



## Emerging technology snapshot

# Diagnosis of mild traumatic brain injury (mTBI)

Traumatic brain injuries (TBIs) typically occur due to an injury to the head as a result of contact and/or acceleration/ deceleration of forces acting on the brain. TBI is a common health problem among civilian, first responders, and military populations. Although frequently undiagnosed or under-reported, mild TBIs (mTBIs) are the most frequent type of TBI (70-90%) and, while typically benign, involve many symptoms and carry a risk of serious short- and long-term sequelae. Current mTBI diagnosis methods (imaging, biomarkers and neuropsychological tests) are limited.



## Enabling Science and Technology

### Biomarkers-general

Finding clinically relevant biomarkers is especially challenging for mTBI and a single protein or metabolite that would be entirely brain specific has yet to be identified. Neurofilaments (including phosphorylated heavy-chain neurofilaments) are a fast growing field of research and have the potential to be a reliable biomarker of mTBI-triggered axonal damage.

### King-Devick test/eye movements

The King-Devick Test quickly evaluates impairment of eye movements, attention and language function. The Mayo Clinic's KDt product received the 2017 VA InnoVAction Award for its TBI Recovery Acceleration Program.

### Connectomes

Connectome-based studies use images of brain structure and connectivity to diagnose mTBI. Combined with machine learning, this is an emerging field of research for military and sports-related injury.

### Diffusion Tensor Imaging (DTI)

DTI and DTI-Fractional anisotropy identify white matter damage through water diffusion patterns. The use of DTI in diagnosing mTBI is a relatively recent phenomenon.

### Early diagnosis

New approaches for early diagnosis, including imaging (mainly spectroscopy) and biomarkers (mainly related to tau proteins) are a fast growing

topic of research. Examples are artificial intelligence (AI) approaches to predict the severity of symptoms and post-concussion complications as well as point-of-care, hand-held, non-invasive and rapid diagnostic tools.

**“There has been much research in the role of structural imaging in diagnosing concussion/mTBI and persistent symptoms. However studies have yet to find a consistent pattern in structural brain changes to diagnose concussion/mTBI and further research is needed.”**

*Guideline for Concussion/Mild Traumatic Brain Injury & Persistent Symptoms. (2018). Ontario Neurotrauma Foundation.*

## Signals

### Academic



Four American universities are among the top 5 publishers in TBI diagnosis: the University of California, Harvard University, the University of Texas and the University of Pittsburgh. They are all heavily involved in imaging research.

### Collaboration



The US military is driving a strong military-academia collaboration network in TBI diagnosis. Partners include the University of California, Harvard University, Baylor College of Medicine. The University of British Columbia is one of the few Canadian collaborators.

### Corporate



The American company Banyan Biomarkers is the first company to receive FDA approval for an mTBI biomarker (March 2018). Their Brain Trauma Indicator is a blood test that detects internal brain bleeding after mTBI.

### Government



The US National Institutes of Health (NIH) is the governmental organization with the most publications in mTBI diagnosis, mainly in imaging diagnosis technologies, notably MRI, and biomarkers.

### Defence



The US military is the number one player in both the TBI and mTBI diagnosis, led by the US Defense and Veterans Brain Injury Center (DVBIC) of the US Veterans Affairs.

**“Mild TBI is one of the most common neurological conditions, with an estimated annual incidence of 500/100,000 in the United States.”**

Bazarian JJ, McClung J, Shah MN, Cheng YT, Flesher W, Kraus J. *Mild traumatic brain injury in the United States, 1998–2000. Brain Injury 2005;19 (2):85-91.*

## Impact



### Social

mTBI can lead to significant sequelae that last a lifetime, especially if undiagnosed. mTBI can affect physical functioning, cognition, sensory processing, communication and behavior, all of which can have a significant impact on a person's life and social interactions (family and workspace).



### Policy

TBI is a significant public health issue, especially for sports, military populations and youth. The US military sector has introduced evidence-based diagnostic guidelines to help mitigate the impact of mTBI. The Ontario Neurotrauma Foundation published one of the few mTBI guidelines in 2018.



### Economic

Faster, better and more accessible diagnosis of mTBI and its related symptoms will lead to better outcomes, thus reduce long-term healthcare and disability costs.



### Defence

mTBI has been labelled the signature injury of the Gulf War (1990-1991) and has been a major concern for the military healthcare community ever since.

**“[mTBI] represents one of the highest research priorities in military medicine because both clinical experience and experimental results suggest specific blast–body–brain interactions cause complex, interconnected physiological and molecular alterations that can lead to long-term neurological deficits.”**

Cernak, I. “Military-Relevant Traumatic Brain Injuries: A Pressing Research Challenge.” *Johns Hopkins Technical Digest*, 31, 4 (2013).

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### Please provide feedback

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