

The Chronic Brain Injury Program Strategic Plan 2018-2022

discovery.osu.edu/cbi



Chronic Brain Injury

Discovery Themes at The Ohio State University



**THE OHIO STATE
UNIVERSITY**

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Table of Contents

Strategic Planning at Ohio State	3
----------------------------------	---

Welcome	5
---------	---

About Us	6
----------	---

Strategic Scan	13
----------------	----

Success	17
---------	----

Sustainability	22
----------------	----

Appendices	
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The Chronic Brain Injury Program

Strategic Planning at Ohio State

Supporting Faculty, Students, Staff and the Infrastructure and Structures that Foster their Success

Ohio State's future will be defined and driven by an unwavering commitment to our faculty, students, and staff, and the infrastructure and structures—physical, administrative, curricular, and financial—that will foster their success. Such a commitment is founded in the overarching principles of the institution's vision, mission, values, and core goals.

VISION

The Ohio State University is the model 21st-century public, land grant, research, urban, community engaged institution.

MISSION

The University is dedicated to:

- Creating and discovering knowledge to improve the well-being of our state, regional, national and global communities;
- Educating students through a comprehensive array of distinguished academic programs;
- Preparing a diverse student body to be leaders and engaged citizens;
- Fostering a culture of engagement and service.
- We understand that diversity and inclusion are essential components of our excellence.

VALUES

Shared values are the commitments made by the University community in how we conduct our work. At The Ohio State University we value:

- Excellence
- Diversity in people and of ideas
- Inclusion
- Access and affordability
- Innovation
- Collaboration and multidisciplinary endeavor
- Integrity, transparency, and trust





The Chronic Brain Injury Program

Strategic Planning at Ohio State

PILLARS

Five institution-wide goals are fundamental to the University's vision, mission and future success:

TEACHING AND LEARNING

Ohio State will be an exemplar of the best teaching, demonstrating leadership by adopting innovative, at-scale approaches to teaching and learning to improve student outcomes.

ACCESS, AFFORDABILITY AND EXCELLENCE

Ohio State will further our position as a leading public university offering an excellent, affordable education and promoting economic diversity.

RESEARCH AND CREATIVE EXPRESSION

Ohio State will enhance our position among the top national and international public universities in research and creative expression, both across the institution and in targeted fields — driving significant advances for critical societal challenges.

ACADEMIC HEALTH CARE

The Ohio State University Wexner Medical Center will continue our ascent as a leading academic medical center, pioneering breakthrough health care solutions and improving people's lives.

OPERATIONAL EXCELLENCE AND RESOURCE STEWARDSHIP

Ohio State will be an exemplar of best practices in resource stewardship, operational effectiveness, and efficiency and innovation.





The Chronic Brain Injury Program

Welcome

Traumatic injury to the brain or spinal cord of the central nervous system (CNS) significantly negatively influences both life span and health span with far-reaching effects on survivors and their caregivers. For brain injury, there are immediate physiological and inflammatory events that contribute to acute cognitive, motor, and behavioral complications. Although these acute complications after injury resolve, functional impairments can develop chronically and even worsen over time. For instance, brain injuries may lead to alterations in behavior, depression, and cognitive decline. In addition, brain injuries are a risk factor for accelerated brain aging and the development of neurodegenerative pathology including Alzheimer's disease and Chronic Traumatic Encephalopathy (CTE). For spinal cord injury, paralysis is the most debilitating consequence, but these injuries are also associated with chronic immune, gastrointestinal, and endocrine dysfunction. In the United States there are 5 million people living with the consequences of brain injury and 300,000 living with a spinal cord injury. Therefore, it is critical that we improve our understanding of the nature and the course of traumatic CNS injuries to develop new treatments and interventions.

To address complex problems associated with CNS injury, one needs an expert team of physicians, surgeons, scientists, therapists, and engineers working collaboratively towards common clinical and research goals. The Chronic Brain Injury (CBI) Program Discovery Theme at the Ohio State University is unique in that it bridges key research areas and unites faculty to work towards transformative solutions for neurotrauma. Our neurotrauma program integrates work between colleges (Arts and Sciences, Medicine, Nursing, and Engineering) and involves key departments including Biomedical Engineering, Electrical and Computer Engineering, Health and Rehabilitation Sciences, Neurology, Neurosurgery, Neuroscience, Material Science, Physical Medicine and Rehabilitation, Psychiatry, Psychology, and Speech and Hearing Sciences.

Here at Ohio State, the goal of the faculty and associates of the CBI program is to improve the detection, treatment, rehabilitation and prognosis of injuries to the





The Chronic Brain Injury Program

Welcome

brain and spinal cord. For example, one expert team of scientists within our CBI program uses animal models to understand the role of inflammation in brain and spinal cord injury. These scientists focus on novel interventions and repair mechanisms to improve recovery. In addition, our scientists examine how other factors and co-morbidities (age, substance abuse, sleep disturbance, and psychological stress) influence injury prognosis and functional recovery. The CBI program also includes scientists and clinicians who work on improving brain imaging techniques for early detection of brain injury (and neurodegenerative disease) and who use innovative neuromodulation techniques to enhance recovery after injury. We have engineers who are exploring cutting-edge solutions for ubiquitous wearables and wireless implants that monitor a number of bodily functions and vitals. Moreover we have experts in brain aging and neurodegeneration that aim to prevent and reverse CNS pathology and improve prognosis. Using novel approaches we have faculty who use the experience of music, dance, and visual art as a powerful tool of injury rehabilitation and for patient and family support. These rehabilitation approaches are also being enhanced by virtual reality and gaming and are being delivered by biomechanists, artists, coders, and speech therapists. Collectively, we have outstanding faculty and excellent resources at Ohio State to help us reach our goals.

The breadth of Ohio State's scientific scope and the depth of its excellence, from trainees to professors to departmental chairs to deans, are harnessed through the CBI program and its membership to create an environment in which we make a difference for our parents and children, athletes and veterans, Ohioans, and the world. Learn more about the exciting work we do, and join us in transforming Ohio State into a solution engine for the chronic effects of traumatic injuries of the brain and spinal cord.

Jonathan Godbout, PhD
Faculty Director, Chronic Brain Injury Program





The Chronic Brain Injury Program

About CBI

OUR VISION

Ohio State is a global leader in the prevention, characterization, detection, and treatment of brain injuries and neurodegenerative disease.

OUR MISSION

The Chronic Brain Injury Program (CBI) drives team science and translation in neurotrauma and neurodegenerative disease, facilitates collaboration and engagement with complementary research teams and external partners, and invests in talent, innovation, shared resources, and experiential training.

OUR VALUES

Faculty, staff, and students must connect beyond college, discipline, cultural, and university boundaries in order to transform brain injury research and treatment.

The complexities of brain injury survivorship must be addressed by an equally diverse team of scientists, clinicians, engineers, and other academics.

The contributions of brain injury survivors, their caregivers, and those at risk of injury are critical in shaping our research and services.





The Chronic Brain Injury Program

About CBI

OUR CHALLENGE

Our brain is the body's most complex organ. It makes us who we are. It is critical to our ability to speak, think, remember, interact and move. Brain injuries of all severities and varieties can have persistent, chronic effects that affect health and wellbeing. The Centers for Disease Control and Prevention report that in the United States, traumatic brain injury (TBI) and related sequelae cost \$77 billion each year resulting from 1.7 million new head injury victims, 2.2 million emergency department visits, 275,000 hospitalizations, and 52,000 deaths. In the US, a TBI occurs every 15 seconds, more frequently than stroke, breast cancer, and heart attacks. TBIs are incredibly complex due to varied causes (falls, assault, blast, sports), vulnerable groups (young children, seniors, military), severity (concussion, moderate/severe TBI), outcomes (Alzheimer's, Parkinson's, motor and language impairment), and burden (job loss, caregiver stress, mood disorders, substance abuse).

OUR GOALS

- * **Improve characterization of brain injury**
through interdisciplinary research and innovation
- * **Enhance the continuum of care**
for patients and caregivers through team-building and innovation
- * **Connect Ohio State researchers**
with partner institutions to enhance expertise, visibility, and impact of our scientific discoveries
- * **Generate, integrate, and utilize data**
through community engagement, technology development, and investments in shared resources
- * **Expand experiential training**
opportunities for students, postdocs, and rising health professionals





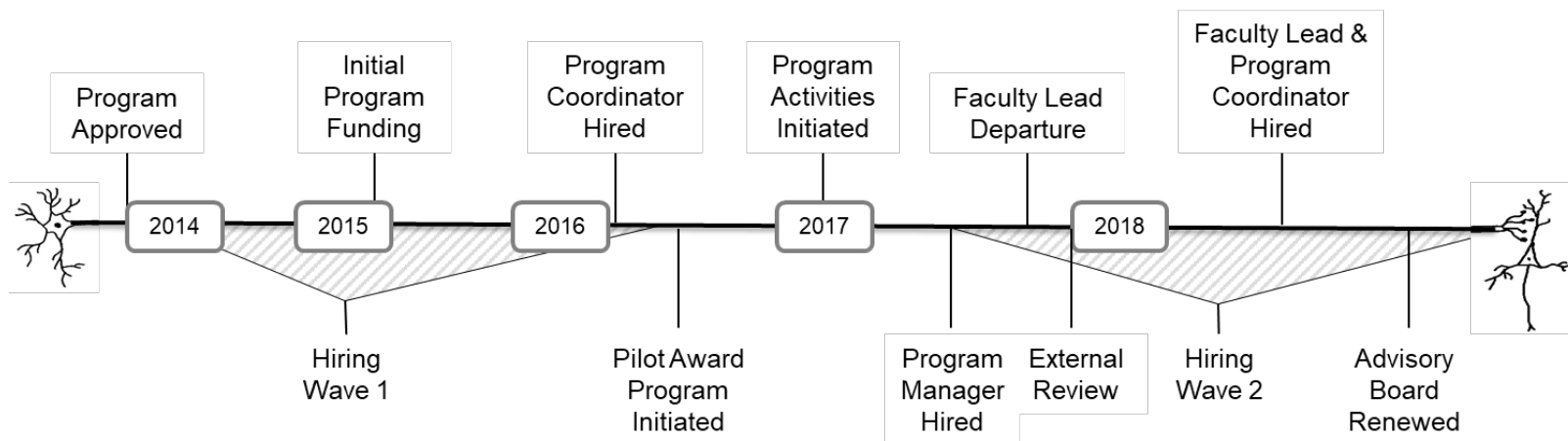
The Chronic Brain Injury Program

About CBI

OUR HISTORY

Initiated in Autumn 2014, CBI has engaged in hiring and program development across two phases of operation. In Phase 1 (FY2014-FY2017), Faculty Lead Randy Nelson primarily focused on building the program team and expanding the faculty base. A first wave of Discovery Themes hires bridged the TBI team to researchers working on stroke, spinal cord injury (SCI), and monitoring and neuroimaging technologies. Program activities began late in FY2016 with the hire of Kedar Hiremath as program coordinator and the first seed grants awarded through the CBI Pilot Award Program.

In FY2017, CBI doubled its seed grant funding and initiated networking activities, conference sponsorship, and investments in shared equipment. By the end of FY2017, CBI had grown its faculty network from 24 members to over 80, had awarded \$526,000 in seed grants – which led to \$3 million in extramural grants – and had hired 10 faculty members in four colleges.





The Chronic Brain Injury Program

About CBI

During Phase 2, CBI launched five new seminar series to build interdisciplinary teams, training opportunities for undergraduates developing mobile health products, acquisition of novel neuroimaging technologies, and development of an interdisciplinary graduate program in the College of Arts and Sciences. The faculty base grew to over 100 members, including an additional seven Discovery Themes hires, and CBI's faculty advisory board was reset to better represent TBI projects rather than university hiring.

Looking forward, CBI will submit proposals for training and program grants, further invest in undergraduate research and outreach, and create centers for neuroimaging and biobanking. Training investments will focus on federally-sponsored fellowships for graduate students and postdocs studying neurotrauma and computational neuroscience. Additionally, undergraduate fellowships will help young researchers gain hands-on experience during summer breaks. Expanding our neuroimaging and biobanking resources will drastically address deficits in human subject research, which can then drive new clinical trials, partnerships, and revenue.

OUR SUCCESSES

- * Discovery Themes hires have had immediate impact, winning \$10.7 million in extramural awards (n=40) from \$85 million in proposals (n=120), effectively capturing 33% proposals. 40% of all proposals are collaborative. Since joining Ohio State, these researchers have produced 145 publications.
- * CBI helped acquire two neurotrauma Model Systems grants from the National Institute on Disability, Independent Living, and Rehabilitation Research, representing \$5 million in awards. Ohio State is now one of eight institutions with two Model Systems programs.
- * The CBI Pilot Award Program awarded \$776,035 in seed funding to 22 projects featuring 68 faculty in 9 colleges, along with \$843,064 in matching funds. These investments have generated 36 papers, 33 proposals, and \$4 million in new awards, representing a 5x return. A full list of funded pilot projects is found in Appendix A.



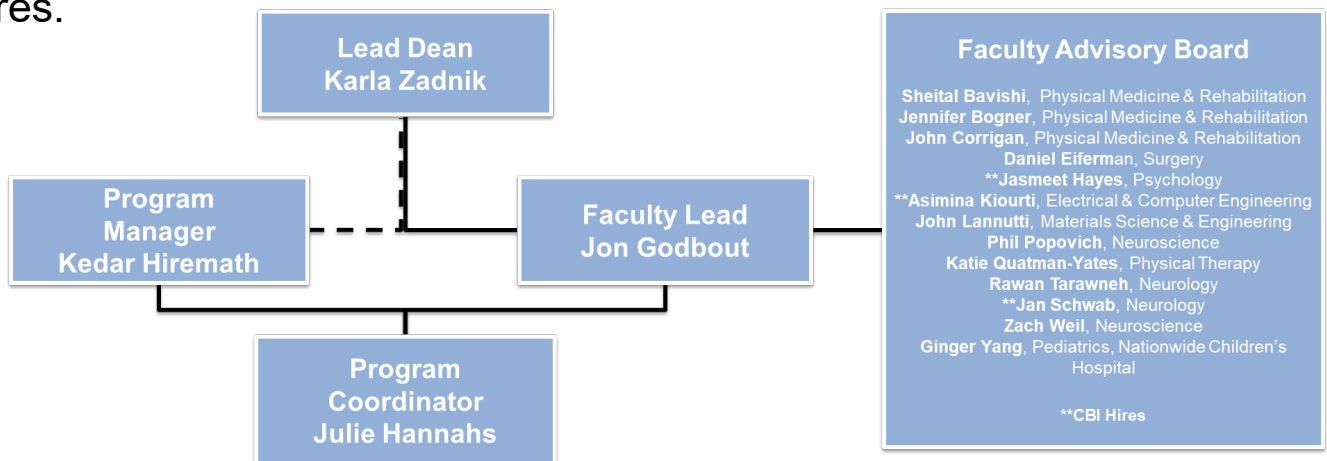


The Chronic Brain Injury Program

About CBI

OUR PEOPLE & PARTNERS

CBI's membership is categorized into the program team, Discovery Themes hires, and affiliated faculty. The program team administers CBI strategy, activities, and operations. Starting in FY2018, this team comprises Lead Dean Karla Zadnik, Faculty Director Jonathan Godbout, Program Manager Kedar Hiremath and Program Coordinator Julie Hannahs. The program team is supported by the Faculty Advisory Board, which comprises several CBI affiliates and hires.



As of March 2019, CBI has hired 17 faculty in nine departments across five colleges. These faculty are clustered into CBI's research themes: translational neurotrauma (11), neuroengineering and data analytics (3), and treatment and prevention (3). Four hires bridge these clusters together. Eight of these faculty are diversity hires, and 15 are junior. CBI has five open searches in translational neurotrauma (4) and neuroengineering (1). A list of current hires is included in Appendix B.

CBI engages existing faculty and research groups. The program has affiliated with 88 existing faculty in nine colleges and 36 departments, harnessing broad university expertise to address the complexities of brain injury. Additionally, CBI works with a variety of colleges and research centers, listed in Appendix C.





The Chronic Brain Injury Program

About CBI

RESEARCH, TEACHING & OUTREACH

CBI's research strategy focuses on three themes: A) translational neurotrauma; B) treatment and prevention; and C) neuroengineering and data analytics. Each of these areas has a distinct teaching and outreach strategy. A summary of research themes and program activities is listed in Appendix D.



Translational Neurotrauma

- How and why does neurotrauma lead to neurodegenerative diseases like Alzheimer's disease and Parkinsonism?
- Why are developing minds at greater risk for long-term consequences of brain injury?
- How do brain injuries and treatment options increase risk for alcohol and opioid addiction?



Treatment and Prevention

- How do we create a successful, feasible comprehensive plan of care for brain injury?
- Which non-pharmacological interventions can holistically rehabilitate survivors and their families?
- How can we better understand, leverage, and pay for arts-based interventions?



Neuroengineering and Data Analytics

- How can we better detect injury status through imaging, sensing, and mobile health technologies?
- What surgical tools and non-invasive techniques will improve outcomes in acute and chronic care?
- What computational methods will better predict chronic brain injury?

Translational neurotrauma represents integrated basic and clinical research to characterize and treat conditions caused by injuries to the central nervous system, collectively referred to as neurotrauma, which include traumatic brain injury, spinal cord injury, and stroke. Key subthemes explore the relationship between neurotrauma and subsequent neurodegenerative diseases like Alzheimer's and Parkinson's, the relative risks and outcomes between adults and children, and the role of comorbid alcohol and opioid addiction after injury and injury treatment. These subthemes connect brain injury to similar conditions at cellular, molecular, individual, and societal levels, across issues that are important to local and global communities. Within this theme, the primary teaching strategy is building research fellowship programs for undergraduate, graduate, and postdoctoral trainees, medical fellowships for physicians, and seminar series for interdisciplinary scientists. The primary outreach strategy is to strengthen the relationship between researchers at Ohio State and Nationwide Children's Hospital.





The Chronic Brain Injury Program

About CBI

RESEARCH, TEACHING & OUTREACH

Neuroengineering and data analytics research centers on detection methods and technology-driven therapies. Current detection methods for brain injury are either too simple, too expensive, or too laborious to be truly effective. Data is sparse and cumbersome, minimizing its effectiveness. Our researchers focus on portable neuroimaging methods, continuous monitoring through invasive and non-invasive means, predictive analytics to better identify at-risk populations, and devices to encourage independent and productive living in the home. To enhance our data, CBI is investing in a best-in-class data repository and biobank of deeply characterized TBI survivors who will be followed longitudinally. Teaching focuses on seminar series, journal clubs, and the Brain Health Hack, a weekend workshop for undergraduates in health sciences and computer science to develop mobile health applications. Within this theme, the primary outreach strategy is to engage industry to develop and deliver medications, innovate cutting-edge imaging and surgical devices, and commercialize home health solutions.

The treatment and prevention theme aspires to develop and enact a comprehensive plan of care for brain injury survivors. Patients enter and exit the health system in various ways, often being lost to follow-up; in the case of concussions, many do not report or receive treatment. To keep patients engaged between acute, rehabilitative, and transitional care, CBI supports research on complementary interventions including financial coaching for patients and caregivers, arts-based rehabilitation, and mobile health applications for mindfulness. To improve reporting, CBI researchers are exploring virtual reality applications that educate children on the experience of concussion. The primary teaching strategy in this theme is to develop a first-in-nation interdisciplinary arts-based therapies graduate program with experiential training facilitated by rehabilitation units in the Wexner Medical Center. The primary outreach strategy is to partner with the Brain Injury Association of Ohio to develop a state-wide voluntary registry for brain injury survivors interested in participating in research.





The Chronic Brain Injury Program

Strategic Scan

To transform the brain injury environment, Ohio State researchers, students, and partners must align into a multidisciplinary enterprise that leverages key university strengths with market opportunities in areas that directly contribute to meeting patient and caregiver needs. The competitive landscape and strategic analyses are summarized in this section and Appendix E.

INTERNAL ENVIRONMENT

Ohio State is home to approximately 50 researchers focusing on brain injury, other neurotrauma, and dementias, spread across several departments and colleges. Similarly, clinical services are equally fragmented, with patients seen in emergency medicine, sports medicine, physical medicine and rehabilitation, and follow up programs like the Aphasia Initiative. Lack of connections between these communities may be limiting translation and continuity of care for brain injury survivors; however, transitions in neuroscience leadership may provide an opportunity to unite faculty in research and clinical teams across the university as the new leadership structure sets in.

Several research teams at the university have already begun to coalesce within five centers. The Center for Brain and Spinal Cord Repair (CBSCR) and the Institute for Behavioral Medicine Research (IBMR) house interdisciplinary basic scientists studying neurotrauma and inflammation, respectively. The Ohio Valley Center for Brain Injury Research and Prevention and the Center for Brain Health and Performance have robust clinical programs in brain injury and concussion, with the former being home to the prestigious TBI Model Systems study. All of these centers are housed within the Neurological Institute in the College of Medicine, and CBI has integrated its new hires and existing faculty into these programs through formal affiliation, collaborative projects, or mentorship. A fifth group, the Center for Cognitive and Behavioral Brain Imaging (CCBBI) houses CBI's neuroimaging faculty. Consolidating this multi-center environment along with contributors in other colleges can increase internal visibility and critical mass for program and project grants.





The Chronic Brain Injury Program

Strategic Scan

From 2014-2018, NIH awarded Ohio State approximately \$6 million to study TBI. In contrast, Ohio State is distinct in federal funding for SCI and neuroinflammation, with each representing over \$9 million from 2013-2016. Other funding agencies, such as the National Institute on Disability, Independent Living, and Rehabilitation Research (NIDILRR), have invested over \$5 million in the Ohio Regional TBI and SCI Model Systems programs since 2014. CBI's new hires have generated \$85 million in proposals and \$10 million in new grants – many from other federal (NSF, DOD) or private institutions – with a capture rate of 37%. CBI expects new individual grants to raise Ohio State's total TBI funding over the next few years, with collaborative and program grants to follow.

At the college level, several groups are focusing on areas of overlap with CBI. The College of Medicine and CBI are co-sponsoring hires in neurodegenerative disease research, with a shared goal of competing for a National Institute of Aging Alzheimer's Disease Center grant by 2022. Similar efforts are ongoing in the College of Nursing. While TBI is not formally part of the Wexner Medical Center's strategic areas, neurotrauma and neurodegeneration are prominently featured. The College of Engineering has a focus on medicine including key areas relevant to CBI: predictive analytics, sensor-based measures of disease, stem cell based regeneration, and non-invasive imaging. The College of Arts and Sciences has co-invested with CBI in functional near-infrared spectroscopy devices (fNIRS) and in expanding the CCBBI user base.

Ohio State also has a unique opportunity to innovate at the intersection of fine arts, social sciences, and medicine, by developing research and degree programs for arts-based rehabilitation. CBI is working with leaders in the Colleges of Arts and Sciences and Medicine, and the Global Arts and Humanities Discovery Theme, to enhance projects and training at the Advanced Computing Center for Art and Design, JamesCare for Life, the Wexner Center for the Arts, and the Nisonger Center. This area of growth can meet the demand for non-pharmacological and community-based interventions for brain injury and cognitive impairment.





The Chronic Brain Injury Program

Strategic Scan

Three main challenges in the internal environment include limited interaction with athletics and sports medicine groups, difficulty with research release time for clinician scientists, and minimal interaction between imaging centers on campus. The first was an initial target collaboration for CBI, which led to a focus on children and seniors instead of athletes. CBI is currently exploring options for revised clinician scientist compensation, as well as incorporating a new College of Medicine compensation plan. While imaging across campus remains a challenge, CBI has investing in technologies to increase utilization of independent groups through new shared imaging resources that will connect various users prior to accessing existing centers.

EXTERNAL ENVIRONMENT

Since 2014, there has been a slight decline in federal funding for traumatic brain injury among peer institutions, while federal funding for concepts related to brain injury (dementia, stroke, etc.) has increased slightly. Over the same period, funding for Alzheimer's and dementia research has increased. NIH is the primary funding source for traumatic brain injury, and Ohio State is not as competitive for these funds as compared to the University of Michigan (\$20 million, University of Pittsburgh (\$55 million), and University of Kentucky (\$15 million). All three of those institutions rank in the top 20 for federally-funded TBI research from 2014-2018, while Ohio State receives only 10% of Pittsburgh's total. With funds increasingly available in neurodegeneration research and through the Department of Defense, CBI may fare better by focusing on TBI in the context of neurotrauma, post-traumatic stress disorder, and blast injury.

Ohio State ranks in the top ten for Administration for Community Living (ACL) funding, primarily through the work at Ohio Valley Center. Adding depth for ACL and NIDILRR awards, including large population studies, registries, and biobanks, could maintain or enhance a competitive advantage in rehabilitation and outcomes research. Further, Ohio State may be able to compete for projects exploring data generated by these large population studies, or by expanding to research questions around independent living and workforce participation.





The Chronic Brain Injury Program

Strategic Scan

Generally, there is consensus in the public eye that concussion is a visible problem to be addressed. Academics and federal funders, along with a handful of private organizations, acknowledge this need, and Ohio State must become a more active voice in these discussions in order to raise visibility. Similarly, Ohio State must contribute to national studies such as TRACK-TBI and FITBIR in order to improve proposal success and reputation.

STRATEGIC ANALYSES

The environmental factors and strategic analyses are listed in Tables 1 and 2 in Appendix E. The resulting strategies are distilled into four overarching themes:

- * **Translation:** Engage CBI's network of researchers to enable translation of research between basic and clinical scientists and across neurotrauma and neurodegenerative diseases;
- * **Visibility:** Form a research and clinical environment conducive to active partnership with major national studies, data repositories, and program grants within academic, federal, and private sectors; and,
- * **Interdisciplinarity:** Develop distinct research projects, teams, and infrastructure to improve use of shared resources and advance novel approaches to treatment and rehabilitation in partnership with health scientists, clinicians, engineers, and fine arts faculty
- * **Impact:** Drive the implementation and commercialization of discoveries into clinical, complementary, and community-based care, through consultation with providers, industry, and brain injury survivors

Ultimately, these strategies must coalesce into transformative solutions. Fundamental science must translate into bedside interventions and disruptive products. Patients, caregivers, and professionals must have access to these solutions through insurance coverage, regional availability or by legislative mandate. To truly and sustainably transform the brain injury environment, CBI will identify policy, social work, finance, and public health experts to evaluate the feasibility, economic impact, and scalability of CBI-driven interventions.





The Chronic Brain Injury Program

Succeeding in our Mission

To realize CBI's mission, CBI has established five core goals and their respective implementation plan. The fit between strategies, goals, activities, and metrics is listed in Appendix F.

Improve characterization of brain injury through interdisciplinary research and innovation

CBI is driving insight into the mechanisms, markers, and interventions for brain injury by hiring talented, interdisciplinary faculty and enabling innovation and translation through seed grants. Individual successes must elevate into team successes, which in turn must raise the visibility and reputation of our team and institution. CBI aspires to cement Ohio State as a top ten US institution for federal funding of brain injury research, which will spur publications, presentations, and sustainable proposal capture.

UNIVERSITY PILLARS

Research and Creative Expression

Academic Health Care

TACTICS

Faculty Hiring

Funding

Seminars

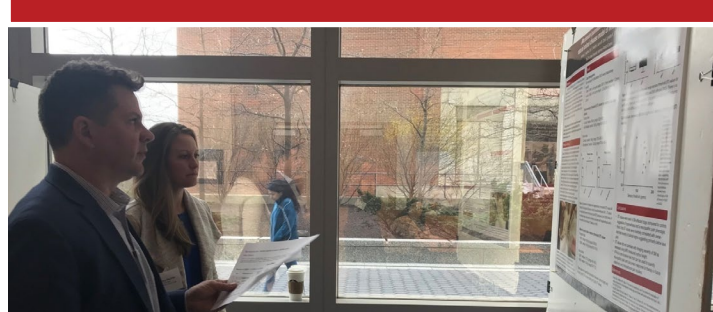
Program Grant Proposal Development

METRICS

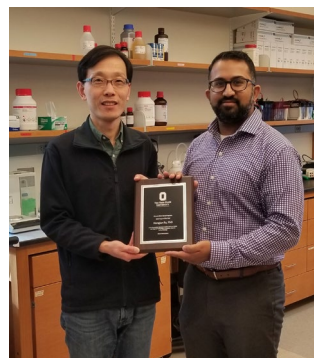
Extramural Awards

Impact Publications

Collaborative Proposal Success Rate



Ashley Hechler (Veterinary Medicine) presents her work to Jonathan Godbout (Neuroscience) during the 2019 CBI Research Day. 40 posters and 18 talks were presented by students, staff, and faculty to showcase the diversity of brain injury research.



Discovery Themes hire Harry Fu receives CBI's Paper of the Year award for his 2019 *Nature Neuroscience* paper identifying neurons vulnerable to the effects of brain injury and dementia.





The Chronic Brain Injury Program

Succeeding in our Mission

Enhance the continuum of care

for patients and caregivers through team-building and innovation

CBI is exploring non-pharmacological interventions for brain injury patients and caregivers to improve modifiable factors, home environments, and social participation. Connecting clinicians across the care continuum with basic researchers, engineers, artists, and community representatives will lead to innovations in treatment and care coordination tactics, while providing rich data and encouraging follow up care. Developing a state-wide registry for brain injury survivors will deepen connections between Ohio State and the community.

UNIVERSITY PILLARS

Research and Creative Expression

Academic Health Care

TACTICS

Clinician and Patient Town Halls

Grand Rounds

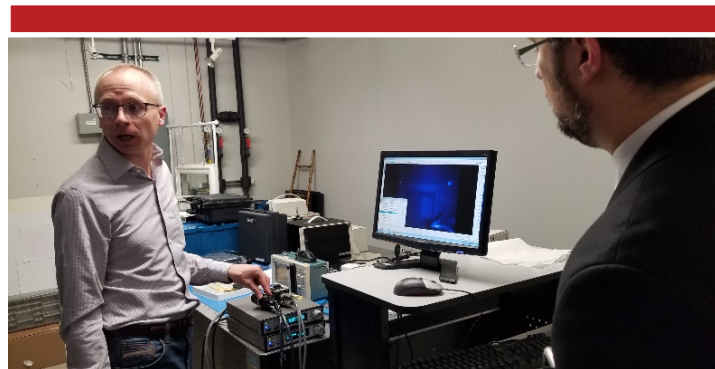
Voluntary Registry

METRICS

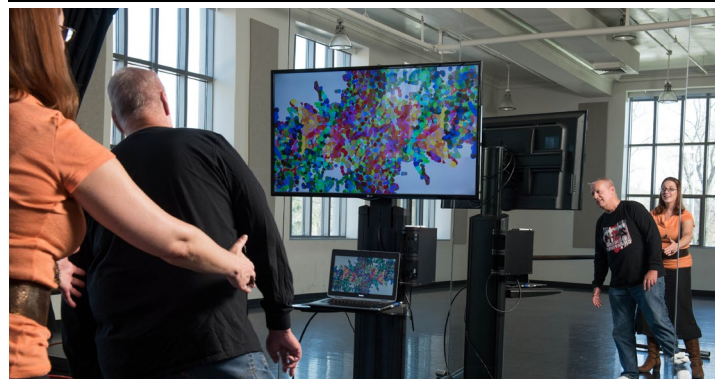
Registry Enrollees

Faculty Engagement

Intervention Studies



TJ Ronningen (Materials Science & Engineering) demonstrates an infrared light detection system to Daniel Prevedello (Neurological Surgery) during a brainstorming session to develop novel surgical tools for brain injury care.



Lise Worthen-Chaudhari (Physical Medicine & Rehabilitation) helps a patient recover movement using an interactive mix of art, and technology.





The Chronic Brain Injury Program

Succeeding in our Mission

Connect Ohio State researchers

with partner institutions to enhance expertise, visibility and impact of our scientific discoveries

Having built a strong internal network, CBI is developing collaborations with external partners such as Nationwide Children's Hospital and the Brain Injury Association of Ohio. Members of each organization are encouraged to attend and present at scientific events, and collaborate with one another through pilot or community-based grants. Next steps will focus on adding depth to existing partnerships, especially in workforce development, and building new industry partnerships.

UNIVERSITY PILLARS

Research and Creative Expression

Academic Health Care

TACTICS

Conferences

Faculty Career Development

Student Workshops

Grant Proposals

METRICS

Faculty and Trainee Engagement

Inter-institutional Research Awards



Faculty, staff and students from Ohio State and Nationwide Children's Hospital present their work at the 2019 Ohio TBI Summit, hosted by the Brain Injury Association of Ohio. 23 researchers presented short talks to area health professionals and members of the Ohio Brain Injury Advisory Council, along with brain injury survivors and their families.





The Chronic Brain Injury Program

Succeeding in our Mission

Generate, integrate and utilize data

through community engagement, technology development, and investments in shared resources

CBI is investing in infrastructure to maximize the value of our research data. Increasing the number of subjects in clinical research, the access to shared datasets and biological samples, and the quality of monitoring and imaging data collection can lead to stronger grant applications, integration with national TBI studies, and new collaborative projects. Development of neurotechnologies and medical devices is key to enabling researchers and clinicians to study and treat brain injury survivors, and can enhance our ability to perform clinical trials and commercialize devices.

UNIVERSITY PILLARS

Academic Health Care

Operational Excellence

and Resource Stewardship

TACTICS

Survivor Registries

Data Repository

Neurotechnology Project Management

Expanded Cores

METRICS

Registry Enrollees

Shared Resource Utilization

Neurotechnology Research Awards



Guest lecturer Ted Huppert (U. Pittsburgh) presents his work on functional near-infrared spectroscopy (fNIRS) to Ohio State brain imaging researchers at CBI's fNIRS Seminar Series directed by Discovery Theme hire Yune Lee. These researchers are part of CBI's fNIRS core and represent several disciplines interested in portable, inexpensive neural imaging.





The Chronic Brain Injury Program

Succeeding in our Mission

Expand experiential training

opportunities for students, postdocs, and rising health professionals

CBI offers hands-on training opportunities to interdisciplinary undergraduate students through workshops, fellowships, travel awards and presentation opportunities. New federally-funded research fellowships, and certificate and degree programs in the arts will create more research and service-learning opportunities for graduate students. Connecting clinical trainees, caregivers, and professionals to brain injury concepts and best practices through continuing medical education and fellowships will bring awareness and capability to a diverse set of care providers.

UNIVERSITY PILLARS

Teaching and Learning

Access, Affordability and Excellence

TACTICS

NIH T32 Training Programs

Internal Fellowship Series

Student Workshops

Interdisciplinary Training Programs

METRICS

Fellows

Trainee Placement

Trainee Engagement



Undergraduate students Jen Schlegel (Biomedical Engineering), George Oshiotse (Neuroscience) and Muyuan Li (Communication) present their smartphone app, *119*, to judges during the 2019 Brain Health Hack co-sponsored by CBI. The app was developed over a weekend workshop and helps brain injury survivors with chronic complications including seizures avoid unnecessary medical transport by guiding passers-by on how to provide aid.





The Chronic Brain Injury Program

Sustainability

Sustained programming and investments are key to achieving CBI's goals and continuing the important work of the initiative. Past and planned investments in people, facilities, and activities are described below.

PEOPLE

To support and retain 24 new faculty at the University, CBI estimates an annual cost of \$2 million in salary support, with an additional one-time investment of \$6 million in startup funding. These figures represent the costs to The Office of Academic Affairs only, with matching funds coming from university departments and colleges. For salary, \$1.3 million has been allocated annually for CBI's full hiring plan with remaining funds planned for retention and salary increases, along with investments in staff and students. \$5.8 million in startup funds has been allocated across 24 hires, with the first 17 hires already capturing over \$10 million in extramural awards. Startup funds, along with internally-sponsored seed grants and fellowships, contribute to tuition costs for graduate students, staff salaries for postdoctoral and other staff researchers, and fees to utilize university resources.

To support the CBI program team, consisting of a faculty lead (0.25 FTE), program manager (1.0 FTE), program coordinator (1.0 FTE), and technical staff (total 1.0 FTE), approximately \$2 million for salary and benefits is required over the next five-year period.

FACILITIES

CBI is actively negotiating co-location of the CBI program, neurotrauma and neurodegeneration researchers, and engineering faculty. Additional space dedicated to an fNIRS imaging core may focus on co-location with the CBI program or with CCBBI resources. CBI is developing the infrastructure to host a large biobank and data repository through a service agreement with the Comprehensive Cancer Center human tissue facility. These facilities will need a mixture of CBI program support, re-investment of research indirect funds, and re-investment of revenue generated by the imaging and biobank services.





The Chronic Brain Injury Program

Sustainability

PROGRAMS

Program support, including seed grant funding, targeted investments, networking activities, conference and seminar support, equipment support, student workshops, and other program activities is expected to cost \$1.75 million over five years. The majority of this investment will contribute to seed grant, fellowships, and infrastructure expansion. A summary of current activities is listed in Appendix D.

SUSTAINABILITY

To continue program activities beyond the initial five year investment, CBI proposes to obtain new investments into its operations budget via five pathways:

- * Fundraising with individuals and organizations to develop an endowment for scholarly and training activities
- * Revenue via new cost centers and grants administration
- * Extramural grants for research support, training programs, and outreach activities
- * Maintaining and expanding state legislative support for TBI research
- * Continued program support from Office of Research, with new investment from Colleges

CHALLENGES

In advancing CBI's programmatic activities, some challenges will need to be addressed in order to ensure the success of this initiative. These challenges include:

- * Need for increased visibility, communication, and understanding of Discovery Themes and CBI by Ohio State researchers and leaders
- * Limited fundraising support for interdisciplinary programming
- * Lack of physical space to convene multidisciplinary research teams
- * Uncertain priorities in partnering Colleges and institutes





The Chronic Brain Injury Program

Appendix A: Pilot Projects

Lead Investigator	Project Title
Adeli	Computer Aided Prediction Of Sensory Correlates Of Motor Recovery Following Constraint Induced Movement Therapy In Chronic Stroke
Agarwal	Ultrastructural Characterization Of Iron In AD
Bockbrader	Noninvasive Brain Stimulation For Chronic Symptoms Of Acquired Brain Injury
Bockbrader	Impact Of Virtual Reality On Adherence To Mindfulness Practices: A Proof-of Concept Randomized Controlled Trial
Bruno	Anti-Nitrative Neuroprotective Activity of Γ -tocopherol In Ischemic Stroke
Gallego-Perez	Pro-angiogenic Cell Therapies For Stroke Recovery: Nanoengineering Blood Vessels Through Direct Reprogramming
Godbout	The Elimination Of Microglia By A CSF-1R Antagonist To Prevent Or Reverse Tbi-induced Chronic Inflammation Associated With Microglia Priming And Reactivity
Guo	A Biological Neuroprosthesis For Restoring Cognitive Function In Learning And Memory
Hannawi	Automated Segmentation Of MRI Features Of Cerebral Small Vessel Disease In Patients With Acute Ischemic Stroke
Hartwick	Pupil Responses To Red And Blue Light In Adolescent Hockey Players Measured Before, During And After One Year Of League Play With Body Checking
Kiourti	Neurocognitive Versus Neuromuscular Deficits Following Mild Traumatic Brain Injury
Kiourti	Batteryless Impedance Matching For Wireless Brain Implants
Kirby	Quantifying The Hippocampal Neural Stem Cell Transcriptome After TBI
Kokiko	Chronic Post-injury Sleep Disruption (SD) As A Catalyst For Neurodegenerative Disease
Lee	Investigating Compensatory Language Processes Prompted By Rhythm Video Game Therapy In Chronic Aphasia
Lin	Small Molecule Activators Of Glutamate Transporter EAAT2 For Alzheimer's Disease
Nimjee	The Effect Of KATP Channel Manipulation On Neuroprotection After Stroke
Nimjee	Translation Of VWF Aptamer Into Large Animal Stroke Model
Obrietan	Mechanisms Underlying Hippocampal Cell Layer-specific Sensitivity To Ischemic Stroke
Reilly	Retinal Changes In Traumatic Optic Neuropathy
Rink	Characterization Of Collateral Remodeling In The Stroke-affected Brain
Tarawneh	Cerebrospinal Fluid Markers Of Synaptic Injury And Functional Connectivity In Alzheimer's Disease
Weil	Mitochondrial Dysfunction Mediated By Insulin Resistance In Repeated Traumatic Brain Injury
Worthen-Chaudhari	Novel Interventions For Mild Traumatic Brain Injury
Wright	Brain Functional Connectivity And Self-management In African Americans With Alzheimer's Disease And Related Dementia Disorders And Hypertension
Yang	Driving Performance After Concussion In Teens
Ziouzenkova	Neuroprotective Role Of A Novel Antioxidant Nanoscaffold In Alzheimer's Disease





The Chronic Brain Injury Program

Appendix B: Hires



Jan Schwab
Neurology



Zeynep Saygin
Psychology



Vibhor Krishna
Neurological Surgery



Liz Kirby
Psychology



Kathy Wright
Nursing



Jasmeet Hayes
Psychology



Emre Ertin
Electrical & Computer
Engineering



Andrea Tedeschi
Neuroscience



Asimina Kiourti
Electrical & Computer
Engineering



Ruth Barrientos
Psychiatry



Scott Hayes
Psychology



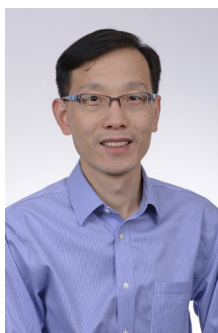
Kiryung Lee
Electrical & Computer
Engineering



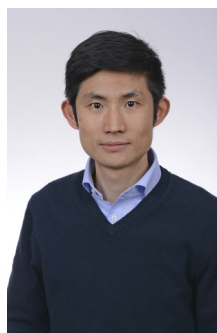
Yune Lee
Speech & Hearing
Sciences



Olga Kokiko-Cochran
Neuroscience



Hongjun Fu
Neuroscience



Jie Gao
Neuroscience



Jeffrey Wing
Epidemiology





The Chronic Brain Injury Program

Appendix C: Campus Partners

Partner	CBI Faculty
College of Medicine	
Center for Brain Health & Performance	Corrigan, Bockbrader, Bogner, Krishna, Schwab, Weil, Zhang
Center for Brain & Spinal Cord Repair	Godbout, Weil, Popovich, McTigue, Schwab, Krishna, Tedeschi, Kiourti, Kirby, Kokiko-Cochran, Y Lee, Saygin, Wright, JP Hayes, S Hayes, Ertin, K Lee, Fu, Gao, Barrientos
Institute for Behavioral Medicine Research	Godbout, Sheridan, Popovich, Weil, Barrientos
Ohio Valley Center for Brain Injury Prevention and Rehabilitation	Bogner, Corrigan
Center for Neuromodulation	Krishna, Bogner, Bockbrader, Corrigan, Guo, Mysiw, Scharre, Weil
Center for Physical Medicine & Rehabilitation	Bavishi, Bockbrader, Corrigan, Mysiw, Worthen-Chaudhari
Center for Movement Disorders	Krishna
Wright Center of Innovation in Biomedical Imaging	Knopp
Comprehensive Stroke Center	Hannawi, Nimjee
Center for Regenerative Medicine and Cell-Based Therapies	McDaniel, Otero, Popovich, Rink, Sheridan, Winter
College of Arts & Sciences	
Advanced Computing Center for Art & Design	Bockbrader, Prakash, Crawfis,
Center for Cognitive & Brain Sciences	Adeli, Agarwal, Balas, Bockbrader, Hannawi, S Hayes, Y Lee, McKoon, Page, Prakash, Ratcliffe, Scharre
Center for Cognitive & Behavioral Brain Imaging	JP Hayes, S Hayes, Kloos, Larsen, Y Lee, Lu, Martinez, Page, Prakash, Saygin
Mathematical Biosciences Institute	Best, Calder
College of Engineering	
ElectroScience Laboratory	Johnson, Kiourti
Institute for Materials Research	Agarwal, Gallego-Perez, Guo, Hansford, Johnson, Lannutti, LJ Lee, Subramaniam, Winter, Zhang
College of Nursing	
Center on Healthy Aging, Self-Management and Complex Care	Balas, McDaniel, Mion, Monroe, Tate, Wright
Discovery Themes	
Translational Data Analytics Institute	Calder, Ertin, Hardy, K Lee, Lu
Global Arts & Humanities	Costa-Giomi, Hawkins, Y Lee





The Chronic Brain Injury Program

Appendix D: Program Summary

Research Strategy



Translational Neurotrauma

- How and why does neurotrauma lead to neurodegenerative diseases like Alzheimer's disease and Parkinsonism?
- Why are developing minds at greater risk for long-term consequences of brain injury?
- How do brain injuries and treatment options increase risk for alcohol and opioid addiction?



Treatment and Prevention

- How do we create a successful, feasible comprehensive plan of care for brain injury?
- Which non-pharmacological interventions can holistically rehabilitate survivors and their families?
- How can we better understand, leverage, and pay for arts-based interventions?



Neuroengineering and Data Analytics

- How can we better detect injury status through imaging, sensing, and mobile health technologies?
- What surgical tools and non-invasive techniques will improve outcomes in acute and chronic care?
- What computational methods will better predict chronic brain injury?

Program Activities

Investing in Research: Seed grants, travel awards, equipment and services support, and funding notifications to interdisciplinary researchers and trainees

Building Teams: Events, programs and staff to help faculty connect to resources, partners and research opportunities

Developing Faculty: Faculty training opportunities that improve management and marketing of research activities

Investing in Students: CBI offers summer research fellowships for undergraduates working in CBI faculty labs, and is developing new programs for graduate students, postdocs, medical students and professionals

Training by Doing: CBI hosts project workshops and arranges internships with community & industry partners, including volunteering and shadowing opportunities

Navigating our Resources: CBI staff help private and community organizations to access Ohio State's talent, resources, and facilities, and to develop new partnership opportunities

Investing in Community Projects: CBI supports partnered research projects between Ohio State faculty and community organizations through the University's Connect & Collaborate program

Reaching Patients & Families: CBI works with community groups to sponsor research and patient education events including an annual TBI Summit





The Chronic Brain Injury Program

Appendix E

	Helpful	Harmful
	<i>Strengths</i>	<i>Weaknesses</i>
Internal	1 Neurological Institute integrates College of Medicine departments and centers along with large patient population	1 Fragmentation between teams and resources
	2 Strong spinal cord injury and neuroinflammation teams	2 Revenue-generation priority for academic clinicians limits research, recruitment and retention
	3 Extensive history of brain injury research through TBI Model Systems	3 Relatively low funding for brain injury research compared to peer institutions and national leaders
	4 University commitment to invest in neurodegenerative disease research	4 Minimal interaction between imaging centers in Colleges of Medicine and Arts and Sciences
	5 Commitment to collaboration between Colleges of Engineering and Medicine	5 Neurotechnology development lacks coordination and is discouraged by existing commercialization agreement
	6 Highly-ranked arts programs with interest in health applications	6 Limited systemic support for arts-based therapies
	<i>Opportunities</i>	<i>Threats</i>
External	1 Increased funding for neurodegenerative disease at National Institute of Aging, which needs populations unique to Ohio for national dementia studies	1 High competition for funding in neurotrauma and neurodegeneration among Midwest peer institutions
	2 High demand and public pressure for brain injury and concussion solutions for children, athletes, and military populations	2 Limited interest to collaborate from OSU Athletics and Columbus Veteran's Administration hospital
	3 Increasing funding for and awareness of holistic therapies and programs, demand for knowledge of economic and social impact of arts-based therapies	3 Increasing local competition for brain injury rehabilitation services and research subjects

Table 1: SWOT analysis of internal and external environment.





The Chronic Brain Injury Program

Appendix E

Strengths & Opportunities	Strengths & Threats
<p>Connect successful neurotrauma and neuroinflammation teams to new themes in neurodegeneration and cognitive impairment for new funding opportunities</p> <p>Strengthen connection to Nationwide Children's Hospital researchers to jointly engage in research and training for brain injury</p> <p>Jointly develop rehabilitation research and services that include humanities and arts programs</p>	<p>Invest in innovation through seed grants, investigator-initiated clinical trials, and proposal development to capture individual and collaborative grants</p> <p>Develop neuroimaging shared resources that connect users across separate imaging centers</p> <p>Invest in data repositories and biobanks that contribute to national studies and databases superior to those at peer institutions</p>
Weaknesses & Opportunities	Weaknesses and Threats
<p>Raise visibility internally and externally through investment in data repositories and biobanks that contribute to national studies and databases</p> <p>Connect successful neurotrauma and neuroinflammation teams to new themes in neurodegeneration and cognitive impairment for new funding opportunities</p>	<p>Identify and fund clinical care and research themes unique to Ohio State at the intersection of neurotrauma, neuroinflammation and neurodegenerative disease</p> <p>Narrow neuroengineering portfolio to basic science and pilot data to avoid interaction with Neurotechnology Innovations Translator while exploring partnerships with local industry</p>

Table 2: Proposed strategies for program success.





The Chronic Brain Injury Program

Appendix F

		STRATEGIES			
		Translation	Visibility	Interdisciplinarity	Impact
GOALS	Characterize	Hiring Pilot Award Program	ADRC Grant TBI/SCI Model Systems TBI Project Grants	Hiring Pilot Award Program	TBI/SCI Model Systems
		Metrics: Collaborative Proposal Success Rate Extramural Awards Impact Publications			
	Care	TBI Grand Rounds	Clinical Trials Ohio TBI Summit TBI Registry	Neurotechnology Projects Connect & Collaborate Grants	Connect & Collaborate Grants Clinical Trials
		Metrics: Registry Enrollees Faculty Engagement Intervention Studies			
	Connect	Research Day Seminars	Faculty Speaker Training Ohio TBI Summit Travel Awards	NeuRHO	Faculty Speaker Training Ohio TBI Summit
		Metrics: Faculty and Trainee Engagement Inter-institutional Research Awards			
	Data	Data Repository	TBI Registry Data Repository	Data Repository fNIRS Core	Neurotechnology Projects TBI Registry
		Metrics: Registry Enrollees Shared Resource Utilization Neurotechnology Research Awards			
	Train	Neurotrauma T32 Undergraduate Fellowships	Faculty Speaker Training Neurotrauma T32 TBI Training Course	Brain Health Hack Clinical Arts Programs	Brain Health Hack Clinical Arts Programs TBI Training Course
		Metrics: Fellows Trainee Placement Trainee Engagement			

Table 3: Strategies, goals, projects, and metrics.

