Global Health Economics and Sustainability

REVIEW ARTICLE

Artificial intelligence in mental healthcare: A review of health economics, sustainability, and global health perspectives

Fabiana Chyczij[1,2], Mariana Paixão[1], and Sara Diogo Gonçalves[3]*

[1]Unidade de Saúde Familiar Fénix, Unidade Local de Saúde de Trás-os-Montes e Alto Douro (ULSTMAD), Vila Real, Portugal

[2]Clinical Academic Center of Trás-os-Montes and Alto Douro, University of Trás-os-Montes and Alto Douro (UTAD), Vila Real, Portugal

[3]Gabinete de Projetos e Investigação Aplicada, Murça, Portugal

Abstract

Mental disorders are among the leading causes of disability worldwide, imposing burdens on individuals, healthcare systems, and economies. Shortages of mental health professionals, unequal access to care, and increasing demand highlight the need for innovative solutions. Artificial intelligence (AI) has emerged as a technology with potential to transform mental healthcare through improved diagnosis, treatment, monitoring, and service delivery. This review examines AI applications in global mental health, focusing on opportunities, challenges, and implications for health equity. A narrative review was conducted using PubMed, Scopus, and Web of Science. Studies addressing AI technologies, digital mental health interventions, predictive analytics, telepsychiatry, health system integration, and mental health were identified and synthesized. Findings indicate that AI can enhance mental healthcare through early detection, personalized treatment planning, predictive risk assessment, digital therapeutics, and remote care delivery. These applications may expand access to mental health services, particularly in underserved and resource-limited settings, while supporting sustainability through resource allocation and data-driven decision-making. However, challenges include data privacy, algorithmic bias, limited transparency, regulatory uncertainty, and the risk of exacerbating health inequalities. Effective implementation requires governance, culturally appropriate applications, and preservation of human-centered care. Future developments in personalized psychiatry, explainable AI, and integration into public health systems may expand AI's role in mental healthcare. Overall, AI represents a tool for addressing global mental health challenges, but its benefits depend on responsible, equitable, and ethical implementation. Collaboration among healthcare professionals, researchers, policymakers, and technology developers is essential to ensure AI improves outcomes and supports sustainable healthcare systems worldwide.

Keywords: Artificial intelligence; Mental health; Global mental health; Health equity; Digital health; Healthcare sustainability

***Corresponding author:**
Sara Diogo Gonçalves
(saradiogogoncalves@gmail.com)

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1. Introduction

The growing prevalence of mental health conditions represents one of the most pressing public health and economic challenges of the 21st century. Globally, the burden of mental disorders continues to escalate, contributing significantly to non-fatal disability and accounting for a massive drain on global economic productivity through lost working days and diminished human capital (Liu *et al.*, 2025). Pervasive mental health workforce shortages severely compound this crisis. Across both low- and middle-income countries and high-income regions, the availability of psychiatrists, psychologists, and specialized nurses falls drastically short of demand (Acuña-Rodríguez *et al.*, 2025). Consequently, traditional face-to-face clinical models are increasingly unsustainable, undermining global efforts to achieve universal health coverage and leaving a critical treatment gap unaddressed.

In response to these systemic constraints, the emergence of artificial intelligence (AI) in healthcare has accelerated, offering alternative paradigms for service delivery aimed at maximizing allocative efficiency within strained health budgets (Faiyazuddin *et al.*, 2025). In recent years, AI-driven technologies such as machine learning systems, conversational agents, and predictive algorithms have been progressively incorporated into healthcare settings, particularly in regions where access to mental health professionals remains limited (Ni & Jia, 2025; Olawade *et al.*, 2024). As global mental health challenges continue to grow, these technologies are increasingly viewed as tools that can complement traditional care models and optimize resource deployment.

Despite these potential benefits, integrating AI into mental health services has also raised significant ethical, clinical, and social concerns. Questions regarding data privacy, transparency, algorithmic bias, and the reliability of automated systems remain central within current medical debates (Chustecki, 2024). Moreover, mental healthcare involves highly sensitive patient information and complex human interactions, making responsible AI use especially important. For this reason, many researchers and international health organizations have emphasized the need for appropriate regulation, ethical oversight, and human supervision in AI-assisted healthcare systems (Ali *et al.*, 2025; Tavory, 2024).

From a global health economics perspective, however, the macroscale implementation of these digital tools risks widening the Global North–South digital divide rather than alleviating it. The global implementation of AI in mental health may reinforce existing inequalities if access to digital infrastructure and technological resources remains uneven across populations and countries. Low-income regions often face systemic barriers related to basic internet access, healthcare investment, and digital literacy, severely limiting the sustainable benefits that AI-based interventions may provide (Löchner *et al.*, 2025). Consequently, understanding the opportunities, challenges, and equity implications of AI in global mental health has become an essential topic in contemporary healthcare research. This article evaluates the economic viability and systemic equity of integrating AI into global mental health frameworks, with a particular focus on mitigating the clinical workforce crisis without widening the Global North–South digital divide.

2. Methods

This study followed a narrative review format. Although it is not a full systematic review, it incorporates key elements of systematic literature identification and study selection to ensure transparency and comprehensiveness. Given the rapidly evolving nature of AI technologies and their applications in mental healthcare, evidence from peer-reviewed articles, reviews, reports, and relevant conference proceedings was considered. Where appropriate, recent abstracts were included to capture emerging developments not yet fully represented in the published literature.

2.1. Literature search

A structured literature search was performed across PubMed, Scopus, and Web of Science using combinations of controlled vocabulary terms and free-text keywords related to AI, mental healthcare, digital health, and global health implications. Boolean operators (AND/OR) were used to combine search concepts. The search strategy was adapted according to the requirements of each database. The complete search strings for each database are provided in Table 1.

The main search concepts included: (i) AI technologies, (ii) mental health and psychiatric applications, and (iii) healthcare systems, accessibility, sustainability, and equity-related outcomes.

Articles published in any language were considered during the search process. However, no eligible non-English articles were identified during screening and selection; therefore, all included studies were published in English, and no translation procedures were required. Priority was given to studies published within the last decade to reflect recent advances in AI technologies; however, seminal papers and landmark reports were included where relevant. Studies were selected based on their relevance to AI applications in mental healthcare, their implications for global health systems, and their discussion of opportunities, challenges, sustainability, accessibility, and equity considerations.

Table 1. Search strategies used for database retrieval

Database	Search string
PubMed	("Artificial Intelligence"[Mesh] OR "artificial intelligence" OR AI OR "machine learning" OR "deep learning" OR "natural language processing") AND ("Mental Health"[Mesh] OR mental health OR mental disorder* OR psychiatry OR depression OR anxiety OR "psychological well-being") AND ("Digital Health" OR "digital mental health" OR chatbot* OR "digital therapeutic*" OR telepsychiatry OR "predictive analytics") AND ("Global Health" OR equity OR accessibility OR "healthcare access" OR "universal health coverage" OR sustainability OR "low- and middle-income countr*")
Scopus	TITLE-ABS-KEY(("artificial intelligence" OR AI OR "machine learning" OR "deep learning" OR "natural language processing") AND ("mental health" OR "mental disorder*" OR psychiatry OR depression OR anxiety OR "psychological well-being") AND ("digital health" OR "digital mental health" OR chatbot* OR "digital therapeutic*" OR telepsychiatry OR "predictive analytics") AND ("global health" OR equity OR accessibility OR "healthcare access" OR sustainability OR "health economics"))
Web of Science	(("artificial intelligence" OR AI OR "machine learning" OR "deep learning" OR "natural language processing") AND ("mental health" OR "mental disorder*" OR psychiatry OR depression OR anxiety OR "psychological well-being") AND ("digital health" OR "digital mental health" OR chatbot* OR "digital therapeutic*" OR telepsychiatry OR "predictive analytics") AND ("global health" OR equity OR accessibility OR "healthcare access" OR sustainability OR "health economics"))

2.2. Eligibility criteria and search date

Literature was considered eligible when it addressed the application, implications, challenges, or future perspectives of AI in mental healthcare. Studies were selected based on their relevance to AI-driven diagnosis, treatment, monitoring, digital mental health interventions, healthcare accessibility, sustainability, health economics, global health equity, or ethical and regulatory considerations. Publications unrelated to AI applications in mental healthcare, studies without sufficient relevance to the review objectives, and non-peer-reviewed sources without scientific contribution were excluded. The literature search was conducted up to June 10, 2026.

As this study represents a narrative review, no formal quality assessment or risk-of-bias evaluation was performed. Instead, evidence was interpreted according to the relevance, scientific contribution, and consistency of findings across the literature.

The identified literature was reviewed and synthesized using a narrative thematic approach. Relevant information was extracted from the selected studies based on their primary focus, reported AI applications, clinical and health system implications, identified benefits, limitations, and recommendations for future implementation. Studies were subsequently grouped into major thematic categories based on recurring concepts identified across the literature. These themes included: (i) AI applications in mental healthcare, including diagnostic support, predictive analytics, digital therapeutics, chatbots, and telepsychiatry; (ii) opportunities for improving healthcare access and service delivery; (iii) implications for global health equity and digital inclusion; (iv) economic and sustainability considerations; (v) ethical, regulatory, and governance challenges; and (vi) future directions for AI integration into mental health systems. This thematic organization allowed synthesis of diverse evidence sources while maintaining the broad perspective appropriate for a narrative review.

3. Results

The literature search identified 636 records: 230 from Scopus, 215 from PubMed, and 191 from Web of Science. The retrieved records were subsequently screened according to their relevance to the objectives of this narrative review, focusing on AI applications in mental healthcare, health system implications, accessibility, sustainability, and equity considerations.

4. Technological taxonomy: Artificial intelligence applications in mental health

To evaluate the economic viability and sustainability of digital health frameworks, it is essential to establish a precise technological taxonomy. Rather than acting as a singular, monolithic entity, AI enters the psychiatric landscape through a diverse ecosystem of specialized tools (Morelli *et al.*, 2024; Santos *et al.*, 2025). From a health economics and systems-engineering perspective, these applications can be structurally categorized based on their clinical goals: either as demand-mitigation mechanisms designed to reduce the influx of patients into primary care, or as clinical-productivity optimizers built to amplify the efficiency of the existing healthcare workforce (Kopach-Konrad *et al.*, 2007; Olawade *et al.*, 2025).

4.1. Chatbots and conversational agents

Automated conversational systems provide immediate, low-threshold psychological assistance by executing structured clinical models, such as digital cognitive behavioral therapy (CBT). Functioning as scalable, first-line intervention tools, these agents operate continuously without incremental human-labor costs (Farzan *et al.*, 2024). By acting as an automated triage or preliminary care layer, they absorb non-acute patient demand, thereby directly alleviating the systemic pressure points caused by the global deficit of human therapists.

4.2. Predictive analytics

Predictive analytics leverages advanced machine learning models to synthesize complex, heterogeneous datasets including electronic health records, continuous physiological monitoring from wearable devices, and environmental indicators (Fahim *et al.*, 2025). These algorithms identify patterns invisible to standard clinical assessment to forecast disease onset, anticipate treatment resistance, and predict acute psychiatric crises before they occur. For healthcare systems, shifting from a reactive care model to a proactive, predictive stance optimizes early intervention strategies and reduces high-cost hospital readmissions (Fahim *et al.*, 2025; Nap *et al.*, 2025).

4.3. Natural language processing and sentiment analysis

Natural language processing (NLP) and computational linguistics offer a highly objective method for clinical evaluation by translating human communication into quantifiable data metrics (Velupillai *et al.*, 2018). By analyzing acoustic properties, text outputs, social media patterns, or vocal inflections during standard video consultations, NLP models perform real-time sentiment analysis. This allows for the precise tracking of subtle cognitive declines, shifting emotional states, and early markers of relapse, enriching practitioners' diagnostic accuracy without increasing the temporal length of clinical sessions (Jain *et al.*, 2023).

4.4. Digital therapeutics

Representing a significant shift in evidence-based medicine, digital therapeutics are clinically validated, software-driven interventions designed to prevent, manage, or treat psychiatric conditions (Insel, 2023). These applications require rigorous clinical trial validation and regulatory approval to be prescribed as legitimate medical treatments (Phan *et al.*, 2023). Digital therapeutics platforms frequently utilize generative AI to tailor behavioral monitoring protocols, exposure therapies, and coping mechanisms to individual user trajectories, offering highly standardized, auditable, and economically sustainable care pathways (Insel, 2023; World Health Organization, 2026).

4.5. Artificial intelligence-augmented telepsychiatry

Telepsychiatry has historically overcome geographical barriers; however, integrating AI transforms remote care into an optimized operational model (Bobkov *et al.*, 2025). AI-augmented telepsychiatry platforms deploy ambient intelligence to automate clinical documentation, extract key metrics from patient interactions, and provide real-time diagnostic support. By reducing administrative friction, which frequently consumes over 30% of a clinician's working hours, this technology increases face-to-face clinical throughput and extends the operational capacity of scarce medical personnel (Razaghi *et al.*, 2026).

Despite the growing evidence supporting AI applications in mental healthcare, the current literature also presents important limitations. Reported benefits vary considerably across interventions and clinical contexts, and the magnitude of effects observed in digital mental health interventions is not consistently superior to established approaches (Torous *et al.*, 2025). Several studies have reported modest improvements in symptom reduction, while others have demonstrated limited clinical relevance or uncertain long-term benefits (Cameron *et al.*, 2025). Furthermore, digital interventions often face challenges with user engagement and retention, with some studies reporting high attrition rates. These limitations may reflect differences in intervention design, usability, digital literacy, patient characteristics, and the level of human support provided alongside technological tools.

In addition, many AI-based mental health applications remain limited by methodological issues, including small sample sizes, short follow-up periods, reliance on self-reported outcomes, lack of external validation, and potential bias arising from non-representative training datasets (Ali *et al.*, 2025). AI models developed in controlled research environments may not perform equivalently when implemented across diverse healthcare systems and populations. Therefore, although AI represents a promising approach for improving access and efficiency in mental healthcare, current evidence should be interpreted cautiously, and further robust clinical evaluations are required to establish efficiency, cost-effectiveness, safety, and long-term sustainability.

5. Health economics perspective: Evaluation of artificial intelligence frameworks

The structural integration of AI within psychiatric networks must be rigorously evaluated through empirical economic evaluation metrics to justify large-scale capital deployment (Mendlovic *et al.*, 2026). Within global health systems, mental health financing has historically suffered from systemic underinvestment, requiring interventions to prove not only clinical efficacy but also strict financial viability (Mahomed, 2020). By examining automated health technologies through an economics lens, ministries of health and private payers can transition from speculative adoption to data-driven procurement. Consequently, assessing these digital interventions requires a comprehensive analysis across four core economic dimensions: cost-effectiveness, budget impact, resource allocation, and the transition toward value-based care pathways (Gomes *et al.*, 2022).

5.1. Cost-effectiveness and utility

Cost-effectiveness analysis in digital mental health measures the financial expenditure required to achieve a specific clinical outcome, typically quantified in terms of quality-adjusted life years or disability-adjusted life years averted (Buntrock, 2024). Traditional psychiatric treatments incur substantial, recurring human-labor costs that scale linearly with patient volume, limiting their incremental efficiency (Flores *et al.*, 2025; Jayawardana *et al.*, 2023). In contrast, AI applications, particularly automated conversational agents and digital therapeutics, exhibit near-zero marginal costs once the initial algorithmic infrastructure is deployed. By delivering evidence-based protocols at a fraction of the cost of face-to-face therapy, these systems demonstrate highly favorable incremental cost-effectiveness ratios, making them competitive interventions for maximizing population health gains under constrained fiscal parameters (Hu *et al.*, 2024).

5.2. Budget impact analysis

While cost-effectiveness evaluates long-term value, budget impact analysis assesses the short- to medium-term financial feasibility and net cash flow changes within a specific healthcare budget. The introduction of predictive analytics and automated triage tools alters healthcare expenditure by shifting the financial burden away from high-cost tertiary interventions, such as emergency psychiatric admissions and prolonged hospitalizations (Reckers-Droog *et al.*, 2024). Although the upfront financial commitment for software licensing, cloud data architecture, and staff training represents a significant budgetary surge, the subsequent reduction in clinical complications and readmissions creates systemic cost offsets. Over a standard three-to-five-year budgetary horizon, these macroeconomic offsets flatten the healthcare expenditure curve, proving that upfront digital investments yield net financial sustainability for national health budgets (Nguyen *et al.*, 2024; White *et al.*, 2023).

5.3. Resource allocation and allocative efficiency

Optimal resource allocation is the cornerstone of sustainable health systems, aiming to distribute scarce clinical assets to maximize societal well-being. Severe workforce shortages mean that highly trained psychiatrists frequently spend substantial portions of their shifts on administrative charting or managing non-acute cases that could be resolved through low-intensity channels (Ballout, 2025; Herrera *et al.*, 2025). AI-augmented telepsychiatry and NLP documentation tools improve allocative efficiency by automating clinical workflows, expanding the existing workforce's treatment capacity without requiring immediate payroll expansion. By creating a stratified care model in which automated systems manage low-acuity triage and human specialists focus exclusively on complex, severe clinical pathologies, health systems minimize resource waste and maximize structural utility (Cunha Reis, 2025).

5.4. Value-based care paradigm

Global healthcare systems are progressively transitioning away from traditional fee-for-service reimbursement models, which incentivize the volume of medical interventions, toward value-based care frameworks that reward objective patient outcomes and cost-containment (Douglas *et al.*, 2025). AI is a critical technological enabler for value-based behavioral health, providing continuous, passive, and objective metrics of patient progress through sentiment analysis and wearable data tracking. This shift from episodic subjective monitoring to continuous objective data streams allows payers to link clinical performance directly to financial compensation (Yeasmin *et al.*, 2025). Ultimately, by preventing clinical relapses through proactive machine learning warnings and standardizing care delivery via digital therapeutics, AI aligns the financial incentives of healthcare providers, patients, and economic payers around long-term recovery metrics (Carrera *et al.*, 2024).

The growing adoption of AI in mental healthcare presents significant opportunities to improve access to services, enhance diagnostic accuracy, support clinical decision-making, and promote more sustainable healthcare systems. At the same time, important challenges related to ethics, equity, governance, and implementation must be addressed to ensure responsible and effective use of these technologies. Furthermore, ongoing advances in personalized psychiatry, explainable AI, and health system integration are expected to shape the future of AI-enabled mental healthcare. Table 2 provides a framework summary. For the purpose of this narrative review, the categories presented in Tables 1 and 2 represent qualitative assessments derived from the reviewed literature rather than formal quantitative scoring systems. Priority level reflects the perceived importance and urgency of each area for advancing sustainable and equitable mental healthcare, considering factors such as unmet clinical needs, scalability, and relevance to health system challenges. Level of evidence refers to the strength and consistency of available scientific support, with higher levels reflecting findings supported by clinical studies, systematic reviews, randomized controlled trials, or multiple consistent reports. Potential impact reflects the expected contribution of each AI application to improving healthcare access, efficiency, quality of care, and patient outcomes.

The growing adoption of AI technologies has expanded the range of tools available for mental healthcare delivery. Current applications address key challenges in diagnosis, treatment, monitoring, and access to care, particularly in underserved populations. A summary of the major AI applications in global mental health and their associated benefits is presented in Table 3.

6. Healthcare sustainability: Long-term viability of artificial intelligence frameworks

The concept of sustainability in contemporary health systems extends beyond ecological considerations to encompass a system's structural, operational, and financial capacity to maintain high-quality care over time (Mortimer *et al.*, 2018). As global populations face increasingly complex health crises, traditional medical frameworks are reaching an operational breaking point because of severe resource constraints and rising costs. Digital technologies, when deeply integrated into structural workflows, can shift the paradigm, transforming vulnerable healthcare architecture into resilient, sustainable infrastructure. Consequently, evaluating the long-term sustainability of AI frameworks in behavioral health requires a multidimensional analysis that focuses on structural digital transformation, access optimization, the containment of systemic healthcare burdens, and the establishment of durable service delivery mechanisms (Anastasiadou *et al.*, 2025; Osareme *et al.*, 2024).

6.1. Digital transformation as a sustainable foundation

True digital transformation involves the complete rewiring of clinical pathways and operational infrastructure, rather than simply overlaying software on outdated legacy medical systems (Stoumpos *et al.*, 2023). Within psychiatric services, this structural evolution replaces highly variable, paper-heavy, and uncoordinated processes with automated, interoperable cloud architectures that streamline the entire continuum of care. By digitizing and processing massive medical data streams, AI systems reduce administrative inertia and minimize diagnostic redundancies that waste hospital resources. This fundamental technological transformation establishes an agile, data-driven operational baseline that enables health departments to remain flexible, rapidly adopt future technological innovations, and maintain longitudinal care stability without requiring exponential budget increases (Chen *et al.*, 2024; Gebler *et al.*, 2025).

6.2. Access optimization and democratic distribution

Optimizing healthcare access is critical to building a socially sustainable medical model that ensures high-quality psychiatric interventions are democratically distributed regardless of patient geography or socioeconomic status (Kruk *et al.*, 2018). Traditional psychiatric networks are plagued by severe centralized bottlenecks, where specialized clinicians are concentrated in affluent urban centers, forcing rural or marginalized populations to

Table 2. Artificial intelligence in global mental health: Framework summary

Aspect	Opportunities	Challenges	Future directions	Priority level
Clinical	Early diagnosis, personalized treatment	Algorithmic bias, data privacy	Personalized psychiatry, explainable artificial intelligence	High
Access and equity	Expanded reach in low- and middle-income countries, telepsychiatry	Digital divide, cultural misalignment	Inclusive datasets, global governance	Critical
Economic	Cost reduction, workforce optimization	High upfront investment, return on investment uncertainty	Value-based care integration	High
Sustainability	Reduced administrative burden	Environmental impact of artificial intelligence training	Carbon-neutral artificial intelligence models	Medium

Table 3. Artificial intelligence applications: Technology, evidence, impact and recommendations

Application	Description	Level of evidence	Potential impact (Access/ Efficiency)	Key limitations	Recommended solutions
Chatbots and conversational agents	Digital CBT, triage	Moderate-High	+++ (24/7 scalability)	Limited empathy, safety risks	Human oversight + hybrid models
Predictive analytics	Risk prediction (suicide, relapse)	High	+++ (proactive care)	Data bias, false positives	Diverse datasets + external validation
NLP and sentiment analysis	Real-time mood monitoring	Moderate	++ (objective tracking)	Privacy concerns	On-device processing + encryption
Digital therapeutics	Validated software interventions	High (RCTs)	+++ (standardized, low-cost)	Regulatory hurdles	WHO/EMA fast-track pathways
AI-augmented telepsychiatry	Documentation + decision support	Moderate–high	+++ (clinician productivity)	Infrastructure needs	Edge computing in LMICs

Note: Evidence level was categorized according to the availability and consistency of supporting studies. Potential impact was qualitatively assessed using a three-level scale based on expected effects on access, efficiency, and healthcare outcomes: + = low potential impact, ++ = moderate potential impact, and +++ = high potential impact. Priority level reflects strategic relevance for implementation in mental healthcare systems.
Abbreviations: AI: Artificial intelligence; CBT: Cognitive behavioral therapy; EMA: European Medicines Agency; LMICs: Low- and middle-income countries; NLP: Natural language processing; RCTs: Randomized controlled trials; WHO: World Health Organization.

endure prolonged, dangerous waiting periods. AI-driven automated conversational systems, predictive triaging, and smartphone-based digital therapeutics bypass these rigid physical boundaries by providing evidence-based, culturally adaptable interventions instantly on a global scale. This programmatic optimization democratizes early intervention, allowing vulnerable individuals to receive essential support before conditions worsen into severe, debilitating crises (Ray *et al.*, 2025; Sun *et al.*, 2023).

6.3. Alleviation of the systemic healthcare burden

The escalating global burden of mental disorders strains primary care clinics, overcrowded emergency departments, and acute inpatient facilities with cases that could have been managed effectively through proactive outpatient strategies (Krishnan *et al.*, 2025). Machine learning models and real-time NLP tools systematically alleviate this compounding pressure by functioning as high-efficiency triage and continuous monitoring buffers (Balaban *et al.*, 2025). By catching early behavioral markers of psychiatric relapse and offering continuous coping strategies, automated systems effectively intercept acute decompensations before they require expensive emergency hospitalization. Deflecting low-acuity and predictable crises away from specialized critical care facilities significantly reduces systemic burden, preserving intensive hospital resources for the most volatile, life-threatening clinical pathologies (El Jabiry *et al.*, 2025).

6.4. Models for sustainable service delivery

For digital health innovations to achieve permanent, sustainable service delivery, they must move beyond temporary, grant-funded pilot programs and integrate into official national reimbursement registries and public health policies. Sustainable deployment requires structured, hybrid human–AI clinical models in which automated tools act as force multipliers rather than full clinician replacements, thereby mitigating high rates of occupational burnout among medical staff (Ahmed *et al.*, 2025). Furthermore, by securing structural policy frameworks, such as standardizing digital prescription codes and establishing transparent value-based financing, health systems can guarantee consistent, long-term operational funding. Ultimately, this formalized integration stabilizes the healthcare workforce, standardizes the quality of psychiatric delivery, and protects public health systems from localized fiscal shocks (Khalil *et al.*, 2025).

7. Global health implications: Demographics, equity, and geopolitics

The macroeconomic and structural analysis of AI in mental health must ultimately be mapped onto the shifting demographic and geopolitical landscapes of the 21st century (Alhuwaydi, 2024). Digital health innovations do not deploy into a vacuum; instead, they intersect with deep global health asymmetries, rapidly shifting age distributions, and structural societal transitions. If technological deployment ignores these shifting epidemiological realities, advanced computational algorithms risk becoming exclusive luxuries that aggravate global health disparities rather than solving them (Ahmed *et al.*, 2025; Alhuwaydi, 2024). Therefore, evaluating the comprehensive global health implications of AI-driven psychiatric frameworks requires a critical assessment across four cross-cutting areas: low-resource settings, structural equity, rapidly aging populations, and the mental health crises driven by rapid global urbanization (Zheng & Zhang, 2025).

7.1. Low-resource settings and the treatment gap

In low- and middle-income countries, the psychiatric treatment gap frequently exceeds 80%, with many low-resource settings possessing fewer than one mental health professional per 100,000 inhabitants (Patel *et al.*, 2025). In these fragile environments, building traditional, brick-and-mortar psychiatric facilities and training a sufficient workforce would require decades of infeasible financial investment. AI applications offer a scalable alternative by utilizing basic smartphone networks to bypass centralized clinical infrastructure and deliver automated, culturally adapted behavioral interventions directly to remote populations (Espino Carrasco *et al.*, 2025). However, for these tools to achieve true structural utility in low-resource environments, international aid and domestic health financing must look past individual software applications to fund basic public digital utilities, preventing localized structural bottlenecks from undermining technical efficacy.

7.2. Equity, accessibility, and the digital divide

Implementing digital health frameworks raises severe ethical and economic concerns about reinforcing the Global North–South digital divide. While high-income regions possess the high-speed data infrastructure, digital literacy, and regulatory maturity to safely deploy predictive machine learning algorithms, marginalized and low-income populations face systemic barriers to basic technological access (Hadjiat, 2023; Western *et al.*, 2025). Furthermore, because the vast majority of machine learning models are trained on clinical data collected from Western, educated, industrialized, rich, and democratic populations, these algorithms exhibit deep algorithmic biases when applied to diverse global communities (Norori *et al.*, 2021). Achieving true global health equity requires an immediate transition toward decentralized data sovereignty, inclusive international algorithmic training sets, and pricing models that prevent advanced diagnostic technologies from becoming commercialized privileges (Bitomsky *et al.*, 2024).

7.3. Aging populations and neurocognitive challenges

The global population is undergoing an unprecedented demographic transition, with the number of individuals aged 60 and over projected to double by mid-century, placing immense structural pressure on long-term healthcare budgets (The Lancet Healthy Longevity, 2021). This demographic shift is accompanied by an escalating prevalence of late-life depression, social isolation, and neurocognitive disorders such as Alzheimer's disease and related dementias (Qin *et al.*, 2025). AI-driven predictive analytics and passive NLP tools offer essential mechanisms for managing this demographic strain by analyzing daily verbal communication, gait adjustments, and sleep patterns to detect early cognitive decline long before clinical symptoms present. By automating early diagnostic triaging and providing continuous monitoring for elderly individuals living alone, smart home health integrations can significantly delay institutionalization, reduce long-term elder-care costs, and preserve the fiscal sustainability of aging national economies (Mohapatra & Anaraky, 2026; Moreno-Pineda *et al.*, 2026).

7.4. Urbanization and the modern environmental strain

For the first time in human history, more than half of the global population resides in urban areas, a structural shift projected to reach nearly 70% over the next few decades, driven by rapid migration across Asia and Africa (Gu *et al.*, 2021). Rapid, uncoordinated urbanization is highly correlated with elevated rates of severe anxiety, chronic depression, and psychotic disorders due to chronic environmental stressors, social fragmentation, and economic inequality (Srivastava, 2009). AI-driven digital therapeutics and geo-spatial predictive algorithms allow public health departments to address this urban crisis by synthesizing real-time environmental data, such as noise pollution, localized air quality index levels, and population density metrics, with individual physiological stress responses. This intersection of environmental data science and mobile health tracking enables systems to deliver targeted, preventive psychological coping mechanisms directly to urban citizens navigating volatile, high-stress areas, transforming municipal health management into a proactive, localized defense network (Subramaniam *et al.*, 2022). Figure 1 provides an overview of the technological taxonomy of AI applications in mental health.

8. Ethical and policy challenges

Despite the considerable potential of AI to improve mental healthcare delivery and expand access to services worldwide, its implementation raises significant ethical, legal, and policy concerns. Addressing these challenges is essential to ensure that AI technologies are safe, equitable, transparent, and beneficial for patients and healthcare systems.

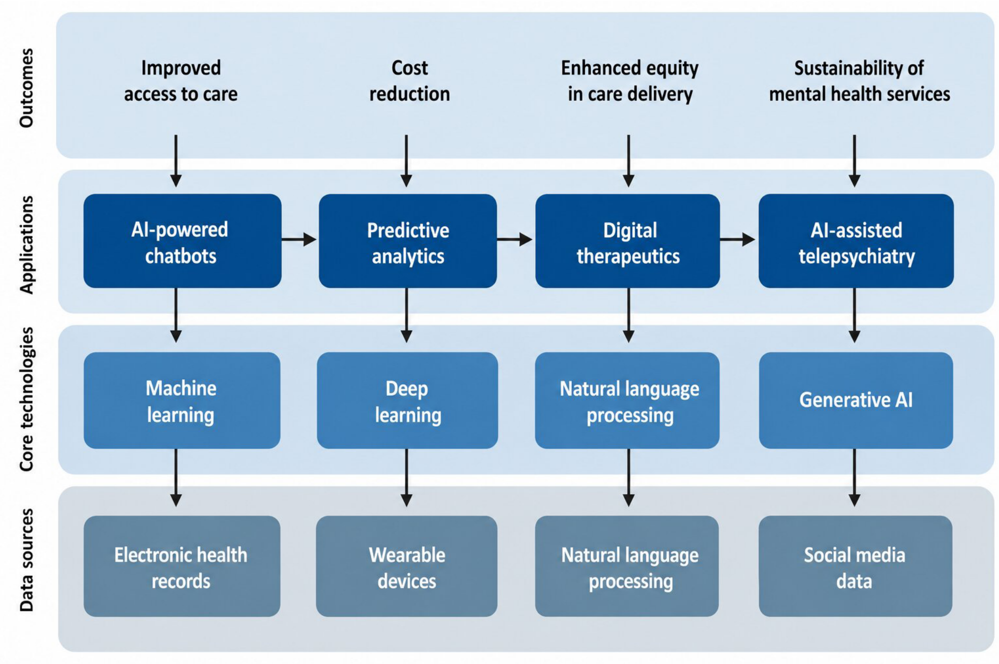

Figure 1. Technological taxonomy of artificial intelligence (AI) applications in mental health. The directional arrows represent the conceptual pathway through which foundational AI technologies (e.g., machine learning, deep learning, and natural language processing) enable specific mental healthcare applications (e.g., predictive analytics, chatbots, digital therapeutics, and AI-augmented telepsychiatry), which may subsequently contribute to improvements in diagnosis, treatment, accessibility, efficiency, and health system sustainability. The arrows indicate a functional relationship rather than a strictly linear process.

8.1. Data privacy and confidentiality

Mental health data are among the most sensitive forms of personal health information. AI systems often rely on large datasets obtained from electronic health records, mobile applications, wearable devices, social media platforms, and digital therapeutics. The collection, storage, and analysis of such data raise concerns regarding privacy, informed consent, data ownership, and cybersecurity (Ali *et al.*, 2025).

Unauthorized access, data breaches, or misuse of personal information may expose individuals to stigma, discrimination, or psychological harm. These concerns are particularly relevant in mental healthcare, where patients may disclose highly personal information regarding emotional states, psychiatric symptoms, or suicidal ideation. Furthermore, many AI-based mental health applications operate across national borders, creating additional challenges in complying with varying data protection regulations. Robust governance frameworks, secure data management practices, and transparent consent procedures are therefore critical for maintaining public trust and protecting patient rights.

8.2. Algorithmic bias and health equity

Artificial intelligence systems are only as reliable as the data they are trained on. If training datasets are incomplete, unrepresentative, or influenced by existing social inequalities, AI models may perpetuate or even amplify health disparities (Norori *et al.*, 2021). Algorithmic bias may result in inaccurate diagnoses, unequal treatment recommendations, or reduced effectiveness among certain demographic groups, including ethnic minorities, rural populations, women, older adults, and individuals from low- and middle-income countries (Joseph, 2025).

In global mental health, bias poses a particular challenge because most AI models are trained on data from high-income countries and may not adequately reflect cultural, linguistic, or socioeconomic differences across diverse populations. Consequently, AI tools designed for one context may perform poorly when applied elsewhere. Ensuring diverse and representative datasets, conducting external validation studies, and regularly auditing algorithms for fairness are essential steps toward promoting equitable mental healthcare (Norori *et al.*, 2021).

8.3. Regulatory and governance challenges

The rapid pace of AI innovation has outpaced the development of comprehensive regulatory frameworks. Questions remain regarding the classification, approval, monitoring, and accountability of AI-based mental health technologies. Unlike conventional medical devices, many AI systems continuously evolve through machine learning, making it difficult to establish standardized regulatory procedures (Mennella *et al.*, 2024).

Governments and healthcare organizations must develop policies that ensure transparency, safety, effectiveness, and accountability while encouraging innovation. Regulatory authorities face the challenge of balancing patient protection with technological advancement (Pham, 2025). Clear standards for clinical validation, post-market surveillance, algorithm explainability, and risk management are needed to support the responsible integration of AI into mental healthcare systems. International cooperation may also be necessary to harmonize regulations and facilitate the safe deployment of AI technologies across different healthcare settings.

Existing regulatory frameworks provide important foundations for responsible AI use in healthcare. In the European Union, the General Data Protection Regulation establishes requirements for the protection, processing, and sharing of personal health data, including principles of data minimization, transparency, informed consent, and individual rights regarding automated decision-making (Gonçalves-Ferreira *et al.*, 2019). In the United States, the Health Insurance Portability and Accountability Act provides standards for safeguarding protected health information and ensuring secure handling of sensitive patient data. These frameworks are particularly relevant for AI-based mental healthcare applications, which often rely on large-scale datasets derived from electronic health records, mobile health platforms, wearable devices, and digital therapeutic systems (Edemekong *et al.*, 2024).

However, existing regulations were primarily developed before the widespread adoption of adaptive AI systems and may not fully address challenges related to continuously learning algorithms, algorithmic transparency, post-deployment monitoring, and cross-border data governance. For global mental health applications, aligning regulatory standards, ethical principles, and local healthcare contexts will be essential to ensure AI technologies are implemented safely, equitably, and responsibly.

Another important regulatory challenge concerns liability and accountability when AI systems contribute to mental healthcare decisions. Unlike traditional clinical tools, AI-based applications such as mental health chatbots, symptom-monitoring platforms, and clinical decision-support systems may operate with varying levels of autonomy, creating uncertainty regarding responsibility when errors occur (Kambar *et al.*, 2026). Potential harms may include inaccurate risk assessments, failure to identify crisis situations such as suicidal ideation, inappropriate therapeutic responses, or recommendations that are inconsistent with clinical guidelines. Determining liability in such cases requires clear governance frameworks that define the responsibilities of technology developers, healthcare institutions, clinicians, and end-users. AI systems should therefore be implemented with appropriate human oversight, continuous performance monitoring, transparent documentation of system limitations, and mechanisms to report and address adverse events (Rudd, 2023).

In mental healthcare, where decisions often involve complex clinical, ethical, and psychosocial considerations, AI should function as a supportive tool rather than an autonomous decision-maker, ensuring that ultimate clinical responsibility remains appropriately assigned.

Despite the substantial opportunities AI offers in mental healthcare, implementation remains associated with significant challenges that may limit its effectiveness and scalability. Evidence from digital mental health interventions indicates that technological availability alone does not guarantee sustained engagement or improved outcomes. Barriers such as user adherence, digital literacy, cultural acceptability, limited access to digital infrastructure, and insufficient integration with existing healthcare pathways may reduce real-world effectiveness (Borghouts *et al.*, 2021). Furthermore, AI systems may face challenges when transferred from controlled research environments to diverse clinical settings because of differences in patient populations, healthcare resources, and available data.

Additional concerns include algorithmic bias from incomplete or non-representative datasets, limited transparency in some AI models, uncertainty about accountability when errors occur, and regulatory challenges around using sensitive mental health information. Therefore, responsible AI implementation requires not only technological innovation but also comprehensive strategies addressing ethical governance, workforce training, infrastructure development, and continuous evaluation of clinical effectiveness and societal impact.

8.4. Maintenance of the human–artificial intelligence balance

Although AI can improve efficiency and support clinical decision-making, it cannot fully replace the human elements central to mental healthcare. Empathy, compassion, trust, and therapeutic relationships remain fundamental components of effective psychiatric and psychological treatment. Excessive reliance on automated systems may risk depersonalizing care and reducing meaningful patient–provider interactions (Orrù & Mannarini, 2026).

Artificial intelligence should therefore be viewed as a complementary tool rather than a substitute for mental health professionals. Human oversight is particularly important in high-risk situations involving suicide assessment, crisis intervention, severe mental illness, and complex clinical decision-making (Lejeune *et al.*, 2022). Maintaining an appropriate balance between technological innovation and human-centered care will be essential to ensure that AI enhances rather than diminishes the quality of mental health services.

Overall, the ethical and policy challenges associated with AI in mental healthcare underscore the need for responsible development, transparent governance, and patient-centered implementation strategies. Addressing privacy, bias, regulation, and human oversight will be critical to maximizing the benefits of AI while minimizing potential risks to individuals and society.

As AI becomes increasingly integrated into mental healthcare systems, concerns about privacy, fairness, accountability, and human oversight are gaining attention. Understanding these challenges is critical for the responsible and equitable implementation of AI technologies. A summary of the principal ethical and policy challenges and corresponding response strategies is presented in Table 4. Figure 2 provides a conceptual framework of AI for sustainable and equitable mental health.

The conceptual framework in Figure 2, called FramewAI (Framework for AI in sustainable and equitable mental health), summarizes the key principles required for responsible AI implementation. It integrates technological capabilities with ethical governance, regulatory oversight, accessibility, sustainability, and human-centered care to support equitable mental health systems.

Despite growing interest in AI applications for mental healthcare, the current evidence base remains heterogeneous and has important methodological limitations. Although several studies report improvements in symptom monitoring, accessibility, and treatment support, findings are inconsistent, and the magnitude of clinical benefits varies across interventions and populations. Some digital mental health interventions have demonstrated only modest effect sizes compared with traditional approaches, suggesting that technological delivery alone may not be sufficient to achieve substantial clinical improvements (Löchner *et al.*, 2025). Furthermore, engagement and retention remain significant challenges, with some digital interventions reporting high attrition rates that may limit effectiveness in real-world settings.

Additional limitations include small, non-representative study populations; short follow-up periods; reliance on self-reported outcomes; differences in intervention formats and levels of human support; and limited external validation of AI models across diverse healthcare contexts. Moreover, many AI systems are developed using datasets that may not adequately represent different demographic, cultural, and socioeconomic groups, raising concerns regarding generalizability and algorithmic bias. Therefore, while AI has the potential to enhance mental healthcare delivery, current findings should be interpreted cautiously, and further high-quality clinical trials, implementation studies, and long-term evaluations are required to determine its true clinical and health system impact.

Although AI offers promising opportunities to improve mental healthcare delivery, its implementation should be approached cautiously. Current evidence remains limited by heterogeneity in study designs, variable clinical effectiveness, insufficient long-term evaluations, and challenges related to accessibility, regulation, and user acceptance. Future developments should therefore prioritize evidence-based, equitable, and human-centered approaches that address both technological capabilities and real-world healthcare constraints.

9. Future directions

The application of AI in mental healthcare is still evolving, with substantial opportunities for innovation and improvement. Future developments should focus on enhancing personalization, improving transparency and trustworthiness, and facilitating the integration of AI technologies into public health systems. These advancements have the potential to improve mental health outcomes while promoting accessibility, efficiency, and equity at a global scale.

9.1. Personalized psychiatry

One of the most promising applications of AI is advancing personalized psychiatry. Traditional mental health treatments often rely on standardized approaches that may not adequately account for individual differences in genetics, clinical history, environmental exposures, behavioral patterns, and social determinants of health. AI technologies can analyze large, complex datasets to identify patient-specific characteristics and predict treatment responses more accurately.

Table 4. Ethical and governance framework for artificial intelligence in mental health

Challenge	Description	Potential consequences	Policy/Technical solutions	Stakeholders involved
Data privacy	Sensitive data in training & inference	Breaches, stigma, loss of trust	General Data Protection Regulation/Health Insurance Portability and Accountability Act compliance, federated learning	Regulators, developers, patients
Algorithmic bias	Non-representative training data	Health inequities, misdiagnosis	Diverse datasets, bias audits, fairness metrics	Researchers, global health organizations
Regulatory gaps	Rapid evolution vs. slow policy	Unsafe deployment	Adaptive regulation, international standards	World Health Organization, governments
Human–artificial intelligence balance	Over-reliance on automation	Depersonalization of care	Mandatory human oversight in high-risk cases	Clinicians, ethicists

Figure 2. Conceptual framework—artificial intelligence (AI) for sustainable and equitable mental health. FramewAI refers to the proposed framework for AI in sustainable and equitable mental healthcare, illustrating the interaction between technological innovation, ethical governance, health system integration, accessibility, and equity considerations. The framework highlights the need to balance AI-driven efficiency with human-centered care, responsible governance, and equitable implementation across diverse healthcare settings.

Machine learning algorithms have the potential to support precision mental healthcare by helping clinicians select the most appropriate interventions, medications, and therapeutic strategies for individual patients. Data from electronic health records, wearable devices, mobile applications, neuroimaging, and patient-reported outcomes may support more tailored treatment plans. Personalized psychiatry could improve treatment effectiveness, reduce trial-and-error prescribing, enhance patient engagement, and ultimately enhance clinical and economic outcomes.

9.2. Explainable artificial intelligence

As AI systems become more sophisticated, transparency and interpretability will be critical to their acceptance in clinical practice. Many advanced machine learning models operate as "black boxes," providing predictions or recommendations without clearly explaining how conclusions were reached. This lack of transparency may reduce trust among healthcare professionals, patients, and policymakers.

Explainable AI seeks to address this challenge by developing models that produce understandable, interpretable outputs. In mental healthcare, explainability is particularly important because clinical decisions often involve complex ethical considerations and significant consequences for patients. Future research should focus on developing AI systems that not only achieve high predictive accuracy but also provide clear explanations for their recommendations. Improved transparency may facilitate clinician acceptance, support informed decision-making, enhance accountability, and assist regulatory oversight.

9.3. Integration into public health systems

Successful implementation of AI in mental healthcare will depend on integrating it into existing public health infrastructures. AI technologies have the potential to strengthen mental health services by supporting early detection, population-level surveillance, resource allocation, workforce planning, and remote care delivery. These capabilities may be especially valuable in regions facing shortages of mental health professionals and limited healthcare resources.

Future efforts should prioritize scalable, cost-effective AI solutions that can be incorporated into national and regional health systems. Integration will require investments in digital infrastructure, workforce training, data governance frameworks, and regulatory standards. Collaboration among healthcare providers, policymakers, technology developers, and public health organizations will be essential to ensure that AI tools are implemented safely and effectively.

In low- and middle-income countries, AI may expand access to mental healthcare through telemedicine platforms, mobile health applications, and decision-support systems. However, successful deployment will depend on addressing challenges related to internet connectivity, digital literacy, affordability, and cultural adaptation. Public health strategies should therefore focus on ensuring equitable access to AI-enabled services while minimizing the risk of widening existing health disparities.

Overall, future advances in personalized psychiatry, explainable AI, and health system integration are likely to shape the next generation of mental healthcare. By combining technological innovation with ethical governance and equitable implementation, AI can significantly improve global mental health and support sustainable healthcare systems.

10. Conclusion

Artificial intelligence offers meaningful opportunities to improve mental healthcare through early detection, better triage, enhanced efficiency, and wider access to services. These potential benefits are highly relevant to global health economics and sustainability because they may help health systems use scarce resources more effectively while expanding care to underserved populations.

However, the implementation of AI in mental healthcare must be guided by strong governance, robust validation, and a clear commitment to equity. Risks related to privacy, bias, regulation, and overreliance on automation must be actively addressed to prevent unintended harm. The most promising future lies in hybrid models that combine technological innovation with human judgment, ethical oversight, and context-sensitive design. Future advancements in personalized psychiatry, explainable AI, and integration into public health systems may further strengthen the role of AI in addressing the growing global burden of mental illness. Overall, AI should be viewed as a supportive instrument for strengthening mental health systems rather than as a replacement for clinical care. Its long-term value will depend on whether it is deployed responsibly, sustainably, and in ways that reduce rather than reinforce global health inequalities.

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Further disclosure

Artificial intelligence tools were used solely to assist with language editing, proofreading, and improving the clarity and readability of the manuscript. No artificial intelligence tools were used to generate or interpret the scientific findings, conduct the analysis, or make scientific conclusions.

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