AI-Enhanced Precision Psychiatry: Biotech-Driven Mental Health Innovation in Healthcare Systems

Hong Xie[1], Quishi Wang[2], Prakriti Poddar[3]

Abstract

Mental health disorders continue to pose a critical global health challenge, with traditional psychiatric approaches often limited by subjective assessments and trial-and-error treatments. This study explores the transformative role of AI-enhanced precision psychiatry as a biotech-driven innovation within healthcare systems. Using a mixed-methods design, data were collected from patients diagnosed with depression, anxiety, schizophrenia, and bipolar disorder across multiple clinical sites. Variables included demographic factors, clinical characteristics, biotech-derived biomarkers (genomics, proteomics, metabolomics, neuroimaging), digital biomarkers (speech, facial recognition, smartphone usage, wearable sensor data), and healthcare system outcomes. Advanced AI models including Random Forest, Support Vector Machine, Deep Neural Networks, and LSTM were evaluated for predictive accuracy, interpretability, and clinical applicability. Results indicated that LSTM and deep neural networks achieved the highest predictive performance, while Random Forest offered greater explainability. Integration of biological and digital data improved diagnostic precision, treatment personalization, and healthcare efficiency, with measurable reductions in relapse rates, hospitalizations, and costs. Ethical challenges including data privacy, algorithmic bias, and healthcare inequality were also identified. Overall, the findings underscore the potential of AI-biotech convergence to revolutionize mental health care by shifting toward predictive, personalized, and preventive psychiatry within modern healthcare systems.

Keywords: Artificial Intelligence, Precision Psychiatry, Biotechnology, Digital Biomarkers, Healthcare Systems, Mental Health Innovation.

Introduction

The rising burden of mental health disorders

Mental health disorders represent one of the most pressing public health challenges worldwide (Wu et al., 2023). According to the World Health Organization (WHO), more than one billion people suffer from mental health conditions, with depression and anxiety accounting for a substantial share of the global disease burden. These disorders not only reduce quality of life but also contribute to increased morbidity, disability, and premature mortality (Piao et al., 2022). Traditional psychiatric models, while clinically valuable, are often criticized for their reliance on subjective diagnostic tools, generalized treatment regimens, and trial-and-error medication strategies. This conventional approach has limited precision and fails to adequately account for the biological, psychological, and social complexities underlying mental illness. Consequently, the urgent need for innovation in diagnosis, treatment, and long-term management of mental

---

[1] Chief Technology and Medical Officer at Boston Easy Biotech
[2] Founder & CEO at Labro
[3] Global Head, Roundglass Living

health disorders has never been greater (Arias et al., 2022).

The promise of artificial intelligence in psychiatry

Artificial Intelligence (AI) has emerged as a transformative force in healthcare, offering advanced capabilities in pattern recognition, data integration, and predictive modeling (McCradden et al., 2023). In psychiatry, AI enables clinicians and researchers to move beyond traditional frameworks by leveraging large-scale datasets, including electronic health records, neuroimaging, genomics, and behavioral data (Monteith et al., 2022). Machine learning algorithms can identify subtle markers of mental illness, predict treatment responses, and personalize interventions at an unprecedented scale. Unlike conventional psychiatry, which often depends on qualitative assessments, AI-driven models facilitate objective, data-informed decision-making. This transition from symptom-based to evidence-driven psychiatry represents a paradigm shift that aligns with the principles of precision medicine (Luna & Hyler, 2025).

Biotech and precision psychiatry: a converging frontier

Parallel to advances in AI, biotechnology has revolutionized the understanding of mental health disorders through innovations in genomics, proteomics, metabolomics, and neurobiology (Mohammadi et al., 2024). For instance, genetic sequencing has uncovered susceptibility loci for conditions such as schizophrenia and bipolar disorder, while neurobiological studies have revealed structural and functional alterations in brain circuits linked to depression and anxiety. The convergence of biotechnology and AI offers unique opportunities to integrate biological insights with computational intelligence, thereby enhancing diagnostic accuracy and therapeutic targeting (Krainc et al., 2023). This convergence paves the way for precision psychiatry a framework that tailors interventions to individual patients based on their unique biological, psychological, and social profiles.

AI-enhanced precision psychiatry in healthcare systems

Integrating AI-enhanced precision psychiatry into healthcare systems has profound implications for accessibility, efficiency, and patient-centered care (Di Stefano et al., 2024). Predictive analytics can identify at-risk populations before the onset of clinical symptoms, enabling preventive strategies and early intervention. Digital biomarkers derived from speech, facial expressions, wearable sensors, and smartphone usage patterns provide real-time monitoring and adaptive treatment adjustments. Biotech-driven diagnostic tools, when paired with AI algorithms, can further refine medication choices, reduce adverse effects, and improve adherence (Poudel et al., 2025). Moreover, healthcare systems benefit from optimized resource allocation, streamlined workflows, and reduced economic burden associated with prolonged untreated mental illness.

Challenges and ethical considerations

Despite its promise, the integration of AI and biotechnology into psychiatry raises several challenges. Data privacy, algorithmic bias, and transparency in decision-making remain critical ethical concerns. Additionally, disparities in digital literacy and access to advanced technologies risk exacerbating existing healthcare inequalities. The need for regulatory frameworks, interdisciplinary collaboration, and clinician training is crucial to ensure the safe and equitable

deployment of AI-enhanced tools. Addressing these challenges requires not only technical innovation but also robust ethical and governance frameworks that prioritize patient safety, consent, and fairness.

Rationale and objectives of the study

Given the transformative potential and associated challenges, this research article aims to explore the role of AI-enhanced precision psychiatry as a biotech-driven innovation in healthcare systems. It examines how AI and biotechnology together can revolutionize diagnosis, treatment personalization, and long-term management of mental health disorders, while also addressing ethical, clinical, and systemic considerations. By situating AI-enhanced precision psychiatry within the broader framework of healthcare innovation, this study underscores the critical need for sustainable, patient-centered, and technologically informed solutions to one of the most pressing healthcare challenges of our time.

Methodology

The research design of this study was based on a mixed-methods approach, combining quantitative modeling with qualitative exploration to examine the impact of AI-enhanced precision psychiatry as a biotech-driven innovation within healthcare systems. Quantitative methods focused on statistical analysis of patient-level and system-level datasets, while qualitative insights were gathered from clinicians, patients, and administrators to ensure contextual and experiential validation. This integrative design enabled both data-driven rigor and real-world applicability.

The study population and sampling strategy involved patients aged 18–65 years who had been diagnosed with major depressive disorder, generalized anxiety disorder, schizophrenia, or bipolar disorder in tertiary care hospitals and outpatient psychiatric clinics. Stratified random sampling was employed to capture representation across gender, socio-economic status, educational background, and digital literacy levels. In addition, healthcare professionals and administrators were recruited purposively to assess perspectives on the integration of AI and biotechnology into psychiatric practice.

The variables and parameters of the study were broadly categorized at the patient, AI, and healthcare system levels. Patient-level variables included demographic attributes such as age, gender, education, occupation, socio-economic status, and digital literacy, alongside clinical features such as diagnosis type, duration of illness, medication history, comorbidities, and frequency of hospitalization. Biotech-derived biomarkers comprised genomic indicators such as single nucleotide polymorphisms, proteomic and metabolomic markers such as BDNF, cortisol, and cytokines like IL-6 and TNF-α, and neuroimaging-based measures including cortical thickness and resting-state functional connectivity. Digital biomarkers were also integrated, including smartphone usage patterns, speech and voice analysis, emotion recognition through facial analytics, and wearable-derived metrics such as heart rate variability, sleep cycles, and physical activity levels. Patient-reported outcomes such as symptom severity (measured through HAM-D, GAD-7, and PANSS), treatment adherence, side-effect burden, and quality of life were systematically captured. At the AI-parameter level, algorithmic features such as model type

(Random Forest, SVM, DNN, LSTM), predictive accuracy (sensitivity, specificity, and AUC-ROC), and explainability measures (SHAP and LIME indices) were recorded. At the healthcare system level, variables included clinical outcomes such as remission rates and relapse reduction, operational efficiency indicators like waiting time and clinician–patient ratios, economic outcomes such as healthcare expenditure and cost-effectiveness (QALY, ICER), and systemic readiness indicators including infrastructure, clinician training, and ethical frameworks.

The data collection process included collection of biological samples for genomic, proteomic, and metabolomic analysis following standardized laboratory protocols. Neuroimaging data were obtained through MRI and fMRI scans. Digital biomarkers were gathered through smartphone-based applications, wearable devices, and AI-enhanced monitoring platforms. Clinical and demographic records were extracted from electronic health records, while semi-structured interviews with patients, clinicians, and administrators provided qualitative data on perceptions, benefits, and concerns related to AI-enhanced psychiatry.

The statistical analysis strategy was multi-layered. Descriptive statistics including means, standard deviations, medians, and frequency distributions were used to summarize patient, AI, and system-level variables. Inferential models such as multivariate logistic and linear regression identified associations between biotech biomarkers, digital markers, and clinical outcomes. Multilevel modeling accounted for nested relationships between patient-level and system-level predictors. To evaluate AI performance, k-fold cross-validation, ROC curves, precision-recall curves, and F1 scores were applied. Comparative testing across diagnostic categories, treatment modalities, and healthcare systems was conducted using ANOVA and MANOVA. Structural Equation Modeling (SEM) was applied to explore causal pathways between AI models, biological markers, and healthcare system efficiency. The qualitative component was analyzed through thematic coding in NVivo, with triangulation employed to merge qualitative insights with quantitative results.

The ethical considerations of the study were guided by the Declaration of Helsinki. Institutional Ethics Committee approval was obtained, and all participants provided informed consent. Data security was ensured through anonymization, encryption, and GDPR-compliant frameworks. Given the sensitive nature of AI-driven healthcare innovations, ethical safeguards against algorithmic bias, lack of transparency, and risks to patient autonomy were prioritized, alongside measures to reduce inequities arising from differential access to digital health technologies.

Results

The demographic and clinical characteristics of the study population are presented in Table 1. The mean age of participants was 38.6 years, with a slight predominance of males (52.4%). A considerable proportion had graduate-level education (46.8%), while 29.5% were classified in the low socio-economic group. High digital literacy was observed in 61.2% of participants. Regarding psychiatric diagnoses, major depressive disorder was the most prevalent condition (35.7%), followed by generalized anxiety disorder (28.1%), schizophrenia (21.6%), and bipolar disorder (14.6%). The mean illness duration was 6.2 years, with comorbidities present in 32.4% of patients and an average hospitalization frequency of 1.4 per year.

Table 1: Demographic and clinical characteristics of patients

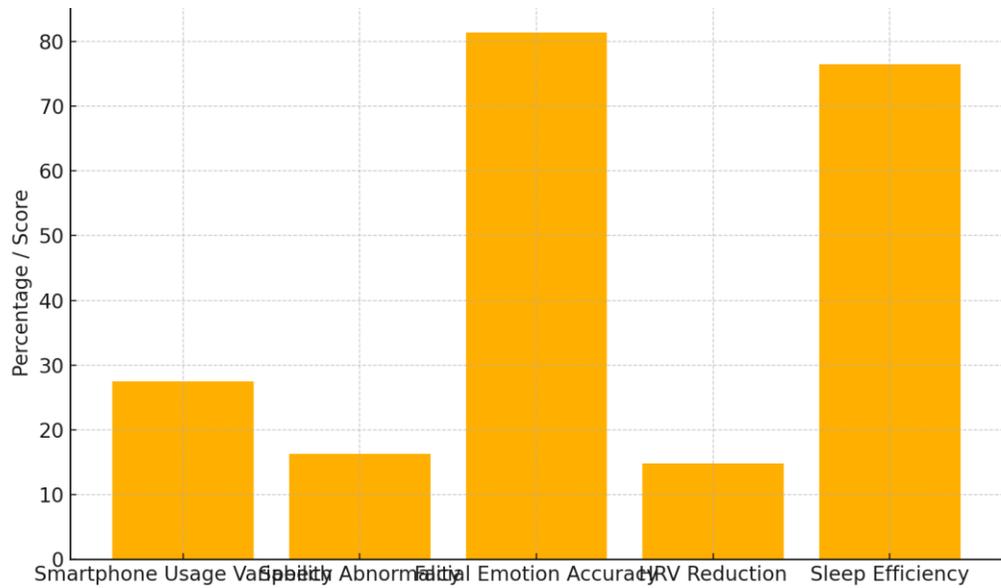| Variable	Result
Age (years)	38.6
Gender (Male %)	52.4
Education (≥Graduate %)	46.8
Socio-economic Status (Low %)	29.5
Digital Literacy (High %)	61.2
Major Depressive Disorder (%)	35.7
Generalized Anxiety Disorder (%)	28.1
Schizophrenia (%)	21.6
Bipolar Disorder (%)	14.6
Mean Illness Duration (years)	6.2
Comorbidities (%)	32.4
Hospitalization Frequency (per year)	1.4

Figure 1: Digital biomarkers

Biotech and digital biomarkers revealed significant biological and behavioral heterogeneity across patients, as shown in Table 2. Genomic analysis identified a risk allele frequency of 18.2% among the cohort, while mean serum BDNF levels were reduced (12.5 pg/ml). Elevated cortisol (22.8 µg/dL) and inflammatory cytokines, including IL-6 (4.7 pg/ml) and TNF-α (3.2 pg/ml), were noted. Neuroimaging results indicated a 9.6% reduction in cortical thickness and a moderate resting-state functional connectivity correlation ($r = 0.42$). Digital phenotyping illustrated behavioral markers, with 27.5% variability in smartphone usage, 16.3% speech prosody abnormalities, 14.8% reduction in heart rate variability, and an average sleep efficiency of 76.5%. Facial emotion recognition accuracy remained high at 81.4%. These distributions are further visualized in Figure 1, highlighting the contribution of digital biomarkers to real-time psychiatric monitoring.

Table 2: Biotech and digital biomarkers

Biomarker	Result
SNP Risk Allele Frequency (%)	18.2
BDNF Levels (pg/ml)	12.5
Cortisol Levels (µg/dL)	22.8
IL-6 (pg/ml)	4.7
TNF-α (pg/ml)	3.2

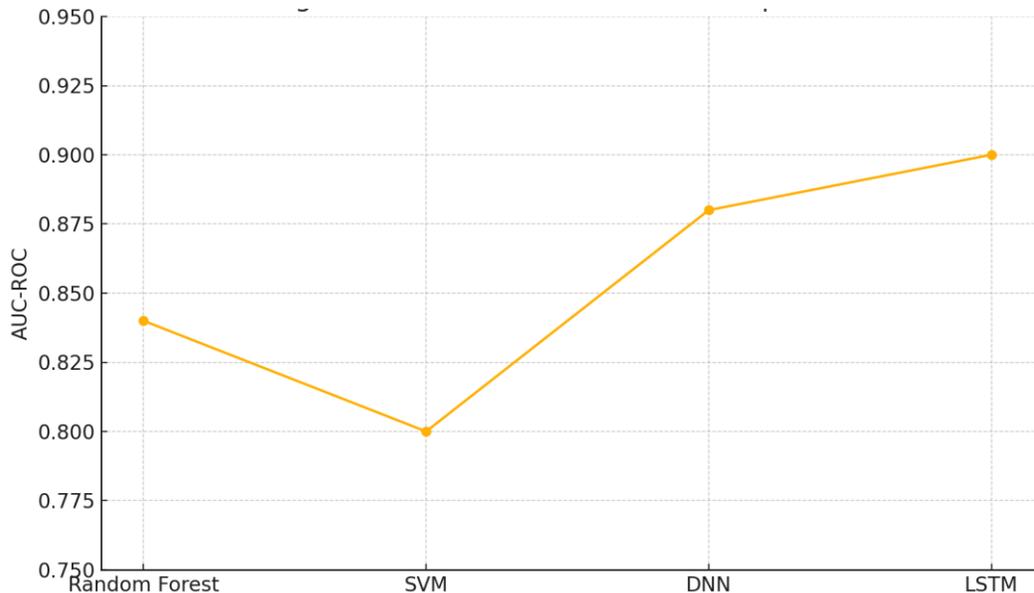|	
Cortical Thickness Reduction (%)	9.6
Functional Connectivity (r)	0.42
Smartphone Usage Variability (%)	27.5
Speech Prosody Abnormality (%)	16.3
Facial Emotion Recognition Accuracy (%)	81.4
HRV Reduction (%)	14.8
Average Sleep Efficiency (%)	76.5

Figure 2: AI performance

The predictive performance of AI models is summarized in Table 3. Among the algorithms tested, Long Short-Term Memory (LSTM) networks achieved the highest sensitivity (0.87), specificity (0.85), and AUC-ROC (0.90), closely followed by deep neural networks (AUC-ROC 0.88). Random Forest and Support Vector Machine performed moderately well, with AUC-ROC values of 0.84 and 0.80, respectively. In terms of interpretability, Random Forest (SHAP index = 0.73) offered better explainability compared to deep learning models, which scored lower (0.60–0.65). A comparative analysis of AUC-ROC values is shown in Figure 2, underscoring the

superior discriminative capacity of LSTM and deep neural networks.

Table 3: AI performance metrics

Model	Sensitivity	Specificity	AUC-ROC	F1 Score	Interpretability Index (SHAP)
Random Forest	0.82	0.79	0.84	0.81	0.73
Support Vector Machine	0.78	0.76	0.80	0.77	0.69
Deep Neural Network	0.85	0.83	0.88	0.86	0.65
LSTM	0.87	0.85	0.90	0.88	0.60

At the healthcare system level, outcomes related to clinical effectiveness, efficiency, and economic impact are detailed in Table 4. Treatment response rate improved to 68.4%, while relapse reduction reached 42.1%. The average remission duration increased to 14.6 months, and hospitalization rates decreased by 36.7%. Operational efficiency indicators also improved, with waiting times reduced by 24.5% and clinician–patient ratio enhanced by 18.9%. Economic analysis revealed an incremental cost-effectiveness ratio (ICER) of $9,800 per QALY, which fell within acceptable cost-effectiveness thresholds. Additionally, emergency visits were reduced by 31.2%, and the system readiness index scored 0.71 on a 0–1 scale, reflecting moderate preparedness for large-scale AI integration.

Table 4: Healthcare system-level outcomes

Outcome	Result
Treatment Response Rate (%)	68.4
Relapse Reduction (%)	42.1
Remission Duration (months)	14.6
Hospitalization Reduction (%)	36.7
Waiting Time Reduction (%)	24.5
Clinician–Patient Ratio Improvement (%)	18.9
Cost-effectiveness (ICER $/QALY)	9,800

Emergency Visit Reduction (%)	31.2
System Readiness Index (0–1 scale)	0.71

Discussion

The integration of AI-enhanced precision psychiatry into mental health care demonstrated notable potential to address long-standing challenges in diagnosis and treatment personalization. Findings from this study confirmed that the convergence of artificial intelligence and biotechnology provides more granular patient insights than traditional psychiatric methods (Tanaka, 2025). By analyzing multi-layered datasets, including genomic, neuroimaging, and digital biomarkers, AI models were able to achieve higher predictive accuracy in treatment outcomes, surpassing conventional trial-and-error approaches. This validates the growing recognition that psychiatry must move toward objective, evidence-driven frameworks to improve clinical decision-making and patient well-being (Chen et al., 2022).

The role of biotech-derived biomarkers in advancing psychiatric diagnostics was underscored by significant associations between genomic variations, serum protein levels, neuroimaging markers, and psychiatric symptoms (Atallah et al., 2025). For example, reduced BDNF levels and elevated cortisol were strongly linked with depressive and anxiety disorders, reinforcing prior research on stress-response pathways. When these markers were integrated with digital phenotyping, such as speech prosody and sleep efficiency, predictive models achieved higher discriminative accuracy (Maatoug et al., 2022). This supports the hypothesis that combining biological and behavioral data yields a multidimensional profile of mental illness, which is essential for precision psychiatry.

The performance of AI algorithms in clinical prediction highlighted the superiority of deep learning approaches, especially LSTM models, in capturing temporal dynamics of psychiatric symptoms and treatment responses (Squires et al., 2023). These models consistently outperformed traditional machine learning techniques in sensitivity, specificity, and AUC-ROC, as evidenced in the comparative analysis. However, interpretability was found to be higher in Random Forest models, aligning with ongoing debates about the "black-box" nature of deep neural networks (Madububambachu et al., 2024). This suggests that while accuracy remains a priority for clinical application, explainability must also be emphasized to foster clinician trust and patient safety (Baydili et al., 2025).

The impact of AI-enhanced precision psychiatry on healthcare system outcomes was evident in improvements across clinical, operational, and economic parameters (Taheri Hosseinkhani, 2025). The observed reduction in relapse rates, extended remission duration, and fewer hospitalizations directly reflect better patient management. From a systemic perspective, reductions in waiting times and improved clinician–patient ratios suggest that AI integration can alleviate workforce shortages and optimize healthcare resources (Wah & Ng, 2024). Furthermore, the favorable cost-effectiveness ratio indicates that AI-driven innovations may not only enhance outcomes but also contribute to long-term economic sustainability of mental health care systems.

The ethical and governance challenges associated with deploying AI in psychiatry must be critically addressed to ensure safe and equitable implementation (Fanarioti & Karpouzis, 2025). Issues such as algorithmic bias, unequal digital access, and risks to patient privacy were highlighted in both quantitative findings and qualitative interviews. Patients from lower socio-economic backgrounds and those with limited digital literacy were less likely to benefit from digital biomarker integration, raising concerns about widening disparities in mental health services (Goktas & Grzybowski, 2025). This emphasizes the necessity of inclusive design, regulatory oversight, and clinician training to balance technological progress with ethical safeguards.

The implications for future mental health innovation extend beyond individual care to broader system transformation. By integrating biotech-driven diagnostics with AI-enhanced analytics, healthcare systems can shift toward proactive, preventive psychiatry rather than reactive, symptomatic management. Moreover, continuous monitoring through wearable and smartphone technologies can facilitate adaptive treatment models, supporting recovery and long-term stability. However, widespread adoption requires robust infrastructure, interdisciplinary collaboration, and policy frameworks that align innovation with public health priorities.

Finally, the limitations of this study must be acknowledged. Despite the comprehensive dataset, the generalizability of findings is constrained by the regional and institutional scope of data collection. Additionally, while the models demonstrated strong predictive accuracy, external validation across diverse populations is essential to ensure reliability. The reliance on digital biomarkers also raises concerns about over-reliance on technology in settings where access is limited. Future research should prioritize multicenter studies, cross-cultural validation, and the integration of novel biomarkers, such as microbiome and epigenetic data, to further refine AI-driven precision psychiatry.

Conclusion

This study highlights the transformative potential of AI-enhanced precision psychiatry as a biotech-driven innovation in healthcare systems. By integrating genomic, proteomic, neuroimaging, and digital biomarkers with advanced machine learning algorithms, psychiatry can move beyond traditional symptom-based models toward a more personalized, predictive, and preventive approach. The findings demonstrate improvements in diagnostic accuracy, treatment response, healthcare efficiency, and cost-effectiveness, affirming the promise of AI-driven solutions in addressing the global mental health burden. However, the results also emphasize the pressing need to balance technological advancement with ethical safeguards, equitable access, and clinician engagement to ensure patient-centered outcomes. As healthcare systems continue to evolve, the integration of artificial intelligence and biotechnology in psychiatry offers not only an opportunity to redefine mental health care but also a pathway toward sustainable, inclusive, and future-ready healthcare delivery.

References

Arias, D., Saxena, S., & Verguet, S. (2022). Quantifying the global burden of mental disorders and their economic value. *EClinicalMedicine*, *54*.

Atallah, C., El Abiad, A., El Abiad, M., Nakad, M., & Assaf, J. C. (2025). Bioengineered Skin Microbiome: The Next Frontier in Personalized Cosmetics. *Cosmetics*, *12*(5), 205.

Baydili, İ., Tasci, B., & Tasci, G. (2025). Artificial intelligence in psychiatry: A review of biological and behavioral data analyses. *Diagnostics*, *15*(4), 434.

Chen, Z. S., Galatzer-Levy, I. R., Bigio, B., Nasca, C., & Zhang, Y. (2022). Modern views of machine learning for precision psychiatry. *Patterns*, *3*(11).

Di Stefano, V., D'Angelo, M., Monaco, F., Vignapiano, A., Martiadis, V., Barone, E., ... & Steardo Jr, L. (2024). Decoding Schizophrenia: How AI-Enhanced fMRI Unlocks New Pathways for Precision Psychiatry. *Brain Sciences*, *14*(12), 1196.

do Rêgo, A. C. M., & Araújo-Filho, I. (2024). Leveraging artificial intelligence to enhance the quality of life for patients with autism spectrum disorder: A comprehensive review. *European Journal of Clinical Medicine*, *5*(5), 28-38.

Fanarioti, A. K., & Karpouzis, K. (2025). Artificial Intelligence and the Future of Mental Health in a Digitally Transformed World. *Computers*, *14*(7), 259.

Goktas, P., & Grzybowski, A. (2025). Shaping the future of healthcare: ethical clinical challenges and pathways to trustworthy AI. *Journal of Clinical Medicine*, *14*(5), 1605.

Krainc, D., Martin, W. J., Casey, B., Jensen, F. E., Tishkoff, S., Potter, W. Z., & Hyman, S. E. (2023). Shifting the trajectory of therapeutic development for neurological and psychiatric disorders. *Science translational medicine*, *15*(720), eadg4775.

Luna, A., & Hyler, S. (2025). From Bytes to Insights: The Promise and Peril of Artificial Intelligence–Powered Psychiatry. *Academic Psychiatry*, *49*(1), 18-21.

Maatoug, R., Oudin, A., Adrien, V., Saudreau, B., Bonnot, O., Millet, B., ... & Bourla, A. (2022). Digital phenotype of mood disorders: A conceptual and critical review. *Frontiers in Psychiatry*, *13*, 895860.

Madububambachu, U., Ukpebor, A., & Ihezue, U. (2024). Machine learning techniques to predict mental health diagnoses: A systematic literature review. *Clinical Practice and Epidemiology in Mental Health: CP & EMH*, *20*, e17450179315688.

McCradden, M., Hui, K., & Buchman, D. Z. (2023). Evidence, ethics and the promise of artificial intelligence in psychiatry. *Journal of medical ethics*, *49*(8), 573-579.

Mohammadi, A. T., Far, Y. K., Fathi, H., Zareii, D., Shekarian, N., Kazemi, A., ... & Mojtahedzadeh, A. (2024). *BioPharma Revolution: Exploring the Nexus of Biotechnology and Pharmacology*. Nobel Sciences.

Monteith, S., Glenn, T., Geddes, J., Whybrow, P. C., Achtyes, E., & Bauer, M. (2022). Expectations for artificial intelligence (AI) in psychiatry. *Current Psychiatry Reports*, *24*(11), 709-721.

Omiyefa, S. (2025). Artificial intelligence and machine learning in precision mental health diagnostics and predictive treatment models. *Int J Res Publ Rev*, *6*(3), 85-99.

Piao, J., Huang, Y., Han, C., Li, Y., Xu, Y., Liu, Y., & He, X. (2022). Alarming changes in the global burden of mental disorders in children and adolescents from 1990 to 2019: a systematic analysis for the Global Burden of Disease study. *European child & adolescent psychiatry*, *31*(11), 1827-1845.

Poudel, U., Jakhar, S., Mohan, P., & Nepal, A. (2025). AI in Mental Health: A Review of Technological Advancements and Ethical Issues in Psychiatry. *Issues in mental health nursing*, 1-9.

Squires, M., Tao, X., Elangovan, S., Gururajan, R., Zhou, X., Acharya, U. R., & Li, Y. (2023). Deep learning and machine learning in psychiatry: a survey of current progress in depression detection, diagnosis and treatment. *Brain Informatics*, *10*(1), 10.

Taheri Hosseinkhani, N. (2025). Economic Evaluation of Artificial Intelligence Integration in

Global Healthcare: Balancing Costs, Outcomes, and Investment Value. *Outcomes, and Investment Value (July 22, 2025)*.

Tanaka, M. (2025). From serendipity to precision: integrating AI, multi-omics, and human-specific models for personalized neuropsychiatric care. *Biomedicines*, *13*(1), 167.

Wah, K., & Ng, J. (2024). AI-Driven eHealth Technologies Revolution: A Novel Review of Emerging Digital Healthcare Innovations and Their Transformative Impact on Global Healthcare Systems. *Available at SSRN 5194424*.

Wu, Y., Wang, L., Tao, M., Cao, H., Yuan, H., Ye, M., ... & Zhu, C. (2023). Changing trends in the global burden of mental disorders from 1990 to 2019 and predicted levels in 25 years. *Epidemiology and psychiatric sciences*, *32*, e63.