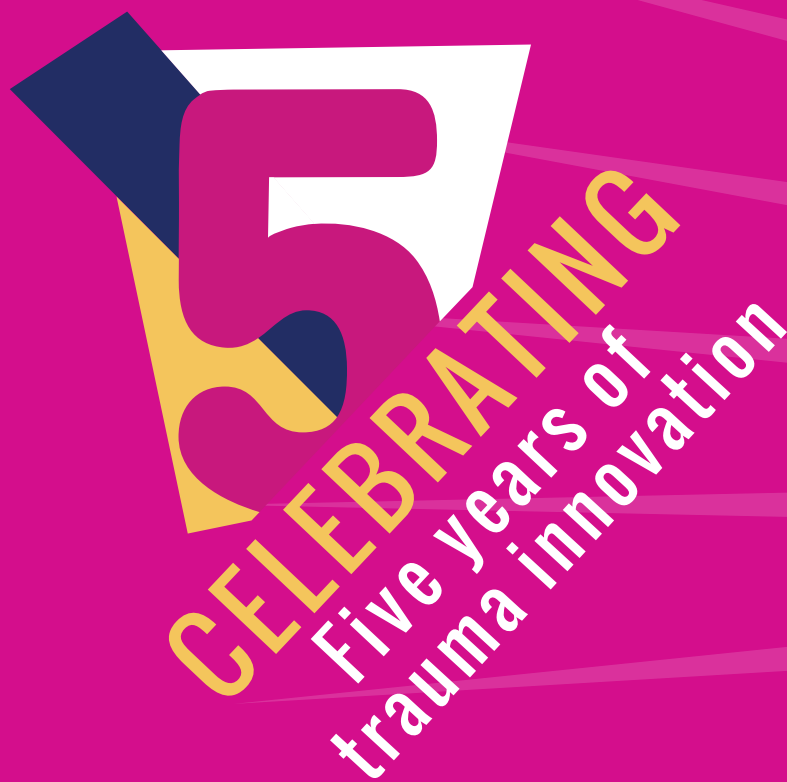


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The Gillian Reny **STEPPING STRONG** Center for Trauma Innovation



Members of the Stepping Strong Center Advisory Board at the Brigham Leadership Summit meeting in October

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