

Julianne P. Sees, DO, MBA, FAOAO, FAOA, FAAOS, Chanel Matney, PhD and Katherine Bowman\*, PhD

# Advancing care and research for traumatic brain injury: a roadmap

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**Abstract:** Across all segments of society in the United States, millions of adults and children experience a traumatic brain injury (TBI) each year, which may pose lifetime health and financial burdens in the billions of dollars. Efforts have been made to advance research and care with goals to improve awareness of the causes and consequences of TBI, but gaps still remain in understanding TBI and delivering high-quality care to everyone who needs it both in military and civilian life. At the request of the Department of Defense, the National Academies of Sciences, Engineering and Medicine recently convened experts to address existing gaps in brain injury science and systems of care. Although many people who experience a TBI recover fully, others experience long-term physical, emotional, and often financial consequences to the patient and family system, and require ongoing accommodations to support their return to the communities in which they live, learn, and work. A holistic approach within the context of osteopathic medicine may be helpful and enhance contributions within the field. This article will discuss the roadmap to help guide the field, including key conclusions and recommendations for actions to advance progress over the next decade while embracing a comprehensive bio-psycho-socio-ecological model of TBI care bringing in the distinctive osteopathic approach not only to improve care and outcomes, but also to understand patient and family experiences on their TBI journey.

**Keywords:** advancing TBI care; head injury; traumatic brain injury.

In the United States, almost five million people are evaluated in emergency departments for potential traumatic brain injuries (TBIs) each year [1] and roughly 224,000 TBI-related hospitalizations and 61,000 deaths are estimated to have occurred in 2017, with the highest rates among older adults [2]. TBI has also been a significant injury of recent wars, with over 450,000 service members experiencing a TBI since 2000 [3]. Many others who experience a TBI are assessed outside of hospital or military settings or may not seek any immediate care. As a result, it is difficult to estimate the full burden arising from TBI, since direct medical expenses are only one part of the total costs associated with these injuries. TBI can cause physical, emotional, and often financial disruptions to the patient and family system, with additional high costs associated with reduced quality of life, lost income, and caregiving.

Awareness of the magnitude and consequences of TBI has grown over the past decades and progress has been made in understanding how the condition affects people and families over time. Protocols for return to duty or return to play have been implemented in sports and military settings and research continues for the biological and physiological understanding of TBI and on effective care practices. However, knowledge gaps remain. At the request of the Department of Defense, the National Academies of Sciences, Engineering, and Medicine recently convened experts to assess progress and challenging in advancing TBI care and research and to develop a roadmap to help guide the field [4]. Key conclusions and recommendations from the resulting report are summarized in Table 1.

The report recommends establishing a comprehensive framework for addressing traumatic brain injury and emphasizes that TBI should be understood as a complex, heterogeneous, and evolving condition in which multiple biological, psychological, and socio-ecological factors influence a person's experience and outcomes. These factors include not only pre-injury characteristics and the nature

\*Corresponding author: Katherine Bowman, PhD, National Academies of Sciences, Engineering, and Medicine, 500 Fifth Street NW, Keck Building, Room 825, Washington, DC 20001, USA, E-mail: kbowman@nas.edu

Julianne P. Sees, DO, MBA, FAOAO, FAOA, FAAOS, National Academy of Medicine, Washington, DC, USA

Chanel Matney, PhD, National Academies of Sciences, Engineering, and Medicine, Washington, DC, USA

**Table 1:** A roadmap for achieving progress in TBI care and research [4].

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To transform TBI care into a learning health system and accelerate improvement in care will require changes in public and professional knowledge about TBI, as well as national goals, care system re-designs, resource allocation, and leadership.

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#### Conclusions

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- TBI care in the United States often fails to meet the needs of individuals, families, and communities affected by this condition.
  - High-quality care for TBI requires that it be managed as a condition with both acute and long-term phases.
  - Public and professional misunderstandings are widespread with respect to the frequency; manifestations; long-term consequences; and proper detection, treatment, and rehabilitation of TBI.
  - The United States lacks a comprehensive framework for addressing TBI.
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#### Recommendations

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1. Create and implement an updated classification system for TBI.
  2. Integrate acute and long-term person- and family-centered management of TBI.
  3. Reduce unwarranted variability and gaps in administrative and clinical care guidance to ensure high-quality care for TBI.
  4. Enhance awareness and identification of TBI by health care providers and the public.
  5. Establish and reinforce local and regional integrated care delivery systems for TBI.
  6. Integrate the TBI system of care and TBI research into a learning health care system.
  7. Improve the quality and expand the range of TBI studies and study designs.
  8. Create and promulgate a national framework and implementation plan for improving TBI care.
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TBI, traumatic brain injury.

of a person's injury, but also their ability to access optimal care across the full continuum through rehabilitation and community reintegration.

To ensure quality and continuity of care for all people with TBI and their families, the many clinical communities, care settings, research fields, patient organizations, federal agencies, and other stakeholders involved in TBI care and research need to be more effectively integrated. A "learning health care system" [5] for TBI needs to be established to coordinate care and better capture and analyze information to drive ongoing improvements. Addressing family and caregiver needs as part of the TBI system of care is a critical element as well, since many people with TBI rely on family or caregiver support and these groups report substantial burdens and stress [6].

The common TBI classification scheme of "mild, moderate, severe" [7, 8] must also be updated to reflect advances

in such areas as imaging and biomarker development and to support more informative assessment, prognostication, treatment, and research. Developing evidence-guided criteria to identify who should be referred to TBI rehabilitation and identifying and implementing best practices to guide third-party coverage of care are also urgently needed.

Many professionals will encounter people with TBI in a variety of care and community settings, and greater awareness of the risk factors, signs, and symptoms of TBI must be achieved. People with TBI and their families also need clear, anticipatory guidance on their expected symptoms and trajectory. Finally, continued investments in TBI research are necessary to continue to build the understanding of why and how factors such as comorbidities, biological sex, gender, race, ethnicity, socioeconomic status, insurance status, and geographic location interact to affect TBI recovery, and how to use that knowledge to develop and deliver more effective treatment. As one venue to foster ongoing dialogue and action across the diverse TBI stakeholder community, the National Academies has recently established a forum on traumatic brain injury [9].

The importance of an integrated bio-psycho-socio-ecological framework for understanding TBI aligns with the approach taken by the field of osteopathic medicine, which emphasizes a whole person view of well-being and focuses on caring for the person as a unit of body, mind, and spirit [10]. Osteopathic physicians place an emphasis on prevention, helping to promote the body's natural tendency toward health and self-healing, while also promoting care improvements and scientific research [10]. The osteopathic medical philosophy can thus bring a valuable approach to care and research in TBI, encompassing the person's injury and symptoms, as well as lifestyle, mental health, environmental, and other factors impacting well-being and health for the person with TBI and their community.

Doctors of Osteopathic Medicine can help to achieve the roadmap proposed in the recent National Academies' report [4]. Potential actions based on the recent report and on application of osteopathic principles include, for example:

- Ensure awareness of the signs, symptoms, and effects of TBI and of relevant clinical practice guidelines.
- Consider discussing lifetime TBI exposure with patients and families to identify those at increased risk of long-term symptoms or who may benefit from being connected with additional care system resources, services, or follow-up.
- Serve as a resource for patients and families who have experienced TBI. This may include advising on

interventions to assist in daily management of physical, cognitive, and behavioral challenges, providing information on additional TBI resources that may be available to them, or helping connect them with other types of health care professionals to support integrated care and prevent patients and families from getting lost from the system.

- Serve as a resource for patients and families who are at higher risk of experiencing a TBI, for example by discussing preventive practices such as removing household slip and fall hazards for older adults.
- Draw on the distinctive osteopathic approach to care of the person as an integrated being of body, mind, and spirit. When making a diagnosis, considering interventions, developing treatment plans, or identifying resources and referrals, integrate information about not only a patient’s medical condition but also their experiences at home, work, and in their community to understand bio-psycho-socio-ecological factors that could affect their health and well-being.
- When appropriate, apply other principles of the practice of osteopathic medicine, including osteopathic manipulation in promotion of the body’s healing processes for the musculoskeletal system.

As recent research has shown, it is more accurate to view TBI through a lens that recognizes the spectrum of physical, psychological, and social effects, which can include headache, vision impairments, seizures, sleep problems, reduced attention, depression, anxiety, and other physical, cognitive, or behavioral concerns. TBI is also frequently associated with posttraumatic stress disorder and pain, often termed the “polytrauma triad.” [11].

The past decade has seen a shift from assumption of a plateau following the acute phase of TBI to awareness that TBI recovery is a process [12], that people may experience symptoms 6–12 months after even seemingly minor injuries such as concussion [13, 14], and that many with more severe TBI experience changes in cognitive function between one and five years post-injury, with 24% reportedly improving and 24% declining [15]. Patients and families may need long-term, person-centered evaluation and follow up to address a person’s function and quality of life. Large-scale research efforts are also continuing to make progress in understanding outcomes and identifying and validating neuroimaging approaches, biomarkers, and other technologies for improving TBI treatment and prognostication [16].

Many osteopathic professionals are part of the primary care workforce and can reinforce the holistic approach to TBI care. Although not addressed by the recent report, osteopathic techniques might be relevant to diagnosis and treatment for those with pain, headache, or musculoskeletal issues following TBI, though caution would be required for cervical injury and other clinical contraindications. Further discussions of TBI care and management in the context of osteopathic medicine may be helpful to inform practitioners and enhance the contributions of the field.

Advancing systems of care and research to meet the needs of all patients and families with TBI requires the effort, investment, and collaboration of multiple stakeholders. The field of osteopathic medicine can be a partner in these efforts, with members providing medical care to patients in all 50 states and the District of Columbia, and serving as health care policy leaders at the local, state, and national levels. Bringing the distinctive approach of the osteopathic medicine community to improving TBI care will foster further research and strengthen collaborative efforts to advance a learning healthcare system for this important and complex condition.

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