Artificial Intelligence and Traumatic Brain Injury: Balancing Technological Advancement with Ethical Responsibility to Provide Equitable Care

Advaita Krishnan1 and Chinmayi Balusu2
1. Center for the Study of Human Health, Emory University; 2. Department of Epidemiology, Columbia University

- Artificial intelligence (AI) has great potential for helping traumatic brain injury (TBI) patients in hospital settings by improving diagnosis, treatment, and recovery outcomes.
- However, it is important to note that the use of AI for TBI care also introduces challenges, such as perpetuating implicit biases related to health disparities, which could lead to inadequate and inequitable care.
- Healthcare systems are increasingly using AI to predict risk rates and healthcare prognosis, that impact decision-making in clinical settings.
- Many algorithms factor in cost when making healthcare recommendations, creating ratings that favor privileged racial and social groups.
- It is crucial to understand how race and socioeconomic factors are accounted for by AI algorithms, and whether it is ameliorating bias or exacerbating it.

AI Applications for TBI Patients
- AI could streamline the comprehensive data analysis of patients’ symptoms, laboratory values, radiology reports, and clinical assessments.
- AI could provide prognosis and personalized treatment options that best fit the individual patient rather than following generalized guidelines.
- AI holds potential for standardizing treatment protocols, mitigating errors, and expediting the clinical decision-making process.
- Computer-aided image processing techniques could assess diagnostic scans (e.g., CT) of TBI-related abnormalities such as hematoma and midline shift measurements.
- This could help reduce the possibility of subjective interpretations or natural inter-personal variability and standardize interpretations to improve patient outcomes.

Overview of TBI
- Due to TBI having the highest incidence among the most common neurological disorders, it poses a significant public health concern.
- Mild TBI and severe TBI affect 55.9 million and 5.48 million individuals annually, respectively.
- TBI can result in short-term memory and cognitive issues as well as increased risk of long-term mental illness and neurodegenerative disease onset.
- TBI is considered a complex and heterogeneous medical concern due to patients experiencing unpredictable symptoms.
- Being able to precisely assess, diagnose, and treat TBI in a timely manner is essential for patients’ recovery.
- AI systems may be able to analyze large amounts of associated data to efficiently determine the severity of injury, especially personalized to individual patients’ pathology.

Ethical Considerations
- Sustained, interdisciplinary collaboration channels between healthcare providers, researchers, and technology innovators throughout the process leading up to clinical implementation is essential.
- Though relevant clinical tools are validated, AI interpretations of the data collected from these tools must be assessed for accuracy and reliability.
- In the midst of the AI revolution, ensuring confidentiality and privacy of patient data are most important, especially when electronic medical records are involved.
- Informed consent procedures need to be revised to reflect ongoing developments.
- Governance and oversight structures need to be established at hospital, institutional, as well as regional scales.

Bias and Disparities
- Remedying bias in healthcare algorithms and predictive AI models is essential, especially for vulnerable populations at increased risk for TBI outcomes.
- Institutional barriers to open-access collaboration poses challenge for validating algorithms with diverse patient populations and assessing biases in data interpretation.
- Even with access to data from diverse populations, there is a critical need to ensure AI training occurs in an equal manner (as seen by past examples of negative AI views towards BIPOC communities).
- If caution is not exercised, AI could introduce biases that act on and add onto existing healthcare disparities.

Access and Equity
- Typically, AI research is conducted at highly funded institutions in urban communities.
- Rural hospitals with limited TBI care could benefit from AI applications -- time and resources need to be invested into developing these partnerships.
- AI research could be incorporated into growing telemedicine outreach efforts to assist healthcare providers treating TBI patients in the Global South.
- Even in settings with limited diagnostic and imaging equipment, AI’s predictive analysis patterns could potentially guide providers based on reported patient symptoms and past medical history.
- Conducting longitudinal neuro-epidemiological TBI studies in resource-limited settings can provide a foundation for AI to learn from.

References

Image Credits: The Noun Project
Disclosures: None