

Artificial intelligence in mental health

Artificial intelligence in mental health refers to the application of artificial intelligence (AI), computational technologies and algorithms to support the understanding, diagnosis, and treatment of mental health disorders.^{[1][2][3]} In the context of mental health, AI is considered a component of digital healthcare, with the objective of improving accessibility and accuracy and addressing the growing prevalence of mental health concerns.^[4] Applications of AI in this field include the identification and diagnosis of mental disorders, analysis of electronic health records, development of personalized treatment plans, and analytics for suicide prevention.^{[4][5]} There is also research into, and private companies offering, AI therapists which provide talk therapies such as cognitive behavioral therapy. Despite its many potential benefits, the implementation of AI in mental healthcare presents significant challenges and ethical considerations, and its adoption remains limited as researchers and practitioners work to address existing barriers.^[4] There are notably concerns over data privacy and training data diversity.

Artificial Intelligence is a rapidly booming field with successful advancements in the field of healthcare. It worked its way into mental health starting major developments in diagnosis, prognosis and treatments. Implementing AI in mental health can eliminate the stigma and seriousness of mental health issues globally. The recent grasp on mental health issues has brought out concerning facts like depression, affecting millions of people annually. The current application of AI in mental health does not meet the demand to mitigate global mental health concerns.^[6]

Background

In 2019, 1 in every 8 people, or 970 million people around the world were living with a mental disorder, with anxiety and depressive disorders being the most common.^[7] In 2020, the number of people living with anxiety and depressive disorders rose significantly because of the COVID-19 pandemic.^[8] Additionally, the prevalence of mental health and addiction disorders exhibits a nearly equal distribution across genders, emphasizing the widespread nature of the issue.^[9]

The use of AI in mental health aims to support responsive and sustainable interventions against the global challenge posed by mental health disorders. Some issues common to the mental health industry are provider shortages, inefficient diagnoses, and ineffective treatments. The global market for AI-driven mental health applications is projected to grow significantly, with estimates suggesting an increase from US\$0.92 billion in 2023 to US\$14.89 billion by 2033. This growth indicates a growing interest in AI's ability to address critical challenges in mental healthcare provision through the development and implementation of innovative solutions.^[10]

AI-driven approaches

Several AI technologies, including machine learning (ML), natural language processing (NLP), deep learning (DL), computer vision (CV) and LLMs and generative AI are currently applied in various mental health contexts. These technologies enable early detection of mental health conditions, personalized treatment recommendations, and real-time monitoring of patient well-being.



Machine learning

Machine learning is an AI technique that enables computers to identify patterns in large datasets and make predictions based on those patterns. Unlike traditional medical research, which begins with a hypothesis, ML models analyze existing data to uncover correlations and develop predictive algorithms.^[10] ML in psychiatry is limited by data availability and quality. Many psychiatric diagnoses rely on subjective assessments, interviews, and behavioral observations, making structured data collection difficult.^[10] Some researchers have applied transfer learning, a technique that adapts ML models trained in other fields, to overcome these challenges in mental health applications.^[11]

Deep learning

Deep learning, a subset of ML, involves neural networks with many layers of neurons, that can grasp complex patterns, similarly to human brains. It is particularly useful for identifying subtle patterns in speech, imaging, and physiological data.^[12] Deep learning techniques have been applied in neuroimaging research to identify abnormalities in brain scans associated with conditions such as schizophrenia, depression, and PTSD.^[13] However, deep learning models require extensive, high-quality datasets to function effectively. The limited availability of large, diverse mental health datasets poses a challenge, as patient privacy regulations restrict access to medical records. Additionally, deep learning models often operate as "black boxes", meaning their decision-making processes are not easily interpretable by clinicians, raising concerns about transparency and clinical trust.^[14]

Natural language processing

Natural language processing allows AI systems to analyze and interpret human language, including speech, text, and tone of voice. In mental health, NLP is used to extract meaningful insights from conversations, clinical notes, and patient-reported symptoms. NLP can assess sentiment, speech patterns, and linguistic cues to detect signs of mental distress. This is crucial because many of the diagnoses and DSM-5 mental health disorders are diagnosed via speech in doctor-patient interviews, utilizing the clinician's skill for behavioral pattern recognition and translating it into medically relevant information to be documented and used for diagnoses. As research continues, NLP models must address ethical concerns related to patient privacy, consent, and potential biases in language interpretation.^[15]

Advancements in NLP such as sentiment analysis identifies distinctions in tone and speech to detect anxiety and depression. "Woebot", uses sentiment analysis to scrutinize and detect patterns for depression or despair and suggests professional help to patients. Similarly, "Cogito", an AI platform uses voice analysis to find changes in pitch and loudness to identify symptoms of depression or anxiety. The application of NLP can contribute to early diagnosis and improved treatment strategies.^{[16][17]}

Computer vision

Computer vision enables AI to analyze visual data, such as facial expressions, body language, and micro expressions, to assess emotional and psychological states. This technology is increasingly used in mental health research to detect signs of depression, anxiety, and PTSD through facial analysis.^[18] Computer vision tools have been explored for their ability to detect nonverbal cues, such as hesitation or changes in eye contact, which may correlate with emotional distress. Despite its potential, computer vision in mental health raises ethical and accuracy concerns. Facial recognition algorithms can be influenced by cultural and racial biases, leading to potential misinterpretations of emotional expressions.^[19] Additionally, concerns at informed consent and data privacy must be addressed before widespread clinical adoption.



LLMs and generative AI

From the introduction of LLMs in the field of AI in correlation to mental health care, a lot of developments have come about. Popular examples of LLMs are ChatGPT and Gemini. LLMs have been trained on a lot of data which has made it capable of being considerate and even mimic how a human behaves but chatbots are only fed scripted data which gives it the lack of empathy when dealing with patients. This kind of LLM technology is very useful for people who hesitate to ask for assistance or do not have access to get treatment.^[20]

But at the same time, LLMs have not exactly been known to be as effective as they seem capable of being. LLMs can experience a condition called hallucination where they can possibly give wrong medical advice to the patients that can be extremely dangerous. LLMs do not exhibit the required level of compassion or empathy needed specially in difficult situations.^[20]

Applications

Diagnosis

AI with the use of NLP and ML can be used to help diagnose individuals with mental health disorders. It can be used to differentiate closely similar disorders based on their initial presentation to inform timely treatment before disease progression. For example, it may be able to differentiate unipolar from bipolar depression by analyzing imaging and medical scans.^[10] AI also has the potential to identify novel diseases that were overlooked due to the heterogeneity of presentation of a single disorder.^[10] Doctors may overlook the presentation of a disorder because while many people get diagnosed with depression, that depression may take on different forms and be enacted in different behaviors. AI can parse through the variability found in human expression data and potentially identify different types of depression.

Prognosis

AI can be used to create accurate predictions for disease progression once diagnosed.^[10] AI algorithms can also use data-driven approaches to build new clinical risk prediction models^[21] without relying primarily on current theories of psychopathology. However, internal and external validation of an AI algorithm is essential for its clinical utility.^[10] In fact, some studies have used neuroimaging, electronic health records, genetic data, and speech data to predict how depression would present in patients, their risk for suicidality or substance abuse, or functional outcomes.^[10] The prognosis seems to be highly promising, though it comes with important challenges and ethical considerations such as:

Early detention AI can analyze patterns in speech, writing, facial expressions, and social media behavior to detect early signs of depression, anxiety, PTSD, and even schizophrenia.^[22]

Treatment

In psychiatry, in many cases multiple drugs are trialed with the patients until the correct combination or regimen is reached to effectively treat their ailment—AI systems have been investigated for their potential to predict treatment response based on observed data collected from various sources. This application of AI has the potential to reduce the time, effort, and resources required while alleviating the burden on both patients and clinicians.^[10]

Benefits

Artificial intelligence offers several potential advantages in the field of mental health care:



- **Enhanced diagnostic accuracy:** AI systems are capable of analyzing large datasets including brain imaging, genetic testing, and behavioral data to detect biomarkers associated with mental health conditions. This may contribute to more accurate and timely diagnoses.^[23]
- **Personalized treatment planning:** AI algorithms can process information from electronic health records (EHRs), neuroimaging, and genomic data to identify the most effective treatment strategies tailored to individual patients.^[23]
- **Improved access to care:** AI technologies can facilitate the delivery of mental health services such as cognitive behavioral therapy (CBT) through virtual platforms. This may increase access to care, particularly in underserved or remote areas.^[23]
- **Early detection and monitoring:** AI tools can assist clinicians in recognizing early warning signs of mental health disorders, enabling proactive interventions and potentially reducing the risk of acute episodes or hospitalizations.^[5]
- **Use of chatbots and virtual assistants:** AI-powered systems can support administrative functions, including appointment scheduling, patient triage, and organizing medical history. This may improve operational efficiency and enhance patient engagement.^[5]
- **Predictive analytics for suicide prevention:** AI models can analyze behavioral, clinical, and social data to identify individuals at elevated risk of suicide, enabling targeted prevention strategies and informing public health policies.^[5]

Challenges

Despite its potential, the application of AI in mental health presents a number of ethical, practical, and technical challenges:

- **Informed consent and transparency:** The complexity and opacity of AI systems particularly in how they process data and generate outputs require clinicians to clearly communicate potential limitations, biases, and uncertainties to patients as part of the informed consent process.^[4]
- **Right to explanation:** Patients may request explanations regarding AI-generated diagnoses or treatment recommendations. Healthcare providers have a responsibility to ensure that these explanations are available and comprehensible.^[4]
- **Privacy and data protection:** The use of AI in mental health care must balance data utility with the protection of sensitive personal information. Ensuring robust privacy safeguards is essential to building trust among users.^{[4][5]}
- **Lack of diversity in training data:** AI models often rely on datasets that may not be representative of diverse populations. This can lead to biased outcomes and reduced effectiveness in diagnosing or treating individuals from underrepresented groups.^[5]
- **Provider skepticism and implementation barriers:** Clinicians and health care organizations may be hesitant to adopt AI tools due to a lack of familiarity, concerns about reliability, or uncertainty about integration into existing care workflows.^[24]
- **Responsibility and the "Tarasoff duty":** In cases where AI identifies a patient as a potential risk to themselves or others, it remains unclear who holds the legal and ethical responsibility to act particularly in jurisdictions with mandatory duty-to-warn obligations.^[25]
- **Data quality and accessibility:** High-quality mental health data is often difficult to obtain due to ethical constraints and privacy concerns. Limited access to diverse and comprehensive datasets may hinder the accuracy and real-world applicability of AI systems.^[26]
- **Bias in data:** Bias in data algorithms means placing preferences of certain groups of people over others which is unfair. AI models are constructed with such biases leading to wrong treatment, incorrect diagnoses and harmful medical outcomes. Because of such bias, groups from diverse backgrounds could be at risk of being underrepresented. Most AI systems are trained on western populations data that can also be a cause of algorithmic bias. If AI systems cannot be trained on inclusive data, it risks increasing racial disparities and mental health issues.^[27]



Current AI trends in mental health

As of 2020, the Food and Drug Administration (FDA) had not yet approved any artificial intelligence-based tools for use in Psychiatry.^[28] However, in 2022, the FDA granted authorization for the initial testing of an AI-driven mental health assessment tool known as the AI-Generated Clinical Outcome Assessment (AI-COA). This system employs multimodal behavioral signal processing and machine learning to track mental health symptoms and assess the severity of anxiety and depression. AI-COA was incorporated into a pilot program to evaluate its clinical effectiveness. As of 2025, it has not received full regulatory approval.^[29]

Mental health tech startups continue to lead investment activity in digital health despite the ongoing impacts of macroeconomic factors like inflation, supply chain disruptions, and interest rates.^[30]

According to CB Insights, State of Mental Health Tech 2021 Report, mental health tech companies raised \$5.5 billion worldwide (324 deals), a 139% increase from the previous year that recorded 258 deals.^[31]

A number of startups that are using AI in mental healthcare have closed notable deals in 2022 as well. Among them is the AI chatbot Wysa (\$20 million in funding), BlueSkeye that is working on improving early diagnosis (£3.4 million), the Upheal smart notebook for mental health professionals (€1.068 million), and the AI-based mental health companion clare&me (€1 million).^[32] Founded in 2021, Earkick serves as an 'AI therapist' for mental health support.^{[33][34]}


An analysis of the investment landscape and ongoing research suggests that we are likely to see the emergence of more emotionally intelligent AI bots and new mental health applications driven by AI prediction and detection capabilities.

For instance, researchers at Vanderbilt University Medical Center in Tennessee, US, have developed an ML algorithm that uses a person's hospital admission data, including age, gender, and past medical diagnoses, to make an 80% accurate prediction of whether this individual is likely to take their own life.^[35] And researchers at the University of Florida are about to test their new AI platform aimed at making an accurate diagnosis in patients with early Parkinson's disease.^[36] Research is also underway to develop a tool combining explainable AI and deep learning to prescribe personalized treatment plans for children with schizophrenia.^[37]

AI systems could predict and plan treatments accurately and effectively for all fields of medicine at levels similar to that of physicians and general clinical practices. For example, one AI model demonstrated higher diagnostic accuracy for depression and post-traumatic stress disorder compared to general practitioners in controlled studies.^[38]

AI systems that analyze social media data are being developed to detect mental health risks more efficiently and cost-effectively across broader populations. Ethical concerns include uneven performance between digital services, the possibility that biases could affect decision-making, and trust, privacy, and doctor-patient relationship issues.^[38]

In January 2024, Cedars-Sinai physician-scientists developed a first-of-its-kind program that uses immersive virtual reality and generative AI to provide mental health support.^[39] The program is called XAIA which employs a large language model programmed to resemble a human therapist.^[40]

The University of Southern California has researched the effectiveness of a virtual therapist named E⁴ Through a webcam and microphone, this AI is able to process and analyze the emotional cues derived from the patient's face and the variation in expressions and tone of voice.^[41]

A team of Stanford Psychologists and AI experts created "Woebot". Woebot is an app that makes therapy sessions available 24/7. Woebot tracks its users' mood through brief daily chat conversations and offers curated videos or word games to assist users in managing their mental health.^[41] A Scandinavian team of software engineers and a clinical psychologist created "Heartfelt Services". Heartfelt Services is an application meant to simulate conventional talk therapy with an AI therapist.^[42]

Incorporating AI with EHR records, genomic data and clinical prescriptions can contribute to precision treatment. "Oura Ring", a wearable technology scans the individual's heart rate and sleep routine in real time to give tailored suggestions. Such AI-based application has an increasing potential in combating the stigma of mental health.^{[20][6]}

Outcome comparisons: AI vs traditional therapy

Research shows that AI-driven mental health tools, particularly those using cognitive behavioral therapy (CBT), can improve symptoms of anxiety and depression, especially for mild to moderate cases. For example, chatbot-based interventions like Woebot significantly reduced depressive symptoms in young adults within two weeks, with results comparable to brief human-delivered interventions.^[43] A 2022 meta-analysis of digital mental health tools, including AI-enhanced apps, found moderate effectiveness in reducing symptoms when user engagement was high, and interventions were evidence-based.^[44]

However, traditional therapy remains more effective for complex or high-risk mental health conditions that require emotional nuance and relational depth, such as PTSD, severe depression, or suicidality. The therapeutic alliance, or the relationship between patient and clinician, is frequently cited in clinical literature as a significant factor in treatment outcomes, accounting for up to 30% of positive outcomes.^[45] While AI tools are capable of detecting patterns in behavior and speech, they are currently limited in replicating emotional nuance and the social context sensitivity typically provided by human clinicians. As such, most experts view AI in mental health as a complementary tool, best used for screening, monitoring, or augmenting care between human-led sessions.^[46]

While AI systems excel at processing large datasets and providing consistent, round-the-clock support, their rigidity and limitations in contextual understanding remain significant barriers. Human therapists can adapt in real time to tone, body language, and life circumstances—something machine learning models have yet to master.^{[44][46]} Nonetheless, integrated models that pair AI-driven symptom tracking with clinician oversight are showing promise. These hybrid approaches may increase access, reduce administrative burden, and support early detection, allowing human clinicians to focus on relational care. Current research suggests that AI in mental health care is more likely to augment rather than replace clinician-led therapy, particularly by supporting data analysis and continuous monitoring.

Criticism

Although artificial intelligence in mental health is a growing field with significant potential, several concerns and criticisms remain regarding its application:

- **Data limitations:** A significant barrier to developing effective AI tools in mental health care is the limited availability of high-quality, representative data. Mental health data is often sensitive, difficult to standardize, and subject to privacy restrictions, which can hinder the training of robust and generalizable AI models.^[47]
- **Algorithmic bias:** AI systems may inherit and amplify biases present in the datasets they are trained on. This can result in inaccurate assessments or unequal treatment, particularly for underrepresented or marginalized groups.^[48] It is important for developments in mental healthcare to be ethically valid. Major ethical concerns are breach of data privacy, bias in data algorithms, unlawful data access and stigma around mental health treatment. Algorithmic biases can result in misdiagnoses and incorrect treatment



which are dangerous. One way to mitigate this is by ensuring that medical data is not segregated based on patient demographics. Another is to get rid of the binary gendering method and ensuring higher ups are informed of any developments in AI tech to avoid bias in the models. Creating a justified system where AI advances ethically, with its real-world applications helping instead of replacing medical professionals needs to be a priority.^{[6][17]}

- **Privacy and data security:** The implementation of AI in mental health typically requires the collection and analysis of large amounts of personal and sensitive information. This raises ethical concerns regarding user consent, data protection, and potential misuse of information.^[49]
- **Risk of harmful advice:** Some AI-based mental health tools have been criticized for offering inappropriate or harmful guidance. For example, there have been reports of chatbots giving users dangerous recommendations, including one case in which a man died by suicide after a chatbot allegedly encouraged self-sacrifice.^[50] In response to such incidents, several AI mental health applications have been taken offline or reevaluated for safety.^[51]
- **Therapeutic relationship:** Decades of psychological research have shown that the quality of the therapeutic relationship empathy, trust, and human connection is one of the most important predictors of treatment outcomes. Some researchers have questioned whether AI systems can replicate the relational dynamics shown to contribute to positive treatment outcomes.^[52] Medical professionals are expected to be empathetic and compassionate when interacting with their patients. However, certain authors have said that people interact with chatbots, fully aware that they are incapable of being genuinely empathetic like a human being and do not expect them to be sentient in their responses. Other authors have implied that it is illogical to expect patients to be emotionally vulnerable and open to chatbots. Only medical professionals have the human "touch" that helps them understand the "x factor" of their patients that machines cannot do. The possibility that therapists and medical professionals could be too emotionally exhausted at the end of the day to show their patients the compassion they are entitled to also exists. AI models and chatbots could have the advantage here. Maintaining a balance between the use of AI models and employing health professionals is important.^{[27][53]}
- **Lack of emotional understanding:** Unlike human therapists, AI systems do not possess lived experiences or emotional awareness that make them limited. These limitations have prompted debate about the role of AI in addressing emotionally complex mental health needs. Some experts argue that AI cannot substitute for human-centered therapy, particularly in cases requiring deep emotional engagement.^[54]
- **Risk of psychosis:** ChatGPT usage has driven some users to experience delusions.^{[55][56]} The realism of the interaction can leave a user believing that a real person is chatting with them, fueling cognitive dissonance.^[57] Some ChatGPT conversations endorsed conspiracies and mystical beliefs, and in some cases lead to suicide.^[58] Delusions and psychosis induced by AI usage has been referred to as chatbot psychosis.^{[59][60]}

Ethical issues

AI in mental health is progressing with personalized care to incorporate voice, speech and biometric data. But to prevent algorithmic bias, models need to be culturally inclusive too. Ethical issues, practical uses and bias in generative models need to be addressed to promote fair and reliable mental healthcare.^{[6][27]}

Although significant progress is still required, the integration of AI in mental health underscores the need for legal and regulatory frameworks to guide its development and implementation.^[4] Achieving a balance between human interaction and AI in healthcare is challenging, as there is a risk that increased automation may lead to a more mechanized approach, potentially diminishing the human touch that has traditionally characterized the field.^[5] Furthermore, granting patients a feeling of security and safety is a priority considering AI's reliance on individual data to perform and respond to inputs. Some experts caution that efforts to increase accessibility through automation may unintentionally affect aspects of the patient experience, such as trust or perceived support.^[5] To avoid veering in the wrong direction, more research should continue to develop a deeper understanding of where the incorporation of AI produces advantages and disadvantages.^[24]

Data privacy and confidentiality are one of the most common security threats to medical data. Chatbots are known to be used as virtual assistants for patients but the sensitive data they collect may not be protected because the US law does not consider them as medical devices. Pharmaceutical companies use this loophole to access sensitive information and use it for their own purpose which results, in a lack of trust in chatbots and patients can hesitate in providing information essential to their treatment. Conversational Artificial Intelligence stores and remembers every conversation with a patient with complete accuracy, smartphones also collect data from search history and track app activity. If such private information is leaked it could further increase the stigma around mental health. The danger of cybercrimes and the government's unprotected access to our data, all raise serious concerns about data security.^{[27][53]}

Additionally, a lack of clarity and openness with AI models can lead to a loss of trust from the patient for their medical advisors or doctors as the regular person is unaware of how they reach conclusions into giving certain medical advice. Access to such information is necessary to build trust. However, many of these models act like "black boxes", providing very little insight into how they work. AI specialists have thus highlighted ethical standards, diverse data and the correct usage of AI tools in mental healthcare.^[27]

Bias and discrimination

Artificial intelligence has shown promise in transforming mental health care through tools that support diagnosis, symptom tracking, and personalized interventions. However, significant concerns remain about the ways these systems may inadvertently reinforce existing disparities in care. Because AI models rely heavily on training data, they are particularly vulnerable to bias if that data fails to reflect the full range of racial, cultural, gender, and socioeconomic diversity found in the general population.

For example, a 2024 study from the University of California found that AI systems analyzing social media data to detect depression exhibited significantly reduced accuracy for Black Americans compared to white users, due to differences in language patterns and cultural expression that were not adequately represented in the training data.^[61] Similarly, natural language processing (NLP) models used in mental health settings may misinterpret dialects or culturally specific forms of communication, leading to misdiagnoses or missed signs of distress. These kinds of errors can compound existing disparities, particularly for marginalized populations that already face reduced access to mental health services.

Biases can also emerge during the design and deployment phases of AI development. Algorithms may inherit the implicit biases of their creators or reflect structural inequalities present in health systems and society at large. These issues have led to increased calls for fairness, transparency, and equity in the development of mental health technologies.

In response, researchers and healthcare institutions are taking steps to address bias and promote more equitable outcomes. Key strategies include:

- **Inclusive data practices:** Developers are working to curate and utilize datasets that reflect diverse populations in terms of race, ethnicity, gender identity, and socioeconomic background. This approach helps improve the generalizability and fairness of AI models.^[62]
- **Bias assessment and auditing:** Frameworks are being introduced to identify and mitigate algorithmic bias across the lifecycle of AI tools. This includes both internal validation (within training data) and external validation across new, diverse populations.^[63]
- **Community and stakeholder engagement:** Some projects now prioritize involving patients, clinicians, and representatives from underrepresented communities in the design, testing, and implementation phases. This helps ensure cultural relevance and supports greater trust in AI-assisted tools.^[64]
- **Transparency and explainability:** New efforts focus on building "explainable AI" systems that provide interpretable results and justifications for clinical decisions, allowing patients and providers to better understand and challenge AI-generated outcomes.^[63]



These efforts are still in early stages, but they reflect a growing recognition that equity must be a foundational principle in the deployment of AI in mental health care. When designed thoughtfully, AI systems could eventually help reduce disparities in care by identifying underserved populations, tailoring interventions, and increasing access in remote or marginalized communities. Continued investment in ethical design, oversight, and participatory development will be essential to ensure that AI tools do not replicate historical injustices but instead help move mental health care toward greater equity.

See also

- [Artificial intelligence in healthcare](#)
- [Artificial intelligence detection software](#)
- [AI alignment](#)
- [Artificial intelligence in healthcare](#)
- [Artificial intelligence](#)
- [Glossary of artificial intelligence](#)
- [Clinical decision support system](#)
- [Computer-aided diagnosis](#)
- [Health software](#)

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