# From Asylums to Algorithms: the Evolution of Psychiatry and the Emergence of AI and Biomarkers

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## Abstract

Psychiatry has undergone a profound transformation over the past two centuries, evolving from custodial models of care characterised by institutionalisation and limited therapeutic efficacy to a modern discipline grounded in evidence based, patient centred practice. Historically, people with mental illness were often confined to asylums where care prioritised containment over recovery. Invasive, poorly evidenced treatments were common, reflecting limited understanding of the biopsychosocial determinants of mental illness and contributing to stigma, loss of autonomy, and long-term harm. In response, contemporary psychiatry has adopted ethical safeguards, multidisciplinary approaches, and the biopsychosocial model, emphasising recovery oriented care, informed consent, and community integration. Alongside these conceptual shifts, advances in neuroscience and digital technology are driving a further paradigm change within the field. Artificial intelligence has gained increasing attention for its potential to enhance diagnostic accuracy, risk stratification, and treatment personalisation through the analysis of large and complex clinical datasets. Data driven computational methods are increasingly being applied to identify patterns that may support earlier diagnosis, improve prediction of treatment response, and enhance the efficiency and accessibility of mental health service delivery. In parallel, growing interest in biomarker informed psychiatry reflects efforts to address the historical absence of objective diagnostic tools within mental health care. Advances in genetics aim to improve diagnostic precision and treatment stratification, supporting more individualised and biologically informed care. This article examines the evolution of psychiatry from its historical foundations to emerging innovations in artificial intelligence and biomarkers that are shaping the future of precision mental health care.

## Introduction

Innovation is a cornerstone of medicine, with advances over the last few centuries resulting in increased life expectancies and improved quality of life globally. Compared to other fields within the umbrella of medicine, however, mental health has only more recently come to the forefront as an important determinant of overall well-being. Historically, stigma towards mental illness has been perpetuated by the segregation of those being treated and remains a barrier to the utilization of mental health services (1).

A systematic review and meta-analysis of over 200 studies across 29 countries estimated that 14.3% of deaths worldwide could be attributed to mental disorders (2), showing a clear potential for further advancements in the field to have a large global impact. The complex relationship between physical and mental health means that improvements within psychiatry could have far-reaching effects. Biomarkers and artificial intelligence are emerging avenues of exploration that have the capacity to revolutionize diagnosis, treatment, and crisis management within psychiatry.

## Historical Practices In Psychiatric Care

Historically, psychiatric care was largely defined by institutionalisation, social isolation, and paternalism, with limited emphasis on patient wellbeing or therapeutic efficacy. From the 18th century until well into the 20th century, individuals with mental illness were frequently confined to large asylums, where the primary objective was containment rather than treatment, often resulting in prolonged or lifelong separation from society and minimal patient autonomy or legal protection (3). Treatment approaches during this period were frequently invasive and poorly evidence-based, aimed at controlling behaviour rather than addressing underlying pathology. Early somatic therapies such as insulin coma therapy, hydrotherapy, and prolonged mechanical restraint were widely implemented despite limited evidence of efficacy and significant associated morbidity (4). Similarly, psychosurgical procedures, most notably lobotomy, were adopted in the early to mid-20th century as perceived last-resort interventions, often resulting in irreversible neurological damage and profound ethical controversy (4). Even electroconvulsive therapy, while now recognised as an effective treatment for severe mood disorders, was initially administered without anaesthesia or adequate safeguards, contributing to patient distress and public mistrust (5,6). The dominance of custodial care over cure reflected a limited understanding of the biological, psychological, and social determinants of mental illness, frequently leading to interventions that caused harm without meaningful long-term improvement. These historical shortcomings played a pivotal role in shaping modern psychiatric ethics and practice, driving the field toward patient-centred care, informed consent, and evidence-based interventions (3,4). Contemporary psychiatry now emphasises recovery-oriented, community-based, and multidisciplinary care grounded in the biopsychosocial model. Against this backdrop, advances in neuroscience, data science, and technology have catalysed a further transformation of the field.

Alongside developments in artificial intelligence, growing interest in biomarker-informed psychiatry reflects a shift away from historically imprecise diagnostic and therapeutic approaches toward objective biological measures that may improve diagnostic accuracy, prognostication, and treatment stratification in modern mental health care.

## Biomarkers and Precision Psychiatry

The future of psychiatry is being powerfully driven by innovation in biomarker discovery, an endeavour that addresses the core challenge of biological heterogeneity and aims to anchor the discipline in the mechanisms of brain health and disease. This evolution promises to reshape diagnosis, prognostication, and treatment selection, bridging the long-standing gap between subjective symptomatology and objective pathophysiology. This shift is propelled by the substantial burden of neuropsychiatric disorders and the limited efficacy of current pharmacotherapies in a significant proportion of patients (7). The impetus for this change is well-founded, notably in the immune hypothesis of psychiatric illness, which is supported by meta-analyses of altered cytokine levels and epidemiological links between autoimmune conditions and psychiatric diagnoses (7). While biomarkers, defined as measurable biological indicators used for screening, diagnosis, and prognosis (8), are foundational in other medical specialties (e.g., troponin in cardiology), their translation into routine psychiatric practice has historically lagged (9). However, a pivotal study by Dardani et al. leverages large-scale genetic data to transcend these limitations, identifying 151 potential causal relationships between immune biomarkers and psychiatric conditions. Their work pinpointed 29 biomarkers with a stringent causal inference, revealing condition-specific immune signatures, with schizophrenia and Alzheimer's disease showing the highest yield, and highlighting specific, "druggable" targets such as AGER and CD40 (7). This approach not only moves the field from correlation to causation but also opens immediate avenues for drug repurposing and the development of novel, mechanistically targeted therapies.

With new studies such as this one pushed to the forefront of psychiatry research, current practice may now shift in diagnostic criteria and understanding of the underlying mechanisms of psychiatric conditions. Therefore, the trajectory of psychiatry is now firmly oriented toward a new paradigm of precision medicine, where biomarker-driven insights will progressively transform clinical practice from syndromic observation to biologically informed, individualized patient care.

Despite the promising research on biomarkers as a future tool in the field of psychiatry, there are several barriers to its implementation. Currently, the potential benefits may not outweigh the large cost associated with the new technology, as their predictive value is currently low (10). Since the cause of mental disorders is multi-factorial, any single gene makes only a small contribution to the risk of developing a disorder. Environmental factors such as socio-economic status, as well as gender, health status, age and ethnicity all contribute to determining an individual's risk of developing a specific psychiatric condition (10). The interactions between all these factors are still poorly understood. Any use of biomarker screening for diagnosis would need to take these complexities, as well as a patient's actual reported symptoms, into consideration. Until panels of biomarkers, rather than single markers can be validated, the clinical utility of using them in practice remain low. Although the Dardani et al. study is promising, this work has not yet translated into a clinic ready process.

## Artificial Intelligence in Modern Psychiatry

Another growing area of research, which has the potential to address some of the barriers to the practical application of biomarker technology, is the role of artificial intelligence (AI) in psychiatry. By 2030, WHO estimates that mental illness will be the leading contributor to global disease burden, yet many diagnostic and therapeutic constraints in the field remain, which could be addressed by AI (11). The capacity to manage multimodal data allows it to integrate both genetic and mental health data into a patient's overall health profile, facilitating personalized medicine (12).

There is potential for AI to one day integrate genetic biomarkers, environmental factors, gender and more to determine diagnoses and prognosis with more accuracy than ever before. Thus, addressing the complexities of psychiatric conditions and aiding in the validation of biomarker panels to be used in practice. AI can develop personalized treatment plans using individually identified biomarkers, physiological data, previous treatment responses, and behavioural patterns (12). It guides decision-making when addressing evolving patient needs, to minimize the trial-and-error nature of psychiatric treatments (12). For example, natural language processing analyses subtle indicators in written or spoken words to identify anxiety and depression (12). Virtual therapists have also been increasingly adopted to enhance accessibility to care, especially in emergencies, acting as first-line interventions while longer-term care is being arranged (12). AI-powered apps, wearables, and algorithms contribute to monitoring and early detection (11,13). Lastly, AI is improving the evaluation of treatment efficacy, with advanced understanding of neurobiological and behavioural patterns, thus detecting relapse earlier, allowing for objective outcome measurements, and achieving earlier remission (11-14).

Despite these benefits, there are issues reducing the effectiveness of implementing AI in psychiatry. AI models are not optimized for psychiatric diagnosis and can only be used as an adjunct rather than replacement, as they are only marginally better than random guessing at predicting diagnosis (11). Psychiatric AI models often include insufficient sample sizes and datasets that are representative of marginalized groups (11,13,14). AI is also not able to adequately integrate the highly multi-interactional aspects of mental illness currently (11). Finally, there are ethical considerations regarding data privacy, algorithm bias, informed consent, and interpretability of AI usage (11,13). Further, regulatory approval would need to be sought before implementation may occur in practice. Overall, AI can be used to support current clinical practices in psychiatry, however, due to current limitations, it cannot fully replace the need for human clinicians.

Future recommendations for AI are its integration into the curriculum of educational institutions for future psychiatrists and psychologists, including a focus on the ethical implications (15). Importantly, using AI to automatically learn patterns from objective data can lead to new classification systems for diagnosis that are more precise than current systems such as the DSM-5 and WHO-11, which are largely based on subjective symptomatology (11). Large scale, longitudinal and multimodal data sets with repeated biomarker measurements, clinical assessments and treatment histories are needed, paired with external validation across diverse populations for AI interpretation to be validated for use within this space.

## Future Practice

The parallel advancement of biomarker discovery and artificial intelligence represents not merely an incremental improvement but a foundational shift in psychiatry, one in which previous symptom clusters may be replaced by data driven and individualized care. The current research on biomarkers in psychiatry offers an exciting picture for the future where biological anchors for psychiatric illness are discovered and correlated with measurable immune, genetic or neurobiological signatures. However, their full potential depends on AI's unique capacity to integrate these multifaceted biological markers with environmental, demographic, and behavioural data, thereby overcoming the reductionism that has limited previous biological approaches. In the future, AI is expected to function as the interpretive and translational engine of precision psychiatry, synthesizing complex biomarker panels, real-time physiological data from wearables, and patient-reported outcomes to enable earlier detection, risk stratification, and individualized treatment plans. It is believed that AI may one day be able to create validated interpretations of both biological and environmental factors that can drive not only diagnoses but effective prediction of treatment and relapse. Rather than replacing clinical judgment, this synergistic model will empower psychiatrists to move beyond diagnostic ambiguity and therapeutic uncertainty, instead, shifting to a new era of mental health care that is more objective and personalized to the needs of each patient.

## Conclusion

Psychiatry has evolved beyond practices now recognised as ineffective or harmful, with advances in scientific understanding and treatment evaluation leading to improved patient outcomes. Current research continues to work towards refining the diagnosis and treatment of mental illness. Both artificial intelligence and biomarkers will help create objective measures of mental illness and individualize treatment for patients. The pattern recognition software utilized by AI, including language processing, will allow for more rapid adaptation of a patient's treatment to emerging symptoms and behaviours. While there are certain challenges and ethical considerations in relation to this new technology, AI can be used as a tool by psychiatrists to help tailor and monitor their patients' treatment. The discovery of biomarkers that underpin the development of mental illness will also have profound impacts in developing new targeted treatment options. Understanding the mechanisms that contribute to the symptomatology of various psychiatric conditions will reveal new pharmacological targets. These advancements have the potential to improve the quality of life of millions of people worldwide, and those entering this field should be prepared to integrate these into their practice.

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