

The Use of Artificial Intelligence to Enhance Diagnostics and Treatments for Depression

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Artificial intelligence (AI) advancements are revolutionizing a new frontier in how healthcare workers can improve screening and treating depression; however, more studies need to address ethical and application barriers. AI is a set of technologies programmed into computers that complete complex tasks. AI tends to carry a negative connotation as concerns grow over people relying on it to replace human tasks. Still, the main research goal of employing AI for depression treatment is to supplement human care and outreach, not replace it. Significant barriers to depression screening and treatment are lack of accessibility, subjectivity and burnout amongst mental healthcare workers, negative stigma, and trial-and-error approaches regarding treatment regimens. AI tools possess many advantages, including streamlining workload, being remotely accessible at a low cost to patients, and helping clinicians personalize treatment. Albeit a promising tool, both clinicians and patients are rightfully apprehensive about AI, highlighting the need for more validated data before the widespread implementation of AI tools in the clinical setting.

Early and vast screening can lead to more prompt diagnosis and treatment, which is crucial for depression. Areas characterized by low education levels, low income, and rural regions lack accessible and affordable mental health services, leading to poor depression literacy and treatment and negative stigma. This is evidenced by the fact that the Appalachian and Southern Mississippi regions tend to carry those characteristics and have the highest prevalence of depression (Lee et al., 2023). AI-powered virtual apps via smartphones can improve community outreach by making screening tools discrete, inexpensive, and accessible from home. Ellie, an AI-driven smartphone app, evaluates user data through a virtual chatbot and has been used successfully to detect early symptoms of depression and PTSD amongst war veterans (Pavlopoulos et al., 2024). Furthermore, studies have shown that patients are more forthcoming

when using a conversational assistant or survey (Mustansir et al., 2021). This candid, discrete method can be the first step in the screening process for individuals negatively influenced by social stigma and who do not feel comfortable reaching out to family, friends, or their healthcare providers. Researchers are also exploring the use of natural language processing (NLP) during patient interviews to assist clinicians in identifying obscure nuances of depression. NLP is an AI technology programmed to understand, interpret, and generate human language. NLP software, used by therapists during interviews with cancer patients, observed frequent use of first person singular pronouns, slower rate of speech, and low occurrences and duration of eye contact to be more prevalent amongst those who were later diagnosed with depression (Smirke et al., 2021). This tool can supplement clinician assessment by providing objective data that clinicians would otherwise fail to observe. Unfortunately, clinicians are susceptible to misjudging or mishandling depressed patients due to heavy caseloads, complex cases, and even compassion fatigue, ultimately leading to inadequate care planning and poor patient outcomes. Surprisingly, half of those who die by suicide make a healthcare visit within 1 month of their death (Nock et al., 2022). While it is impractical and inefficient for clinicians working in acute settings like an emergency department (ED) to conduct several thorough interviews and comb through patients' entire medical, social, and financial history to depict patients' suicide risk accurately, AI has the power to capture extensive patient data timely to complete more comprehensive assessments. A hospital in Massachusetts employed an AI suicide risk program that processed clinician assessment, electronic health records (EHRs), and patients' self-report surveys to determine how likely a patient will commit suicide after one and six months following their ED admission. The AI program predicted suicide attempts with 77% accuracy at one month and 79% accuracy at six months compared to clinician assessment alone, which revealed only 67% and 60% accuracy

(Nock et al., 2022). With further improvements, this AI program offers a way to improve patient outcomes by standardizing suicide screening and decreasing variation attributed to clinicians' subjective assessments.

AI-powered chatbots, cognitive behavioral therapy (CBT) apps, and mood-tracking apps are also in the foreground of digitally supported depression treatment. Mobile mental health apps have demonstrated that internet-based approaches are feasible and as effective as in-person treatment, prompting the World Health Organization's support of electronic and mobile health technologies in its Mental Health Action Plan for 2013-2020 (Popescu et al., 2021). AI chatbots like Woebot and Sanvello are easily accessible by anyone with a smartphone and empower individuals seeking to enhance their depression awareness and symptom management (Pavlopoulos et al., 2024). Chatbot applications gather users' symptoms and goals to offer personalized, evidence-based practices (EBPs), including coping strategies, health promotion practices, CBT strategies, and medication adherence reminders. While this is not comparable to professional help, these convenient and inexpensive applications are especially advantageous for populations who do not have access to treatment and therapy. Because mental health applications provide consistent patient data tracking between appointments, medical professionals have started endorsing them to identify specific patient needs and modify interventions based on data (Pavlopoulos et al., 2024). AI wearable devices can also track patient data and progress. BioBase and Moodmetric gather users' sleep patterns, heart rates, speech patterns, activity levels, diet, and mood throughout their day (Pavlopoulos et al., 2024). This AI technology highlights common physiological manifestations of depression to help both users and providers track triggers, behavioral patterns, and regression. Digital tools' effectiveness heavily relies on user diligence but has been shown to improve confidence in managing depression symptoms if users

routinely engage with them. Beyond self-help tools, AI advancements have generated predictive models that support clinicians in personalizing treatment. A predictive model is an AI tool that uses variables and patterns to predict outcomes. Because psychotherapeutic treatments are only effective for 30-50% of patients (Mustansir et al., 2021), there is growing interest in its potential to initiate more effective and timely treatment plans. Antidepressants are commonly used to treat depression, but it takes weeks to evaluate response, and often, patients will endure several unsuccessful trials with different medications. This delays care and may demotivate patients from pursuing further treatment. Researchers are attempting to alleviate this issue by exploring how to use physiological biomarkers and AI to predict antidepressant responses. One study used AI to evaluate brain biomarkers most associated with depression from participants' electroencephalograms and electromagnetic tomographies. Researchers then developed a predictive model that can determine patients' likeliness of response or nonresponse to their antidepressants with 88% accuracy (Jaworska et al., 2019). Similar studies aiming to predict antidepressant response have created predictive models based on magnetic resonance imaging and even genetics. The Star-d and ISPO trials have created a 69% accurate predictive model in their most recent study of pharmacogenomic biomarkers (Athreya et al., 2019). While these predictive models are not an infallible solution, they offer clinicians some insight into which antidepressant patients will likely respond to before initiating treatment. Clinicians face many challenges when prescribing the proper treatment; moreover, they are overwhelmed by cumulative caseloads, documentation, and administrative tasks that impose burnout and time restrictions on face-to-face care (Sadeh-Sharvit et al., 2023). Patient outcomes ultimately suffer as a result. The AI platform Eleos Health is attempting to lessen the burden of clinicians by “summarizing and transcribing therapy sessions, providing feedback to therapists on the use of

EBP, draft sessions' progress notes, and integrating routine, standardized questionnaires by patients" (Sadeh-Sharvit et al., 2023, p. 1). One study evaluating the effectiveness of Eleos Health elicited positive results from clinicians and patients in the AI group. Clinicians using the platform submitted progress notes 55 hours earlier than those in the regular group, and participants in the Eleos group attended 67% more sessions and experienced a reduction of depression symptoms by 34% versus 20% in the control group (Sadeh-Sharvit et al., 2023). These results demonstrate AI's ability to lessen therapists' workload while promoting therapy adherence and effectiveness. As nurses are at the forefront of implementing depression treatment, researchers are formulating ways to optimize their work while ensuring patient safety and care.

In acute psychiatric inpatient units, nurses monitor each patient every 15 to 30 minutes. While this practice maintains patient safety and gathers important behavioral data, it comes at a cost to both patients and staff. This practice interrupts patients' sleep and is often perceived as demoralizing and intrusive, impeding the rapport between nurses and patients. Decreased sleep duration and consistency also have a negative correlation with length of stays, incidences of aggression, and symptoms of psychosis, mania, and depression (Barrera et al., 2020). One possible solution that has emerged from AI technology is digitally assisted nursing observations. In one inpatient psych unit, the use of remote sensors resulted in a reduction of both insomnia scores amongst patients and incidences of verbal and physical aggression towards staff (Barrera et al, 2020). Staff reported no missed incidents during the time of this study. These results show that remote observations through AI can ensure patient safety while improving patient and staff experience. With more validating studies, this option may soon become a new practice nurses will implement in psych units. Furthermore, remote AI sensors can be developed to track heart

rate, movement, respiration, and other biomarkers to enhance treatment planning further. Nurses working on non-psych units can also utilize AI technology for depression screening and treatment. Depression has a high correlation to other comorbidities; many patients admitted for chronic illnesses like cardiovascular disease or diabetes often have depression that may affect how well they manage their illnesses (Lee et al., 2023). Addressing patients' mental health needs on non-psych units will provide more holistic care and, in turn, improve patient outcomes. Clinical Decision Support Systems (CDSS) is an AI algorithm that supplements risk assessment and treatment planning by analyzing patient data and delivering recommendations based on data, scientific evidence, and the most current guidelines (Mustansir et al., 2021). Aifred is a CDSS explicitly designed to augment major depressive disorder treatment. This application uses patients' EHRs and brief patient surveys to compile a risk score that would be viewable by nurses, who can then consult the appropriate professionals to conduct follow-ups (Popescu et al., 2021). Through AI assistance, even nurses on medical floors can be effective champions in treating depression, an essential aspect of care that is often overlooked on medical floors.

While AI developments have shown promising results, the use of AI for depression screening and treatment is still in its preliminary stages, emphasizing the need for extensive research addressing its barriers and limitations. The prevailing concerns regarding adopting AI in the clinical setting are privacy and data security. With the emergence of AI possibly handling confidential patient data, governing bodies need to revise ethical guidelines that enforce strict encryption laws on AI companies to meet Health Insurance Portability and Accountability Act (HIPAA) standards. Another notable barrier to digital AI technologies like chatbots is poor retention rates. However, integrating human feedback and in-app mood monitoring features has been shown to significantly lower dropout rates (Popescu et al, 2021). To further validate

predictive model data, studies need to include diverse participant demographics and different antidepressant classes apart from selective serotonin reuptake inhibitors. Furthermore, while some AI technologies like mobile apps are inexpensive options to complement screening and treatment, other technologies like CDSS systems are costly to integrate into larger clinical settings like a hospital.

Despite its barriers, evolving AI technology has presented innovative approaches to address the complex barriers hindering timely and effective depression screening and treatment. Easily accessible digital technologies like chatbots, wearable devices, and mental health apps enhance patient-centered care by empowering users to participate actively in their treatment plans. Furthermore, predictive models have achieved high accuracy in predicting antidepressant response, proving to be a promising tool for clinicians in prescribing the most effective antidepressant. AI programs also offer standardized methods of screening for depression and suicide that have shown positive implications on patient outcomes. Nurses on both psych and medical floors may be able to enhance patient care further through assistive AI technologies. With further research and ethical guidelines, AI technology has the potential to change and strengthen current depression screening and treatment.

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