NL Neurology Letters

Letter to Editor

https://doi.org/10.61186/nl.3.1.20

The Role of Artificial Intelligence in Depression Diagnosis, Prognosis, and Treatment: Gaps and Future Directions

Kimia Kazemzadeh[1,2*]

1- Students' Scientific Research Center, Tehran University of Medical Sciences, Tehran, Iran.
2- Network of Neurosurgery and Artificial Intelligence (NONAI), Universal Scientific Education and Research Network (USERN), Tehran, Iran.

*Corresponding author: Kimia Kazemzadeh

Email: kimia_kazemzadeh@yahoo.com

Published online 30 January 2024

Cite this article as: Kazemzadeh, K. The Role of Artificial Intelligence in Depression Diagnosis, Prognosis, and Treatment: Gaps and Future Directions. Neurology Letters, 2024; 3(1): 20-21. doi: 10.61186/nl.3.1.20.

Dear Editor,

I am writing to discuss the current state of artificial intelligence (AI) in the field of depression diagnosis, prognosis, and treatment as well as to address the gaps that exist in this area. It is well known that depression is a global public health issue, and the accurate and timely diagnosis of this mental disorder is crucial for effective treatment (1). AI has demonstrated promising potential in this domain, yet areas still require attention to fully harness its capabilities.

Firstly, one of the gaps in the utilization of AI for depression diagnosis lies in data collection. While a considerable amount of data is available, including electronic health records, social media data, and patient-reported outcomes, the lack of standardized and comprehensive data collection protocols hinders the ability to develop robust AI models. Standardization of data collection methods, such as the inclusion of standardized depression assessment scales, could enhance the reliability and comparability of AI algorithms across different settings (2). Secondly, the interpretability and transparency of AI models for depression diagnosis need to be addressed. Deep learning models, such as convolutional neural networks and recurrent neural networks, have shown remarkable performance in various applications, but their lack of interpretability hinders their clinical adoption. Clinicians need to understand how AI algorithms arrive at their diagnostic decisions to build trust and confidence in their use. Developing explainable AI models and providing clinicians with the tools to interpret their output will be crucial in ensuring successful integration into clinical practice (3). Additionally, the issue of equity and bias in AI-based depression diagnosis deserves attention. The data used to train AI models are often biased, reflecting the demographics of the population from which the data were collected. Consequently, this can lead to biased predictions and negatively impact underrepresented populations. Mitigating such biases requires diverse training data that encompasses the demographic and socio-economic diversity of the target population. Collaborations with diverse communities and active efforts to address bias in data collection and model training are essential (4). Furthermore, the real-world applicability of AI models for depression diagnosis needs to be evaluated. The majority of AI research in this field focuses on controlled settings, such as hospital data or research databases, which may not reflect the complexity and variability of real-world clinical environments. It becomes crucial to validate the performance of AI models on diverse populations and in different clinical settings to ensure their generalizability and practical utility (5).

AI-based tools can play a crucial role in enhancing the accuracy and efficiency of depression diagnosis and screening. Machine learning algorithms can analyze large datasets, including electronic health records, genetics, and social media activities, to identify patterns and predict the risk of depression. However, ensuring the privacy and ethical use of personal data is a critical concern that must be addressed in the application of AI for depression diagnosis (6, 7). One of the major advantages of AI in depression treatment lies in its ability to provide personalized interventions. AI algorithms can analyze individual patient data, such as symptoms, treatment history, and biomarkers, to develop tailored treatment plans. Virtual agents and chatbots powered by AI

can offer 24/7 support and therapy, helping individuals manage their depression. However, the integration of AI with traditional mental health services should be carefully coordinated to ensure a human-centered approach and avoid overreliance on technology (8). AI-based systems can assist in long-term monitoring of individuals with depression, providing continuous assessments of symptoms and treatment responses. By utilizing various sensors and wearable devices, AI algorithms can analyze changes in behavior, speech patterns, or physiological signals to detect early warning signs of relapse. However, ensuring the reliability and validity of these monitoring techniques and addressing the challenges of data privacy and security remain crucial for their successful implementation (9).

AI-based predictive modeling can leverage large and diverse datasets to identify patterns and risk factors associated with depression prognosis. By analyzing data sources such as electronic health records, genetic information, lifestyle factors, and social media activities, AI algorithms can generate prognostic models that aid in predicting the course of depression and identifying individuals at high risk for relapse. However, the availability of comprehensive and reliable data is crucial for the accuracy and validity of these models. AI can also leverage biometric markers, such as neuroimaging data or physiological signals, to assess the prognosis of depression. Machine learning algorithms can analyze brain activity patterns captured through functional magnetic resonance imaging (fMRI) or electroencephalogram (EEG) to identify specific biomarkers associated with depression outcomes. However, the adoption of these techniques in clinical practice requires standardized protocols, robust validation, and consideration of ethical concerns related to data collection and privacy. The integration of multiple data modalities can provide a more comprehensive understanding of depression prognosis. By combining clinical, genetic, imaging, and behavioral data, AI algorithms can develop models that capture the complexity of depression and its heterogeneity. This integration enables a more personalized approach to treatment and facilitates the identification of novel subtypes of depression. However, the interpretation and fusion of these diverse data sources present methodological challenges that need to be addressed (10, 11).

In conclusion, while AI holds great promise in revolutionizing depression diagnosis, prognosis, and treatment; addressing the existing gaps and challenges is important. Standardizing data collection, enhancing interpretability, addressing equity and bias, and evaluating real-world applicability are crucial steps forward. By focusing our efforts on these areas, we can pave the way for AI to become an indispensable tool in improving the diagnosis and treatment of depression.

Declaration

Funding

None.

Conflict of interest

The authors declare no conflicts of interest.

Ethical approval statement

Not applicable.

Acknowledgment

Not applicable.

Keywords: Artificial Intelligence, AI, Depression, Diagnosis, Prognosis, Treatment.

References

1. Marcus M, Yasamy MT, Ommeren M, Chisholm D, Saxena S. Depression: A global public health concern. World Health Organization Paper on Depression. 2012:6-8.
2. Christensen H, Griffiths KM, Farrer L. Adherence in internet interventions for anxiety and depression: systematic review. Journal of medical Internet research. 2009;11(2):e1194.
3. Holzinger A, Plass M, Holzinger K, Crisan GC, Pintea C-M, Palade V. A glass-box interactive machine learning approach for solving NP-hard problems with the human-in-the-loop. arXiv preprint arXiv:170801104. 2017.
4. Mamykina L, Heitkemper EM, Smaldone AM, Kukafka R, Cole-Lewis H, Davidson PG, et al. Structured scaffolding for reflection and problem solving in diabetes self-management: qualitative study of mobile diabetes detective. Journal of the American Medical Informatics Association. 2016;23(1):129-36.
5. Steinhubl SR, Muse ED, Topol EJ. The emerging field of mobile health. Science translational medicine. 2015;7(283):283rv3-rv3.
6. Insel TR. Digital phenotyping: technology for a new science of behavior. Jama. 2017;318(13):1215-6.
7. Chekroud AM, Zotti RJ, Shehzad Z, Gueorguieva R, Johnson MK, Trivedi MH, et al. Cross-trial prediction of treatment outcome in depression: a machine learning approach. The Lancet Psychiatry. 2016;3(3):243-50.
8. Fitzpatrick KK, Darcy A, Vierhile M. Delivering cognitive behavior therapy to young adults with symptoms of depression and anxiety using a fully automated conversational agent (Woebot): a randomized controlled trial. JMIR mental health. 2017;4(2):e7785.
9. Saeb S, Zhang M, Karr CJ, Schueller SM, Corden ME, Kording KP, et al. Mobile phone sensor correlates of depressive symptom severity in daily-life behavior: an exploratory study. Journal of medical Internet research. 2015;17(7):e4273.
10. Viviano JD, Buchanan RW, Calarco N, Gold JM, Foussias G, Bhagwat N, et al. Resting-state connectivity biomarkers of cognitive performance and social function in individuals with schizophrenia spectrum disorder and healthy control subjects. Biological Psychiatry. 2018;84(9):665-74.
11. Aghajani M, Veer IM, Van Tol M-J, Aleman A, Van Buchem MA, Veltman DJ, et al. Neuroticism and extraversion are associated with amygdala resting-state functional connectivity. Cognitive, Affective, & Behavioral Neuroscience. 2014;14:836-48.