Executive Summary
Concussion, or mild traumatic brain injury, has received increased focus and concern among clinicians, researchers, sporting organizations, military personnel and athletes, and is now a major public health concern facing the medical community and society at large in the United States and worldwide. Due to many factors, concussion research is in its infancy with substantial gaps in our fundamental understanding of injury prevention, pathophysiology, diagnostics, management, acute and long-term outcomes, and the financial impact for players and owners. Faculty at the University of Michigan have a strong track record in many aspects of concussion research and clinical care, but the University lacks leaders in the areas of basic injury neuroscience and interventions that will advance us to international forefront of concussion research. With support of the Bioscience Initiative, we will coalesce existing faculty and staff with new hires into a formal Concussion Center that will be self-sustaining within five years. We believe this is possible by capitalizing on over $300 million (FY 2017) in research funding allocated by the Department of Defense and National Institutes of Health, along with additional funding from various foundations and private organizations aimed at addressing these concerns.

The Concussion Center will provide infrastructure to advance concussion knowledge and health care by implementing a multi-disciplinary approach to answer fundamental questions on concussion prevention, identification, diagnosis, management, and outcomes. The Center's structure revolves around three cores with distinct, yet mutually supportive functions: 1) the Research Core functions as the foundation, supporting and integrating outstanding University of Michigan faculty to promote innovative research collaborations; 2) the Clinical Core will exist symbiotically with the Research Core by identifying clinically relevant questions, serving as an access point to patient populations for study, and translating cutting edge Research Core findings into clinical care when appropriate; 3) the Outreach Core will help fulfill the mission of the Center and the University through public engagement of the research findings among the relevant stakeholders (e.g., clinical providers, legislators, sporting organizations, etc.) and providing educational opportunities (e.g., conferences, web content). Support for the Concussion Center application from existing University of Michigan administration, faculty, and staff has been exceptional by offering strong support to this application. Among them are 23 members of the Michigan community (see Key Personnel), including 10 in the Research Core, 8 in the Clinical Core, and 5 in the Outreach Core, although some will have a roles in multiple domains (e.g., clinical and research).

While we welcome the addition of other faculty into the Center, our current research topics and team include:

- **Injury Biomechanics**: Dr's Arruda, Broglio, and Eckner have all completed various research related to the biomechanics related to head impact exposure in football and ice hockey, reducing injury risk through training and strengthening techniques and mitigating concussion risk by developing new helmet materials to lessen impact forces in football and other helmeted sports.
- **Fluid Biomarkers**: Dr Fredrick Korley will investigate fluid biomarkers related to concussion that will aid in the diagnosis, prognostics, and return to sport/school/work decision making of concussed individuals. Dr Korley conducts similar work on TRACK-TBI, the largest civilian traumatic brain injury research project in the country.
- **Neuroimaging**: Dr's Noll, Broglio, and Eckner have implement advanced imaging techniques (eg fMRI, DTI, SWLS, EEG, etc) to provide insight into the biological underpinnings of injury and differentiate clinical from biological recovery.
- **Acute Outcomes**: Dr's Eckner, Broglio, Lorincz, and Almeida have collaborated on several projects related to injury assessment, management, and natural history using clinically applicable methods. Dr Eckner has a strong record of accomplishment of sideline evaluation techniques that can be implemented at all levels of play. Dr Broglio is coPI of the NCAA-DoD CARE Consortium, the largest study to define the acute natural history of concussion, of which Dr Eckner is the University of Michigan site PI.
• **Persistent Outcomes:** Dr Steven Broglio will lead longitudinal research aimed at understanding the long-term effects of concussion and/or head impact exposure. Dr Broglio is currently coPI on the NCAA-DoD CARE Consortium, a multi-site trial with the foundation to conduct such work.

• **Sports Analytics:** Dr’s Rosentraub, Fort, and Szymanski have conducted research surrounding the influence of concussion on economic outcomes (eg player salaries) surrounding concussion.

• **Biostatistics:** Dr’s He and Goldstick have collaborated with several concussion researchers on campus to optimize findings and interpretation/implementation into the clinical setting.

In addition to the research areas noted above, we believe our research would be further strengthened with the addition of faculty in the following domains.

• **Basic Neuroscience:** A faculty hire focused on *in vitro* and/or animal models to better understand concussion pathophysiology and potentially identify pathways for intervention.

• **Interventions:** A faculty member will be hired with expertise in developing and implementing pharmacological or clinical interventions aimed at improving patient outcomes by reducing overall symptom load, recovery time, and/or mitigating long-term effects.

• **TBD:** With guidance from the Executive Committee, a third domain (e.g., genetics, pathology, or epidemiology) will be identified for a faculty position to collaborate with aspects of the multi-disciplinary research outlined above.

Keeping with the collaborative culture of the University of Michigan, the **Concussion Center** will receive guidance by an Executive Committee, chosen from a diverse number of stakeholders representing key groups across campus. Direction will evolve from key members of the Athletics Department, Exercise and Sport Science Initiative, Injury Prevention Center, and Michigan Medicine. In addition, a five member External Scientific Advisory Board will be selected to serve as a resource to the Executive Committee and advise them on research trends in this area. Composition of the Scientific Advisory Board will include representatives with domestic and international research and clinical experience in sport concussion, biostatistics and informatics, and a current or former NCAA athlete and military service member. Within the overall structure described above, primary responsibility for all day-to-day aspects of the *Center* will rest with the Director (Dr Broglio), who will oversee the operations of the Research, Clinical, and Outreach Cores. In addition, Dean Lori Ploutz-Snyder from the School of Kinesiology has provided start-up funding and indicated space availability in the renovated Kraus Building as a physical home.

Key to the success of the **Concussion Center** will be our ability to fulfill the mission of the University. We believe our record of accomplishment over the previous five years represents our capacity to do so with over $80 million in funding, published over 325 manuscripts, and delivered over 400 reviewed and invited conference presentations. In addition, Center faculty will continue to mentor and train undergraduate, graduate, and professional degree students; run journal clubs; invite preeminent speakers; and host meetings similar to our 2015 summit.

In the last 10 years, concussion has captured the public’s attention. Some sports are facing an existential crisis, concussion has become the signature injury of the two most recent military conflicts, and civilian injuries occur in a number of settings (e.g., falls, auto accidents). Researchers from the University of Michigan and our peer institutions (e.g., UCLA, North Carolina, Pittsburgh) are fervently working to address gaps in the literature, but while some schools excel in research or clinical care, none embody the scope presented here. The Bioscience Initiative offers the opportunity to grow the existing Michigan faculty in a way that will fill key gaps, create new synergies, and generate innovative findings that are otherwise unlikely to occur. The addition of strategic faculty hires will position us as domestic and international leaders on this important topic by transforming our existing collaborations and structure into one of extraordinary distinction.