CHRONIC BRAIN INJURY PROGRAM
Fiscal Year 2019

THE OHIO STATE UNIVERSITY
TABLE OF CONTENTS

About Us 3
Outcomes 5
Community 9
Operations 12
Future 15
Appendices 16
VISION
Ohio State will be a global leader in the prevention, characterization, detection, and treatment of brain injuries and neurodegenerative disease.

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.

discovery.osu.edu/cbi
TBI: The Invisible Epidemic

The Centers for Disease Control reports that in the United States, traumatic brain injury (TBI) and related long-term challenges cost $77 billion in direct care, rehabilitation, and lost productivity.

In the US, a TBI occurs every 15 seconds, more frequently than stroke, breast cancer, and heart attacks.

In Ohio, 1 in 5 adults is a brain injury survivor. Care and consequences of TBI cost the state over $4 billion each year.

As part of a successful response to this invisible epidemic, we need to address the overt and unseen effects that limit living an independent, productive, and healthy life.

OUR GOALS

Develop and inform a comprehensive plan of care for brain injury survivors and caregivers

Translate an improved understanding of brain injury into new interventions and technologies

Enhance our ability to produce, use, and access clinical research data

Expand experiential training for professionals and students

Create a community of researchers, clinicians, and survivors across the university and its partners
METRICS OF SUCCESS

* Publication and funding data represents core faculty only

OUTCOMES

Chronic Brain Injury Program | Annual Report | FY 2019
RESEARCH IMPACT

Transforming Brain Injury Research at Ohio State

Ohio State’s strengths in neuroimmunology, spinal cord injury, and engineering complement its unique position as a large, diverse, and community-oriented research institution. Since 2014, CBI has built on this foundation by creating connections that produce a portfolio of impactful projects.

Our Key Research Areas

- **Translational Neurotrauma**: We are discovering the mechanisms and signs of brain injury’s chronic effects, including the relationships to development and degeneration.
- **Treatment & Prevention**: We are informing a comprehensive, connected recovery plan through medication, healthy aging, nutrition, mindfulness, and the arts.
- **Engineering & Data Analytics**: We are developing technologies and datasets that better detect injury, evaluate interventions, and predict recovery, all in a smarter plan of care.

Ohio State Brain Injury Research NIH Funding & Projects by Fiscal Year

<table>
<thead>
<tr>
<th>Year</th>
<th>Projects (n)</th>
<th>Total Funding ($)</th>
</tr>
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<tbody>
<tr>
<td>2008</td>
<td>2</td>
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<tr>
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<td>25</td>
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</tr>
<tr>
<td>2019</td>
<td>30</td>
<td>$25,000,000</td>
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CBI Activities Commence
Seeding Interdisciplinary Innovation | The CBI Pilot Award Program

CBI's signature program invests in teams of scientists that bridge colleges and institutions. Each team is granted $25,000 to realize ambitious ideas and to advance projects to the next level. In 3 years, CBI has created 32 new teams of investigators, who have brought in over $6.8 million in new awards to the university – a 7.6X return on investment.

**RESEARCH IMPACT**

<table>
<thead>
<tr>
<th>2019 Pilot Award Projects</th>
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<tbody>
<tr>
<td>Effects of adolescent traumatic brain injury on the maturation of executive functions and modulation by social stress</td>
<td>Coutellier &amp; Godbout&lt;br&gt;Arts &amp; Sciences, Medicine</td>
</tr>
<tr>
<td>Long-term Neurobiological Outcomes Among OSU Student Athletes with Concussion</td>
<td>JP Hayes, Corrigan &amp; Wolfe&lt;br&gt;Arts &amp; Sciences, Medicine, Nationwide Children's Hospital</td>
</tr>
<tr>
<td>Reproductive Experience and Traumatic Brain Injury in Females</td>
<td>Leuner &amp; Kokiko-Cochran&lt;br&gt;Arts &amp; Sciences, Medicine</td>
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<tr>
<td>DTRI-03 Dosing in Canine Middle Cerebral Artery Occlusion</td>
<td>Nimjee, Rink, Hamlin &amp; Lu&lt;br&gt;Medicine, Veterinary Medicine, Arts &amp; Sciences</td>
</tr>
<tr>
<td>Trajectory of Salivary miRNA Expressions in Children with Concussion</td>
<td>Yang, Lu, Mardis &amp; MacDonald&lt;br&gt;Nationwide Children's Hospital, Arts &amp; Sciences</td>
</tr>
<tr>
<td>Propagation of pathological tau strains from Alzheimer's disease and traumatic brain injury in cerebral organoids</td>
<td>Fu, Scharre &amp; Hester&lt;br&gt;Medicine, Nationwide Children's Hospital</td>
</tr>
<tr>
<td>Synaptrode: A Synaptomimetic Neural Interface with Programmable Plasticity</td>
<td>Guo &amp; Zhou&lt;br&gt;Engineering, Medicine</td>
</tr>
<tr>
<td>Early life traumatic injury: sex differences, immune cells, and neurobehavioral outcomes across the lifespan</td>
<td>Lenz &amp; Kokiko-Cochran&lt;br&gt;Arts &amp; Sciences, Medicine</td>
</tr>
<tr>
<td>Infrared Hyperspectral Imaging for In Vivo Detection of Neuromarkers of Cerebral Ischemia</td>
<td>Ronningen, Wolfe, Prevedello &amp; S. Krishna&lt;br&gt;Engineering, Nationwide Children's Hospital, Medicine</td>
</tr>
<tr>
<td>Effectiveness of a psychological intervention for children with post-concussion syndrome</td>
<td>Rose, McNally, Saygin &amp; Yang&lt;br&gt;Nationwide Children's Hospital, Arts &amp; Sciences</td>
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</tbody>
</table>

**Outcomes**

- $876K INVESTED BY CBI
- $1.1M MATCHED FUNDS
- $6.8M RESULTING EXTRAMURAL AWARDS
- 64 DISTINCT FACULTY AWARDED
- 38 PUBLISHED PAPERS
- 7.6X RETURN ON INVESTMENT

https://discovery.osu.edu/chronic-brain-injury/funding-opportunities
ReSEARCH Impact

Building Research Successes & Resources

Research Highlights

Olga Kokiko-Cochran and Hongjun Fu were awarded DOD New Investigator Research Awards. They will explore the connections between TBI and Alzheimer’s disease from the perspectives of sleep, inflammation, and genetics.

Kiryung Lee and Zeynep Saygin presented their neuroimaging innovations at the Minisymposium on Quantitative Neuroscience, curated by CBI and Ohio State’s Mathematical Biosciences Institute, which convened 60 faculty and staff to elevate computational biology projects.

Jennifer Lundine and colleagues received CDC funding to evaluate return-to-school programming for K-12 students with TBI, which may provide a foundation to improve Ohio’s often variable transition services.

Asimina Kiourti won an NSF EAGER grant to continue her CBI pilot work on wearable monitors to evaluate biomechanical deficits following concussion.

New Resources

Ohio State’s Neurosciences Core provides basic scientists with imaging and animal modeling services. CBI partnered with behavioral researchers to acquire the Closed Head Impact Model of Engineered Rotational Acceleration (CHIMERA), which provides a non-invasive and much more translatable method of modeling mild brain injury in rodents.

CBI, Yune Lee, the College of Arts & Sciences, and the Neuroscience Research Institute collectively acquired the best-in-class Shimadzu LABNIRS functional near-infrared spectroscopy system. Housed in Pressey Hall, this device replicates fMRI techniques during seated and standing tasks, helping to evaluate interventions in contextualized settings while also including those unable to undergo MRI.

Vibhor Krishna and the Wexner Medical Center expanded focused ultrasound modalities to make Ohio State one of five US sites with both types of these minimally-invasive neurosurgery systems. Focused ultrasound uses sound waves to destroy harmful tissue and improve medication delivery into deeper brain structures.

https://discovery.osu.edu/chronic-brain-injury/projects-highlights
COMMUNITY

EDUCATION

Developing the Next Generation of Researchers

SEMINARS AND CONFERENCES
CBI and the Center for Brain & Spinal Cord Repair jointly launched the Neurotrauma Research in Progress Seminars (NT-RIPS), which brings together faculty, staff, and students to discuss on-going projects in bi-weekly meetings. CBI also launched its inaugural Research Day, hosting a full day symposium with 18 faculty and student speakers, and 40 student poster presentations. NT-RIPS and Research Day are key to creating a connected, engaged research community.

BRAIN HEALTH HACK
CBI co-created this interdisciplinary workshop in 2018, bringing together undergraduate students from computer science, electrical engineering, and neuroscience to develop smartphone and virtual reality tools for brain injury research and recovery in a weekend sprint. 2019 competitors 119 and iTBI created proof-of-concept tools to avoid unnecessary medical transport for disabled individuals, and help parents better use discharge paperwork while their children recover from injury, respectively. Most importantly, these projects have since continued, with iTBI developing next steps with researchers at Nationwide Children’s Hospital, and 119 receiving several high-profile development grants.

NEUROIMMUNOLOGY FELLOWSHIPS
Jonathan Godbout and Phillip Popovich were awarded an NIH T32 Training Grant to provide sponsored graduate and postdoctoral research fellowships in neuroimmunology, including key areas such as neurotrauma and aging.

UNDERGRADUATE RESEARCH
CBI launched the Summer Undergraduate Research Fellowship (SURF) program to enable young researchers to complete summer projects with our affiliates. These fellowships create an additional training component to funded research projects.

Understanding macrophage activation to promote regeneration of cortical neuronal networks in vitro
Fellow: Sebastian Bejanaro | Neuroscience
Mentor: Liang Guo, PhD | Elec. & Comp. Engineering | NSF Career Award

Pathways of ER stress associated with tau pathology
Fellow: Praneethkumar Madhu | Neuroscience
Mentor: Hongjun Fu, PhD | Neuroscience | NIH / NIA K01 Award

Neural signatures of rhythm similarity: How edit-distance and rhythm primacy affect neural processing
Fellow: Matthew Moritz | Neuroscience
Mentor: Yune Lee, PhD | Speech & Hearing Sciences | CCBBI Pilot Award
COMMUNITY

OUTREACH

Implementing the Land-Grant Mission

CONNECT & COLLABORATE GRANTS
CBI partnered with the Office of Outreach & Engagement to fund three community-based research projects. These targeted investments offer new opportunities to increase awareness of brain injury on and off campus, and establish partnerships with local and Ohio groups.

Improving the Quality of Life of Chronically Ill Individuals Through Financial Coaching | Cazilia Loibl | Family & Consumer Sciences
Partners: Brain Injury Association of Ohio, Ohio Valley Center for Brain Injury Prevention & Rehabilitation

A Virtual Reality Intervention to Improve Youth Concussion Recognition and Reporting | Ginger Yang | Epidemiology
Partners: Mid-Ohio Select Soccer League, Buckeye Premier Youth Soccer League, COSI

A Novel Parkinson’s Disease Therapy Program for Columbus Community | Yune Lee | Speech & Hearing Sciences
Partners: Columbus Department of Recreation & Parks, Thompson Community Center

OHIO TBI SUMMIT
The Brain Injury Association of Ohio (BIAOH) is the largest advocacy and support organization for TBI survivors, caregivers, and health professionals across Ohio. CBI and BIAOH partnered to expand research presentations at the Ohio TBI Summit, a state-wide conference that convenes professionals and community members to share resources and best practices for recovery.

CBI hosted a lightning talks and poster session featuring 18 faculty and student talks and 22 posters. Brain injury advocates were excited to access our researchers to help promote an expansion of funding and accommodations for brain injury survivors and community programs.
Creating a Collaborative Community

NEURODEVELOPMENTAL RESEARCH
CBI worked with faculty and leaders at Nationwide Children’s Hospital (NCH) to develop a new Research Affinity Group (RAG) around brain injury and neurodevelopment. Pediatric TBI is woefully understudied, but researchers at Ohio State and NCH can collaborate to address this important gap. Ten Ohio State-based CBI faculty affiliates will join almost 50 NCH researchers to pursue new projects relevant to one of the largest at-risk populations for brain injury.

SPECIAL POPULATIONS
CBI is developing new partnerships to address other at-risk populations. Ongoing discussions with the Veterans Affairs Central Ohio Healthcare System and Ohio Domestic Violence Network will bring new opportunities to engage in clinical research with military veterans and victims of domestic violence.

PARTNERS

CAMPUS PARTNERS
College of Arts & Sciences
Institute for Behavioral Medicine Research
Center for Brain & Spinal Cord Repair
Center for Brain Health & Performance
Center for Cognitive & Behavioral Brain Imaging
College of Engineering
College of Medicine
Neuroscience Research Institute
College of Nursing
Ohio Valley Center for Brain Injury Prevention & Rehabilitation
Community
Partners Campus Partners
https://discovery.osu.edu/chronic-brain-injury/resources
PROGRAM ACTIVITIES

Investing in Research
The primary activities of CBI relate to **funding projects and students**, via seed grants, travel awards, equipment and services support, and fellowships. Offered annually, these activities drive engagement and ambitious research.

Building Teams
Events, project development roundtables, and informal retreats **help faculty connect to resources, partners and research opportunities**. CBI staff identify funding opportunities and community needs that align with college priorities, and recruit faculty to propose solutions and develop proposals.

Experiential Training
Faculty and student training opportunities build new skills at every level, and enhance the visibility of our work. These efforts extend to **educating survivors, caregivers, and clinical professionals** at and outside Ohio State.

Navigating our Resources
CBI staff help our researchers and external organizations to **access Ohio State's talent, resources, and facilities**. Often, this involves developing relationships, compiling resource libraries, and communicating opportunities.
CBI receives an annual budget from the Office of Research to support our programming. Three-quarters of the annual budget is dedicated to program staff and seed grants, with the remainder focused on essential functions and resource stewardship. Cost-sharing from partnered resource investments and matching pilot funds help to extend our activities even further.

In FY2019, nearly half of CBI’s expenditures went directly to support faculty research projects, primarily through the seed grant program. In the future, additional operational investments will be made to improve marketing, communications, and partnership development.
FUTURE

LOOKING FORWARD TO 2020

NEW PROJECTS & INVESTMENTS

TRANSLATIONAL RESEARCH INFRASTRUCTURE
CBI is developing a statewide voluntary registry and a TBI biobank in alignment with Arts & Sciences and Wexner Medical Center priorities, which will provide better access for researchers to patients and improve data sharing.

CLINICAL GRAND ROUNDS
We plan to partner with clinical departments to support “grand rounds” presentations that offer a venue in which clinical experts discuss their needs and challenges with basic scientists.

TRANSLATIONAL PILOTS
We expect to help support one “biomarker” or “intervention” pilot study per year in partnership with the College of Medicine and/or Nationwide Children’s Hospital.

COMMUNITY OUTREACH
We are planning a community outreach program, NeuroNights, to engage with TBI survivors and better understand their needs, which launches in Spring 2020. Funds for this program will be raised by the Buckeyes Raising Awareness in Neuroscience (BRAIN) student group during the Annual Brain Injury Awareness 5K & 1 Mile Walk on March 18, 2020.

PROFESSIONAL EDUCATION
Aiming further out to 2021, CBI will be developing education programs to better address limited training in brain injury topics, particularly in the existing and incoming medical and health professions.

CHALLENGES TO ADDRESS

PHYSICAL SPACE
We have unique and innovative ways for our groups to engage, interact and collaborate. However, connected research labs and office space that houses interdisciplinary CBI working groups is ideal. We are working with university leadership to identify shared spaces to become a more physical – rather than virtual – institute.

SUSTAINABILITY
To promote sustainability, CBI will revise pilot award requirements to recoup indirect funds from resulting extramural awards. This will help continue reinvestment in faculty research, training fellowship, and other activities that drive shared success.

FUNDRAISING
CBI will address fundraising limitations by establishing formal alignment with key Colleges and working with leadership to identify direct development support. In 2019, CBI leadership presented at “intersections” to get our message out to university development officers, and these efforts will continue into the coming years.

MARKETING & COMMUNICATIONS
CBI will recruit and invest in students to help develop, plan, and maintain our projects and operations. CBI will hire a part-time communications assistant to improve the website, launch and coordinate our social media presence, and contribute to internal and external reporting of our accomplishments.
APPENDIX A: CORE FACULTY

Ruth Barrientos, PhD
Psychiatry
Medicine

Michelle Basso, PhD
Health & Rehab Sciences
Medicine

Sheital Bavishi, MD
Physical Medicine & Rehabilitation
Medicine

Cynthia Beaulieu, PhD
Physical Medicine & Rehabilitation
Medicine

Marcia Bockbrader, MD, PhD
Physical Medicine & Rehabilitation
Medicine

Jennifer Bogner, PhD
Physical Medicine & Rehabilitation
Medicine

John Buford, PT, PhD
Physical Therapy
Biomedical Engineering
Medicine & Engineering

Jaclyn Caccese, PhD
Physical Therapy
Medicine

John Corrigan, PhD
Physical Medicine & Rehabilitation
Medicine

Daniel Eiferman, MD, PhD
Surgery
Medicine

Emre Ertin, PhD
Electrical & Computer Engineering

Jill Heathcock, MPT, PhD
Health & Rehab Sciences
Medicine

Kristin Hoskinson, PhD
PEDIATRICS
NATIONWIDE CHILDREN'S HOSPITAL

Kari Hoyt, PhD
Pharmaceuticals & Pharmacological Chemistry
Pharmacy

Asimina Kouri, PhD
Electrical & Computer Engineering

Elizabeth Kirby, PhD
Psychology
Arts & Sciences

Anne Kloos, PT, PhD
Physical Therapy
Medicine

Niki Kokiko-Cochran, PhD
Neuroscience
Medicine

Yousef Hannawi, MD
Neurology
Medicine

Andrew Hartwick, OD, PhD
Optometry

Christine Koterba, PhD
Pediatrics
NATIONWIDE CHILDREN'S HOSPITAL

Vibhor Krishna, MD
Neurological Surgery
Medicine

John Lannutti, PhD
Materials Science & Engineering
Engineering

Kiryung Lee, PhD
Electrical & Computer Engineering

Yune Lee, PhD
Speech & Hearing Science
Arts & Sciences

Jinghua Li, PhD
Materials Science & Engineering

Russell Lonser, MD
Neurological Surgery
Medicine

Jennifer Lundine, PhD
Speech & Hearing Science
Arts & Sciences

Dana McTigue, PhD
Neuroscience
Medicine

W. Jerry Mysiw, MD
Physical Medicine & Rehab Medicine

Lauren Southerland, MD
Emergency Medicine
Medicine

Rawan Tarawneh, MD
Neurology
Medicine

H. Gerry Taylor, PhD
Pediatrics
NATIONWIDE CHILDREN'S HOSPITAL

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Neuroscience
Medicine

Jeffrey Wing, PhD
Epidemiology
Public Health

Karen Rose, PhD
Nursing

Sean Rose, MD
Pediatrics
NATIONWIDE CHILDREN'S HOSPITAL

Ouliana Zlouzenkova, PhD
Human Sciences
Education & Human Ecology

CBI Hires
CBI Advisory Board
CBI Key Affiliates

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APPENDIX B: AFFILIATED FACULTY

Hojjat Adeli, PhD
Civil Engineering & Geodetic Engineering

Gunjan Agarwal, PhD
Biomedical Engineering

Michele Balas, PhD, RN
Nursing

John Bolte, PhD
Mechanical & Aerospace Engineering

Laura Boxley, PhD
Psychiatry

Jennifer Brello, MEd, CCC-SLP
Speech & Hearing Science

Vanessa Chen, PhD
Biomedical Engineering Engineering

Stacey Choi, PhD
Optometry

Kara Corps, DVM, PhD
Assistant Professor, Veterinary Biosciences
Veterinary Medicine

Eugenia Costa-Giomi, PhD
Music Education
Arts & Science

Roger Crawfis, PhD
Computer Science & Engineering

Holly Dabelko-Schoeny, PhD
Social Work

Nathan Dobie, PhD
Optometry

Frank Farhadi, MD, PhD
Neurological Surgery
Medicine

Daniel Gallego-Perez, PhD
Biomedical Engineering Engineering

Derek Hansford, PhD
Biomedical Engineering

Lyn Hardy, PhD, RN, FAAN
Nursing

Mark Hester, PhD
Pediatrics
Nationwide Children’s Hospital

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Chemistry & Biochemistry
Arts & Science

Shannon Jarrott, PhD
Social Work

Joel Johnson, PhD
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Deborah Kegelmeyer, DPT
Physical Therapy
Medicine

Michael Knopp, MD, PhD
Professor, Radiology Medicine

Sebastian Kurtek, PhD
Statistics
Arts & Sciences

Deb Larsen, PT, PhD
Health & Rehabilitation Sciences
Medicine

Kathryn Lenz, PhD
Psychology
Arts & Science

C. Glenn Lin, PhD
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Médicine

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Arts & Science

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Material Science Engineering Engineering

Jodi McDaniel, PhD
Nursing

Gail McKoon, PhD
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Arts & Science

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Medicine

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Veterinary Medicine

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Medicine

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Medicine

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Medicine

Stephen Page, PhD
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Engineering

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Optometry

Mingjun Zhang, PhD, DSc
Biomedical Engineering Engineering

Min Zhou, PhD
Neuroscience Medicine

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Acknowledgements

This report was compiled by the CBI Program Staff:
Kedar Hiremath, Julie Hannahs & Jonathan Godbout.

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College of Arts & Sciences
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College of Nursing
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Office of Research
University Marketing
Wexner Medical Center

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