

Unveiling the Future: How Can GAI Transform Mental Health Care?

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Abstract:

Generative AI (GAI) is an emerging and promising technology with significant potential in mental health care, though research on its technological aspects in this field is still limited. This study provides a scoping review of GAI's role in mental health, aiming to advance current knowledge. Adhering to PRISMA guidelines, the review analyzed 35 studies from databases including Web of Science, PubMed, IEEE Xplore, medRxiv and bioRxiv. The results identified four main applications of GAI: mental health assessments, psychosocial counseling support, clinical practices, and task-oriented optimizations. The results of this review serve to enlighten a range of stakeholders, including researchers, clinicians, and individuals seeking mental health support, about GAI's potential benefits and challenges in mental healthcare.

Keywords: Generative AI; ChatGPT; mental health; scoping review; artificial intelligence; depression; anxiety

Introduction

According to World Health Organization (WHO), one in eight people globally experience mental disorders, with depression and anxiety being most prevalent (WHO, 2022). These conditions affect millions and significantly increase suicide risks, especially in low- and middle-income countries (WHO, 2022, 2023). Challenges in mental health care include limited access to services, professional shortages, and stigma (Billah et al., 2023; Garapati et al., 2023).

Advancements in AI and machine learning, particularly generative AI (GAI), show promise in mental health care. GAI, evolving from early examples like the ELIZA chatbot to advanced deep learning techniques, offers potential in diagnosis,

treatment, and decision-making (Librenza-Garcia et al., 2017; Pandey & Sharma, 2023).

Therefore, this review synthesizes literature on GAI's role in mental health care to guide stakeholders in understanding its potential benefits and challenges in enhancing mental health services.

Methods

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) extension for Scoping Reviews (Tricco et al., 2018) was followed to facilitate the review process. A thorough search was conducted across three reputable databases—Web of Science, PubMed, and IEEE Xplore—from January 1, 2020, to July 28, 2023, to identify relevant studies including both general and health care-specific sources. Additionally, to capture emerging literature on the use of GAI models for addressing mental health issues, two preprint servers (medRxiv and bioRxiv) were consulted from January to July 2023. This approach, commonly employed by researchers, helps to uncover applications not yet published in peer-reviewed literature (Syrowatka et al., 2021; Tessema et al., 2021). The search query mainly consists of two components: generative AI and relevant terms (e.g., GAI OR generative model OR ChatGPT), and mental health and related terms (e.g., mental health OR depression OR anxiety OR bipolar disorder).

All research designs were considered for inclusion in this review. To be included, studies needed to be empirical, original, utilize AI-based technologies to produce new outputs for mental health enhancement, and be published in English. However, articles presented solely as opinion pieces or not pertinent to AI-generated content production were excluded to maintain the relevance and accuracy of the review. For data screening and extraction, records were imported into Endnote for screening, duplicates removed, and relevance assessed based on titles and abstracts by one reviewer. Another reviewer evaluated full texts against criteria, with regular discussions ensuring consensus and continual review of criteria for consistent application.

Results

The structured search on databases identified 381 unique records, among which 304 are peer-reviewed and 77 preprints. The screening process resulted in 35 articles investigating the use of GAI models and are eligible for in-depth review. The review found four key uses of GAI models in mental health assessment and treatment, expanding into areas such as task-oriented optimization and clinical practice. There has been a noticeable rise in research on GAI's role in mental health over the past three years. However, studies on these topics were scarce before 2021, particularly in clinical practice.

Mental Health Assessment & Support

Generative AI (GAI) is increasingly used for early detection and management of mental health issues. In this review, 11% of the studies (4/35) focused on GAI for mental health detection, particularly through analyzing social media activities and user-generated content on platforms such as Reddit and Twitter. Some studies employed

neural networks and large language models to detect signs of anxiety and depression (Xu et al., 2023; Zeberga et al., 2022). Others used GPT-3 for analyzing language in private data (Hayati et al., 2022; Yang et al., 2023b). However, the effectiveness of these methods varies, with some GPT models underperforming in specific scenarios (Xu et al., 2023; Yang et al., 2023a).

Psychosocial Counselling

GAI models are predominantly used for counseling assistance in mental health, accounting for 31% of cases in relevant studies (n=11). These models focus on providing emotional support and developing empathy-centric counseling chatbots for peer support and proactive healthcare (Beredo & Ong, 2022; Elyoseph et al., 2023; Ratican & Hutson, 2023; Sharma, Lin, et al., 2023). Notably, “CareCall,” an audio-based chatbot for supporting isolated individuals was also introduced (Jo et al., 2023). These GAI models excel in generating empathetic, context-aware responses, surpassing traditional rule-based or retrieval-based models (Beredo & Ong, 2022). In addition, GAI models are also frequently used for personalized counseling services. Key applications include generating tailored treatment recommendations for mental health issues and creating motivational dialogues using reinforcement learning (Brocki et al., 2023; Farhat, 2023; Saha et al., 2021).

In therapeutic assistance, 40% of GAI studies (n=14) focus on traditional, music, and art or writing therapies. Conventional therapy dominates, integrating AI and GPT models for cognitive behavior therapy, while music therapy studies, such as DeepTunes, use facial recognition and GPT-2 for emotion-driven music creation (Vishesh et al., 2022). Art and writing therapies leverage GAN models and the Midjourney system for therapeutic image creation and emotional engagement (Burrows et al., 2022; Gao et al., 2023). These studies often utilize supplementary datasets to enhance context and reduce biases.

Clinical Practice

GAI extends its utility beyond mental health care, being used in practitioner training and clinical decision-making. Stapleton et al. (2023b) describe using ChatGPT for training suicide gatekeepers by simulating patients with suicidal thoughts. In decision-making, studies also highlight GAI tools for generating medical reports and aiding in urgent case triage (Lai et al., 2023; Zhou, 2023). Additionally, Perlis (2023b) explores ChatGPT-4’s application in optimizing psychopharmacologic practices through heuristic guidance.

Task-oriented optimization

The GAI approaches were also used in mental health for data optimization and safety. Studies by Liyanage et al. (2023b) and Qiu, Zhao, et al. (2023) utilized ChatGPT for creating data instances and conversation datasets, while Tlachac et al. (2022) focused on generating labeled data for depression detection. This data augmentation addresses issues such as data scarcity and imbalance. Furthermore, ensuring safety and explainability in GAI-generated mental health conversations is vital. A study by Roy et

al. (2023) addressed this by combining a process knowledge framework with GAI to ensure safety and explainability in GAI-generated mental health conversations. An overview of the use cases using GAI approaches is presented in Table 1.

Table 1. Overview of use cases of GAI in mental health care.

Use Case	Reference
Mental Health Assessment & Support	(Hayati et al., 2022; Xu et al., 2023; Yang et al., 2023a; Zeberga et al., 2022)
Psychological Counselling	(Azuaje et al., 2023; Beredo & Ong, 2022; Brocki et al., 2023; Burrows et al., 2022; Elyoseph et al., 2023; Farhat, 2023; Gao et al., 2023; Haman et al., 2023; Hou, 2022; Jo et al., 2023; Kumar et al., 2023; Li et al., 2022; Rajagopal et al., 2021; Rajcic & McCormack, 2020; Ratican & Hutson, 2023; Saha et al., 2021; Salhi et al., 2021; Sharma, Lin, et al., 2023; Sharma, Rushton, et al., 2023; Vishesh et al., 2022; Wang et al., 2021; Wang, 2022)
Clinical Practice	(Lai et al., 2023; Perlis, 2023a; Stapleton et al., 2023a; Zhou, 2023)
Task-oriented Optimization	(Liyanage et al., 2023a; Qiu, He, et al., 2023; Roy et al., 2023; Tlachac et al., 2022)

Discussion

Prior studies have stressed the importance of AI-based approaches in addressing the social, economic and human rights challenges faced by mental health care (D'Alfonso, 2020; Jenkins et al., 2011). As the GAI has achieved significant progress, new opportunities have been shown for application in mental health support.

In this scoping review, we mainly explored the key use cases where the GAI was applied for mental health and identified four use cases: mental health assessment, psychosocial counselling, clinical practice, and task-oriented optimization. While there were many examples of novel areas, some were still at the research or developmental stage and had not yet been properly evaluated by extra experiment. For example, despite studies having shown the potential of GAI in generating image as a response to individuals' negative expression, evidence regarding its impact on mood improvement or stress reduction after intervention is rare (Azuaje et al., 2023; Burrows et al., 2022). Some existing tools have been adapted or modified for mental health support in various areas, including detection, counselling, and therapy delivery. However, the effectiveness of these tools has shown mixed results. ChatGPT, for example, has

demonstrated superior emotional awareness compared to humans. However, its performance in providing mental health counselling has been considered unsatisfactory, as indicated by peer-reviewed articles (Elyoseph et al., 2023; Farhat, 2023).

Given the technological limitations in the past, it is understandable that most research using traditional generative approaches (in the brief review) highlighted the role of chatbots, virtual assistants or avatars and their conversational functions to enhance mental well-being. Although the in-depth review in our research also revealed numerous instances of conversation generation, more opportunities and possibilities have emerged with the advancement of technology to complement the limitations of traditional approaches. These advancements include: (a) delivery of more personalized conversation in counselling session: GAI models have revolutionized the field of mental health counselling by providing unprecedented support and assistance. Unlike traditional pattern-matching approaches which often rely on pre-defined templates, GAI models can engage in personalized and empathetic conversations (Saha et al., 2022). Using neural networks, these models are capable of understanding and generating contextually relevant responses, which allows for more effective communication with individuals seeking mental health support; (b) Data augmentation for accuracy improvement: GAI models enable significant advancements in mental health through data augmentation.

Traditional pattern-matching approaches usually rely on a limited dataset, which may result in suboptimal performance and generalization. GAI models, leveraging techniques such as GANs, can generate synthetic data that closely mimics real-world examples. This augmented data can be used to train mental health models, enabling them to learn from a diverse and larger set of synthetic experiences. This could improve predictive accuracy and achieve better adaptability to a wide range of mental health conditions; (c) Image generation for therapeutic purpose: one of challenges for traditional approaches to generate images is the difficulty of accurately representing emotions or conveying therapeutic concepts. The reliance on pre-existing patterns often led to the production of generic and repetitive visuals (Teterwak et al., 2019), which could reduce the effectiveness of using images as a therapeutic medium. However, this can be addressed using GAI which has improved image generation capabilities through allowing for the manipulation of various visual factors. Images generated by GAI can be tailored to evoke specific emotional responses or cater to individual preferences (Burrows et al., 2022). This personalization in image generation can significantly enhance therapeutic experience, allowing individuals to engage with images that are truly meaningful and relatable.

Challenges of leveraging GAI

The implementation of GAI for mental health faces several challenges. One key challenge is the lack of interpretability and explainability. Deep learning models used in generative AI often operate as black boxes, making it difficult to understand how and why they arrive at specific decisions or recommendations (Yang et al., 2022). This lack of interpretability can create distrust in AI-generated suggestions among mental health professionals and patients. To address this challenge, research efforts should be focused

on developing techniques that enhance the interpretability of GAI models, such as generating explanations or providing transparency into the decision-making process. Similar principles have also been adapted to Wysa, an AI chatbot using natural language processing. Different from the GAI, each response produced by Wysa is provided by an accredited psychologist and undergoes rigorous evaluation to ensure clinical safety (Wysa, 2023). Therefore, through enabling people to be more aware of the reasoning behind the GAI-generated outputs, the integration of GAI in mental health care can achieve a higher level of reliability and trustworthiness.

The ethical concerns involved posed another significant challenge. Content creation by GAI models is subject to datasets, it is necessary to ensure that they are programmed and trained in an ethically responsible way. This is because the potential for biases, both explicit and implicit, in the data used to train these models can reinforce existing stereotypes in mental health, and result in discriminatory or life-threatening outcomes. Nabla, a healthcare company in Paris, utilized GPT-3 for promotion and prevention in mental health. Unexpectedly, when a user raised the question “Should I take my own life?,” GPT-3 generated a response of “I think you should” which was considered to encourage suicidal behavior, thereby sparking concerns regarding the implementation of GAI models in mental healthcare (News, 2020). Given this potential risk, ethical guidelines and frameworks should be developed to define the appropriate use and limitations of GAI in mental health care, guiding practitioners in responsible decision-making and emphasizing the importance of a human-centered approach.

Another key challenge is the privacy and security of sensitive mental health data. Unintentional collection of personal information can occur during users’ interactions with AI systems. This information may include users’ names, identities, and contact information which originate from human-AI conversation history. The application of GAI models for data processing generates significant attention regarding the potential disclosure or inappropriate use of personal data (Fui-Hoon Nah et al., 2023). This is of particular concern in mental health care. One unique example that highlights this concern is the practice of emotion detection, in which users’ facial expression images are collected by GAI systems for mental health prediction (Burrows et al., 2022). These collected images has the potential to be misused to infringe upon individuals’ privacy rights and undermine their trust in mental health services. Hence, implementing security measures, data anonymization techniques, and clear consent mechanisms are critical steps in addressing this challenge and protecting the confidentiality of mental health data.

Implications

Several implications have emerged from this study. First, the findings of this scoping review highlight the urgent need to develop large databases specifically tailored for mental health at the national or international level. Currently, the available datasets for training GAI models in mental health care are limited in scope and diversity. The development of large databases can help minimize biases and improve the generalizability and accuracy of AI-generated recommendations and interventions in mental health care. Second, while the potential of GAI in mental health care is

promising, there is a pressing need for more research to bridge the gap between theoretical advancements and practical implementations. Therefore, future studies should focus on rigorous evaluation and validation of GAI models in real-world clinical settings, with a particular emphasis on their effectiveness and feasibility. Third, this scoping review indicates the necessity of developing GAI tools that incorporate different modes of generation. By integrating text, image, audio, and video, mental health professionals, care providers or support seekers can benefit from more comprehensive assessments, personalized interventions, and interactive support systems.

Limitations

This study has two limitations. Firstly, this review includes preprint articles to examine the rapidly expanding research on GAI. However, caution is advised in interpreting these articles, as they have not undergone the formal peer-review process. Although unconventional, the inclusion of preprints aligns with practices in prior studies (Pan et al., 2020; Syrowatka et al., 2021). Secondly, the study aims to outline the fundamental roles of GAI in mental health care, focusing on key applications rather than in-depth evaluation of specific GAI methods. Future research should focus on evaluating the practical efficacy of these approaches in clinical environments.

Conclusion

This study provides insights into the application of GAI models in the field of mental health care. Through an in-depth review, four key scenarios using the GAI models have been identified, which include mental health assessment, psychosocial counseling support, clinical practice, and task-oriented optimization, and clinical decision making. Overall, this scoping review underscores the promising role of GAI models in transforming mental health care across various areas.

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