Review Articles

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Artificial intelligence in psychiatric diagnosis: challenges and opportunities in the era of machine learning

Inteligência artificial no diagnóstico psiquiátrico: desafios e oportunidades na era do aprendizado de máquina

Inteligencia artificial en el diagnóstico psiquiátrico: desafíos y oportunidades en la era del aprendizaje automático

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ABSTRACT:

The integration of artificial intelligence (AI) into psychiatric diagnosis heralds a new era in mental health care, offering unprecedented opportunities to enhance diagnostic accuracy, personalize treatment, and

streamline clinical workflows. A systematic approach was utilized, adhering to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. This literature review explores the current state of AI in psychiatric diagnosis, highlighting key technologies such as machine learning, natural language processing, and deep learning. We discuss the application of these technologies across various psychiatric disorders, including depression, anxiety, and schizophrenia. While AI holds immense promise, significant challenges remain, including issues of data privacy, model bias, and the clinical validation of AI tools. Furthermore, ethical and regulatory considerations must be addressed to ensure responsible implementation. This review also examines the potential future directions of AI in psychiatry, emphasizing the importance of collaboration between AI systems and human clinicians. As the field evolves, AI has the potential to transform psychiatric practice, offering new avenues for early detection, personalized care, and therapeutic monitoring.

Keywords: artificial intelligence, psychiatric diagnosis, machine learning, mental health technology, personalized psychiatry

RESUMO:
A integração da inteligência artificial (IA) no diagnóstico psiquiátrico anuncia uma nova era nos cuidados de saúde mental, oferecendo oportunidades sem precedentes para melhorar a precisão do diagnóstico, personalizar o tratamento e agilizar os fluxos de trabalho clínicos. Uma abordagem sistemática foi utilizada, aderindo às diretrizes PRISMA *(Preferred Reporting Items for Systematic Reviews and Meta-Analyses).* Esta revisão da literatura explora o estado atual da IA no diagnóstico psiquiátrico, destacando tecnologias-chave como aprendizado de máquina, processamento de linguagem natural e aprendizado profundo. Discutimos a aplicação dessas tecnologias em vários transtornos psiquiátricos, incluindo depressão, ansiedade e esquizofrenia. Embora a IA seja imensamente promissora, permanecem desafios significativos, incluindo questões de privacidade de dados, preconceitos de modelo e validação clínica de ferramentas de IA. Além disso, considerações éticas e regulamentares devem ser abordadas para garantir uma implementação responsável. Esta revisão também examina as possíveis direções futuras da IA na psiquiatria, enfatizando a importância da colaboração entre os sistemas de IA e os médicos humanos. À medida que o campo evolui, a IA tem o potencial de transformar a prática psiquiátrica, oferecendo novos

caminhos para a detecção precoce, cuidados personalizados e monitorização terapêutica.

Palavras-chave: inteligência artificial, diagnóstico psiquiátrico, aprendizado de máquina, tecnologia de saúde mental, psiquiatria personalizada

RESUMEN:
La integración de la inteligencia artificial (IA) en el diagnóstico psiquiátrico presagia una nueva era en la atención de la salud mental, ofreciendo oportunidades sin precedentes para mejorar la precisión del diagnóstico, personalizar el tratamiento y optimizar los flujos de trabajo clínicos. Se utilizó un enfoque sistemático, siguiendo las pautas PRISMA (Elementos de informe preferidos para revisiones sistemáticas y metaanálisis). Esta revisión de la literatura explora el estado actual de la IA en el diagnóstico psiquiátrico, destacando tecnologías clave como el aprendizaje automático, el procesamiento del lenguaje natural y el aprendizaje profundo. Discutimos la aplicación de estas tecnologías en diversos trastornos psiquiátricos, incluidas la depresión, la ansiedad y la esquizofrenia. Si bien la IA es inmensamente prometedora, persisten desafíos importantes, incluidos problemas de privacidad de datos, sesgo de modelos y validación clínica de las herramientas de IA. Además, se deben abordar consideraciones éticas y regulatorias para garantizar una implementación responsable. Esta revisión también examina las posibles direcciones futuras de la IA en psiquiatría, enfatizando la importancia de la colaboración entre los sistemas de IA y los médicos humanos. A medida que el campo evoluciona, la IA tiene el potencial de transformar la práctica psiquiátrica, ofreciendo nuevas vías para la detección temprana, la atención personalizada y el seguimiento terapéutico.

Palabras clave: inteligencia artificial, diagnóstico psiquiátrico, aprendizaje automático, tecnología de salud mental, psiquiatría personalizada

Introduction

The integration of artificial intelligence (AI) in psychiatry marks a significant evolution in the field of mental health care. AI's journey in medicine began decades ago, rooted in the development of early computational models that aimed to replicate human cognition. The foundational work of pioneers like Alan Turing and later advancements in

machine learning (ML) laid the groundwork for AI's application in various medical disciplines, including psychiatry. Early AI systems, such as ELIZA and PARRY, were among the first attempts to simulate human dialogue, highlighting the potential for AI to interact with patients, albeit in a limited capacity [1]. However, these early systems were more experimental than practical tools for diagnosis.

The real shift occurred as computational power and data availability expanded, allowing for the development of more sophisticated algorithms. In psychiatry, AI initially found its applications in diagnostic assistance and pattern recognition. For example, the DENDRAL project in the 1960s demonstrated the potential of AI in complex problem-solving, which was later adapted to include diagnostic applications in various fields, including psychiatry [2].

Today, AI in psychiatry is not just a theoretical exercise but a burgeoning reality. Modern AI systems leverage vast datasets, including electronic health records and patient-reported outcomes, to assist in diagnosing conditions like depression, anxiety, and schizophrenia. These systems use ML models to identify patterns that may be indicative of mental health disorders, often with a level of accuracy that rivals human clinicians [3]. Moreover, AI tools are increasingly being integrated into clinical settings to monitor patient progress, predict treatment outcomes, and personalize therapeutic interventions.

Despite these advancements, the current state of AI in psychiatric diagnosis is still evolving. While AI has shown promise in enhancing diagnostic accuracy and efficiency, challenges remain, particularly regarding the generalizability of AI models across diverse populations and the ethical implications of AI-driven diagnoses. The field continues to grapple with issues related to data privacy, algorithmic bias, and the need for robust validation studies to ensure that AI tools complement rather than replace human judgment [4].

Methodology

A systematic approach was utilized for this literature review, adhering to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to gather relevant articles and studies in Emergency medicine’s critical cases. A thorough search was conducted in reputable databases, including PubMed, Google Scholar, Scopus, and Web of Science, using specific keywords such as "Artificial Intelligence," "Psychiatric

Diagnosis," "Machine Learning," "Mental Health Technology," and "Personalized Psychiatry." to ensure comprehensive coverage of pertinent literature.

The inclusion criteria for the studies were as follows: **(1)** publications in English, **(2)** studies focusing specifically on artificial intelligence, and **(3)** studies reporting on AI in psychiatric diagnosis. Initially, 161 articles were retrieved from the databases. After a meticulous examination to eliminate duplicate references, 23 unique articles met the inclusion criteria. These articles underwent rigorous evaluation through a comprehensive assessment of their titles, abstracts, and full texts, confirming their alignment with the established inclusion criteria and warranting their inclusion in the review.

To provide a clear overview of the study selection process, the PRISMA flow diagram is included below [Figure 1], illustrating the number of records identified, screened, and included in the review, along with reasons for exclusion at each stage.

Types of ai technologies in psychiatry

Artificial intelligence (AI) technologies are revolutionizing psychiatry, offering new ways to enhance diagnostic accuracy and personalize treatment. Among the most prominent AI tools in this field are machine learning (ML) algorithms, natural language processing (NLP), deep learning models, and AI-driven wearable technologies, each playing a distinct role in advancing mental health care.

Machine learning, a subset of AI, uses statistical techniques to enable computers to learn from and make predictions based on data. In psychiatry, ML algorithms, particularly those involving supervised learning, are employed to identify patterns in patient data that may indicate the presence of psychiatric disorders. For example, these algorithms can be trained to differentiate between patients with depression and those with anxiety based on specific clinical features. Unsupervised learning, on the other hand, is used to uncover hidden structures in data, such as subtypes of psychiatric conditions that are not immediately apparent. Reinforcement learning is also gaining traction, where AI systems learn to make decisions by receiving rewards or penalties, potentially optimizing therapeutic interventions [5].

NLP, another crucial AI technology, focuses on the interaction between computers and human language. In psychiatry, NLP is increasingly utilized to analyze the language patterns of patients, which can provide insights into their mental state. By processing large volumes of text from clinical notes or patient conversations, NLP algorithms can detect signs of mental health issues, such as depression or schizophrenia, with a level of nuance that traditional methods may overlook [6]. This is particularly valuable in screening and early diagnosis, where subtle linguistic cues can be indicative of underlying psychiatric conditions.

Deep learning, a more complex form of ML, involves neural networks with many layers that can model intricate patterns in data. In psychiatry, deep learning models have been applied to diverse data sources, including neuroimaging and electronic health records, to identify biomarkers associated with psychiatric disorders. These models excel in recognizing complex, non-linear relationships in data, which are common in psychiatric conditions. For instance, deep learning has been used to predict the onset of conditions like Alzheimer's disease years before clinical symptoms appear, by analyzing brain scans and genetic data [7].

AI-driven wearable technology is another innovative tool that is making significant strides in mental health care. Wearable devices equipped with sensors can continuously monitor physiological and behavioral data, such as heart rate variability, sleep patterns, and physical activity levels. These data points can be analyzed by AI algorithms to detect early signs of psychiatric conditions or to monitor the effectiveness of ongoing treatment. For example, changes in sleep patterns or heart rate variability may indicate the onset of a depressive episode, allowing for timely intervention [6].

AI applications in specific psychiatric disorders

Artificial intelligence (AI) has emerged as a transformative tool in the diagnosis and management of various psychiatric disorders, demonstrating particular promise in addressing complex conditions such as depression, anxiety disorders, schizophrenia, bipolar disorder, and autism spectrum disorders (ASD).

In the realm of depression, AI has shown its capability in both diagnosis and predicting treatment outcomes. Machine learning models can analyze vast datasets, including patient history and genetic information, to identify individuals at high risk for major depressive disorder (MDD). These models

are also being used to predict the efficacy of specific treatments, such as antidepressants or psychotherapy, allowing for more personalized treatment plans [8]. Additionally, AI-driven tools are being utilized to monitor patients' moods and symptoms through mobile apps, enabling early intervention before symptoms worsen.
For anxiety disorders, including generalized anxiety disorder (GAD) and social anxiety disorder, AI is being applied to refine diagnostic processes and treatment strategies. Natural language processing (NLP) technologies, for instance, analyze speech and text patterns to detect signs of anxiety, offering an objective measure that can complement traditional assessment methods [8]. AI algorithms are also helping to personalize therapeutic approaches, such as cognitive-behavioral therapy, by tailoring interventions to the specific cognitive patterns of each patient.

Schizophrenia, a disorder characterized by its heterogeneity and complex symptomatology, has seen significant advancements with AI. Early detection is crucial, and AI models utilizing neuroimaging data have been developed to identify biomarkers associated with the disorder. These tools can distinguish schizophrenia from other psychiatric conditions with overlapping symptoms, such as bipolar disorder, improving diagnostic accuracy and enabling earlier, more targeted interventions [9]. AI is also being employed to predict the course of the illness and potential responses to antipsychotic treatments, which vary widely among individuals.

In bipolar disorder, AI helps differentiate between bipolar and unipolar depression, a common diagnostic challenge due to the overlapping depressive symptoms. Machine learning algorithms analyze patterns in patient data, including mood fluctuations and response to treatment, to enhance diagnostic precision. These technologies also assist in predicting mood episodes and optimizing long-term treatment strategies, reducing the risk of misdiagnosis and inappropriate treatment [10].

Lastly, in autism spectrum disorders (ASD), AI's role in early diagnosis is particularly impactful. AI models, often based on genetic, behavioral, and neuroimaging data, can identify early signs of ASD, which is critical for timely intervention. These models are also being used to develop personalized intervention plans that cater to the unique needs of each individual on the spectrum, enhancing the effectiveness of therapeutic efforts [11].

Data sources and challenges

The integration of Artificial Intelligence (AI) into psychiatric practice presents numerous opportunities, particularly in utilizing various data sources. However, it also introduces significant challenges, especially concerning data privacy, security, and the potential for biases.

Electronic Health Records (EHRs) are a crucial data source in AI-driven psychiatric diagnosis. AI can analyze vast amounts of patient data within EHRs to identify patterns and predict mental health conditions, improving diagnostic accuracy. However, the complexity of psychiatric data, combined with the variability in how symptoms are documented across different healthcare providers, can introduce inconsistencies. These inconsistencies, if not properly managed, may lead to inaccurate predictions or diagnoses. Additionally, the integration of AI with EHRs often requires overcoming challenges related to data interoperability, the heterogeneity of data formats, and the sheer volume of information [12].

Patient-generated data from sources like social media, mobile apps, and wearable devices offer valuable insights into patients' mental health. AI algorithms can analyze this data to detect subtle changes in behavior or mood that might indicate the onset or progression of psychiatric conditions. Despite its potential, using patient-generated data poses significant challenges. Issues include ensuring the accuracy and reliability of this data, which is often unstructured and generated in non-clinical settings. Moreover, the integration of such data with traditional healthcare data raises concerns about the standardization and meaningful interpretation of diverse data types [13].

Data privacy and security are paramount when handling sensitive mental health information. AI systems must navigate complex regulatory environments designed to protect patient confidentiality. As AI increasingly relies on large datasets to train models, the risk of data breaches and unauthorized access grows. Ensuring robust encryption methods, secure data storage, and strict access controls are essential to mitigating these risks. Additionally, AI systems must be designed to comply with privacy laws like the General Data Protection Regulation (GDPR) to protect patients' rights and confidentiality [12, 13].

Bias in AI models presents another significant challenge in psychiatric applications. AI algorithms trained on biased data can perpetuate and even exacerbate existing disparities in mental health care. Biases in EHR data,

often stemming from historical inequities in healthcare delivery, can lead to skewed diagnostic outcomes, disproportionately affecting marginalized groups. Addressing these biases requires careful consideration of the data used to train AI models, along with the development of strategies to identify and mitigate bias. Ongoing efforts to create more inclusive datasets and to adjust algorithms to recognize and compensate for bias are crucial steps toward equitable AI-driven psychiatric care [13].

Challenges in AI implementation

The implementation of AI in psychiatry presents a range of challenges that must be addressed to ensure successful integration into clinical practice. One of the primary hurdles is the clinical validation of AI models. While AI systems, particularly those based on machine learning and deep learning, have shown promise in preliminary studies, there remains a significant gap between these models and their widespread adoption in clinical settings. This gap is primarily due to the need for robust validation studies that can demonstrate the efficacy, accuracy, and generalizability of these models across diverse patient populations and real-world scenarios. Without rigorous validation, there is a risk that AI tools may not perform as expected when applied outside controlled research environments, potentially leading to misdiagnosis or suboptimal treatment outcomes [14, 15].

Regulatory and ethical considerations also pose significant challenges. The regulatory landscape for AI in healthcare is still evolving, and existing frameworks may not fully address the unique characteristics of AI technologies. For instance, there are concerns about how to effectively regulate AI-driven diagnostic tools to ensure they meet safety and efficacy standards while also allowing for innovation. Additionally, ethical issues such as informed consent, algorithmic transparency, and the potential for AI to exacerbate existing healthcare disparities must be carefully managed. The opacity of some AI models, particularly those based on deep learning, complicates efforts to ensure transparency and accountability, making it difficult for clinicians and patients to understand how decisions are made [16, 17].

Another challenge is the integration of AI into routine clinical practice. Many clinicians are skeptical about adopting AI tools, often due to concerns about the reliability of these technologies and a lack of understanding of how they function. This skepticism is compounded by the need for extensive training for healthcare providers to effectively use AI tools.

Moreover, the integration of AI into clinical workflows requires significant changes in practice, including adapting to new diagnostic processes and incorporating AI outputs into decision-making. The success of AI in psychiatry will depend not only on the technology itself but also on the willingness of clinicians to embrace these tools and the support systems in place to facilitate their use [18, 19].

Opportunities and future directions

Artificial intelligence (AI) presents transformative opportunities for the future of psychiatry, particularly in personalized care, early detection, therapeutic monitoring, and collaboration with human clinicians. Personalized psychiatry is one of the most promising applications, where AI can integrate genetic, environmental, and behavioral data to tailor treatments to individual patients. This approach is being driven by advancements in machine learning (ML) and the analysis of multi-omics data, which could lead to more precise diagnostic and prognostic tools, revolutionizing how psychiatric care is delivered [20].

AI also shows significant potential in the early detection and intervention of psychiatric disorders. By analyzing large datasets, including electronic health records (EHRs) and real-time patient-generated data from mobile devices, AI can identify individuals at risk of developing psychiatric conditions before symptoms become clinically apparent. For example, the use of digital phenotyping through smartphone apps is already being explored to monitor patients' mental health continuously, potentially identifying changes in behavior or mood that signal the onset of a disorder [21].

Furthermore, AI can play a crucial role in therapeutic monitoring, offering real-time insights into patient progress. AI-driven tools like the mindLAMP app allow for continuous monitoring of symptoms and behaviors, providing data that can be used to adapt treatment plans dynamically. This real-time feedback loop enhances the ability to manage chronic conditions and could significantly improve patient outcomes [21].

However, despite these advancements, it is crucial to acknowledge the limitations of AI in psychiatric practice. The complexities of human behavior, the nuanced understanding required to differentiate between normality and pathology, and the cultural and historical contexts that influence mental health are areas where human expertise remains indispensable. While AI can assist by analyzing complex data and providing

diagnostic suggestions, it lacks the capacity to engage with patients on a phenomenological level—a critical aspect of effective psychiatric care. Consequently, AI should be viewed as an augmentative tool rather than a replacement for human psychiatrists [22, 23].
The concept of collaborative AI underscores this role, emphasizing that AI will likely serve to enhance, not supplant, the expertise of human clinicians. AI's strength lies in its ability to process vast amounts of data and identify patterns that may not be immediately apparent to human practitioners. However, the ultimate decision-making and the empathetic, ethical engagement with patients will continue to rely on the judgment of trained psychiatrists. As AI continues to evolve, its integration with human expertise is expected to enhance the overall quality of psychiatric care, but it will remain an auxiliary tool that supports rather than replaces human providers [20].

Case studies
The integration of Artificial intelligence (AI) into psychiatric practice has yielded a range of case studies that demonstrate both successful implementations and significant challenges, providing valuable insights for future endeavors.

One notable example of successful AI implementation is Stanford Health Care's use of AI to enhance clinical operations. Through comprehensive pilot programs, Stanford was able to integrate generative AI into various aspects of patient care, which resulted in improved clinician efficiency and patient outcomes. The institution's experience underscores the importance of a detailed evaluation process prior to AI adoption, which includes rigorous testing to ensure the technology aligns with clinical needs. This case highlights the potential for AI to significantly streamline healthcare delivery, provided there is a robust framework for integration [24].

Another case study involves Deep 6 AI, which has revolutionized the recruitment process for clinical trials. Traditionally, identifying suitable candidates for trials is a laborious process, but Deep 6 AI's application of machine learning to analyze vast amounts of patient data has drastically accelerated this process. By efficiently sifting through medical records and matching participants with specific trial criteria, this AI-driven approach has significantly shortened trial timelines, thereby speeding up medical research. This example illustrates how AI can enhance operational efficiency in healthcare settings, particularly in areas requiring extensive data analysis [25].

However, not all AI projects in psychiatry have met with success. For instance, some initiatives have faced challenges due to the complexity of mental health data and the variability in how psychiatric disorders present across different populations. These challenges often stem from the inherent biases in training data, which can lead to less accurate or even harmful outcomes when the AI is deployed in real-world settings. Lessons from these projects emphasize the critical need for careful consideration of data sources and the potential for bias, as well as the importance of ongoing monitoring and adjustment of AI systems after deployment [25].

Conclusion

In conclusion, the integration of Artificial intelligence (AI) into psychiatric practice is rapidly evolving, offering significant opportunities to enhance diagnostic accuracy, personalize treatment, and improve patient outcomes. Through the exploration of various AI technologies, such as machine learning, natural language processing, and wearable technology, this literature review has highlighted the profound impact these innovations can have on mental health care. However, the successful implementation of AI in psychiatry is not without its challenges, including issues related to data privacy, algorithmic bias, and the need for rigorous clinical validation. Despite these hurdles, case studies of AI applications in specific psychiatric disorders demonstrate the potential for AI to revolutionize psychiatric diagnosis and treatment. As AI continues to advance, its role in psychiatry is likely to expand, leading to more effective, personalized, and accessible mental health care, provided that ethical considerations and clinical integration are carefully managed.

References

1. Garber M. When PARRY met ELIZA: a ridiculous chatbot conversation From 1972. Washington: The Atlantic; 2014. https://www.theatlantic.com/technology/archive/2014/06/when-parry-met-eliza-a-ridiculous-chatbot-conversation-from-1972/372428/

2. Lindsay RK, Buchanan BG, Feigenbaum EA, Lederberg J. Applications of artificial intelligence for organic chemistry: the Dendral project. New York: McGraw-Hill; 1980.

3. Lee EE, Torous J, De Choudhury M, Depp CA, Graham SA, Kim HC, Paulus MP, Krystal JH, Jeste DV. Artificial intelligence for mental health care: clinical applications, barriers, facilitators, and artificial wisdom. Biol Psychiatry Cogn Neurosci Neuroimaging. 2021;6(9):856-64. https://doi.org/10.1016/j.bpsc.2021.02.001 PMID:33571718 - PMCID:PMC8349367

4. Brunn M, Diefenbacher A, Courtet P, Genieys W. The future is knocking: how artificial intelligence will fundamentally change psychiatry. Acad Psychiatry. 2020;44(4):461-6. https://doi.org/10.1007/s40596-020-01243-8 PMID:32424706

5. Squires M, Tao X, Elangovan S, Gururajan R, Zhou X, Acharya UR, Li Y. Deep learning and machine learning in psychiatry: a survey of current progress in depression detection, diagnosis and treatment. Brain Inform. 2023;10(1):10. https://doi.org/10.1186/s40708-023-00188-6 PMID:37093301 - PMCID:PMC10123592

6. AI for Precision Mental Health. Kourtzi Z, Liakata M, organisers; Schönlieb CB, Lyons T, Tino P, researchers. London: The Alan Turing Institute; 2019. https://www.turing.ac.uk/research/research-projects/ai-precision-mental-health

7. Li M, Jiang Y, Zhang Y, Zhu H. Medical image analysis using deep learning algorithms. Front Public Health. 2023;11:1273253. https://doi.org/10.3389/fpubh.2023.1273253 PMID:38026291 PMCID:PMC10662291

8. Bracher-Smith M, Crawford K, Escott-Price V. Machine learning for genetic prediction of psychiatric disorders: a systematic review. Mol Psychiatry. 2021;26(1):70-9. https://doi.org/10.1038/s41380-020-0825-2 PMID:32591634 - PMCID:PMC7610853

9. Dwyer DB, Falkai P, Koutsouleris N. Machine learning approaches for clinical psychology and psychiatry. Annu Rev Clin Psychol. 2018;14:91-118. https://doi.org/10.1146/annurev-clinpsy-032816-045037 PMID:29401044

10. Zafar F, Fakhare Alam L, Vivas RR, Wang J, Whei SJ, Mehmood S, Sadeghzadegan A, Lakkimsetti M, Nazir Z. The role of artificial intelligence in identifying depression and anxiety: a comprehensive

literature review. Cureus. 2024;16(3):e56472. https://doi.org/10.7759/cureus.56472

11. Shim M, Kim DW, Lee SH, Hwang HJ. Editorial: AI-based computer-aided diagnosis and prognosis for psychiatric disorders. Front Hum Neurosci. 2022;16:901525. https://doi.org/10.3389/fnhum.2022.901525 PMID:35517988 - PMCID:PMC9062226

12. Ye J, Woods D, Jordan N, Starren J. The role of artificial intelligence for the application of integrating electronic health records and patient-generated data in clinical decision support. AMIA Jt Summits Transl Sci Proc. 2024;2024:459-67. http://www.ncbi.nlm.nih.gov/pmc/articles/pmc11141850/ PMID:38827061 - PMCID:PMC11141850

13. Perets O, Stagno E, Yehuda EB, McNichol M, Anthony Celi L, Rappoport N, Dorotic M. Inherent bias in electronic health records: a scoping review of sources of bias. medRxiv [Preprint]. 2024:2024.04.09.24305594. https://doi.org/10.1101/2024.04.09.24305594 PMID:38680842 PMCID:PMC11046491

14. Cresswell K, Rigby M, Magrabi F, Scott P, Brender J, Craven CK, Wong ZS, Kukhareva P, Ammenwerth E, Georgiou A, Medlock S, De Keizer NF, Nykanen P, Prgomet M, Williams R. The need to strengthen the evaluation of the impact of artificial intelligence-based decision support systems on healthcare provision. Health Policy. 2023;136:104889. https://doi.org/10.1016/j.healthpol.2023.104889 PMID:37579545

15. Farah L, Borget I, Martelli N, Vallee A. Suitability of the current health technology assessment of innovative artificial intelligence-based medical devices: scoping literature review. J Med Internet Res. 2024;26:e51514. https://doi.org/10.2196/51514 PMID:38739911 - PMCID:PMC11130781

16. Van Laere S, Muylle KM, Cornu P. Clinical decision support and new regulatory frameworks for medical devices: are we ready for it? - A viewpoint paper. Int J Health Policy Manag. 2022;11(12):3159-63. https://doi.org/10.34172/ijhpm.2021.144 PMID:34814678 PMCID:PMC10105190

17. Karalis VD. The integration of artificial intelligence into clinical practice. Appl Biosci. 2024;3(1):14-44. https://doi.org/10.3390/applbiosci3010002

18. Rogers WA, Draper H, Carter SM. Evaluation of artificial intelligence clinical applications: detailed case analyses show value of healthcare ethics approach in identifying patient care issues. Bioethics. 2021;35(7):623-33. https://doi.org/10.1111/bioe.12885 PMID:34046918

19. Pashkov VM, Harkusha AO, Harkusha YO. Artificial intelligence in medical practice: regulative issues and perspectives. Wiad Lek. 2020;73(12 cz 2):2722-7. PMID:33611272

20. Hassan S. Advancing precision psychiatry: leveraging AI and machine learning for personalized diagnosis, treatment, and prognosis. Tustin: MarkTechPost; 2024. https://www.marktechpost.com/2024/07/29/advancing-precision-psychiatry-leveraging-ai-and-machine-learning-for-personalized-diagnosis-treatment-and-prognosis/

21. IEEE Pulse. Artificial intelligence and the future of psychiatry. IEEE Pulse; 2020. https://www.embs.org/pulse/articles/artificial-intelligence-and-the-future-of-psychiatry/

22. Lhotská L. Artificial intelligence in medicine and healthcare: opportunity and/or threat. Cas Lek Cesk. 2024;162(7-8):275-8. PMID:38981711

23. Sanches M. On the unique utility of digital technology for bipolar disorder: is there still room for phenomenology? Bipolar Disord. 2020;22(5):530-1. https://doi.org/10.1111/bdi.12908 PMID:32276283

24. Bajwa J, Munir U, Nori A, Williams B. Artificial intelligence in healthcare: transforming the practice of medicine. Future Healthc J. 2021;8(2):e188-94. https://doi.org/10.7861/fhj.2021-0095 PMID:34286183 - PMCID:PMC8285156

25. DigitalDefynd. 40 detailed artificial intelligence case studies. [place unknown]: DigitalDefynd; c2024. https://digitaldefynd.com/IQ/artificial-intelligence-case-studies/

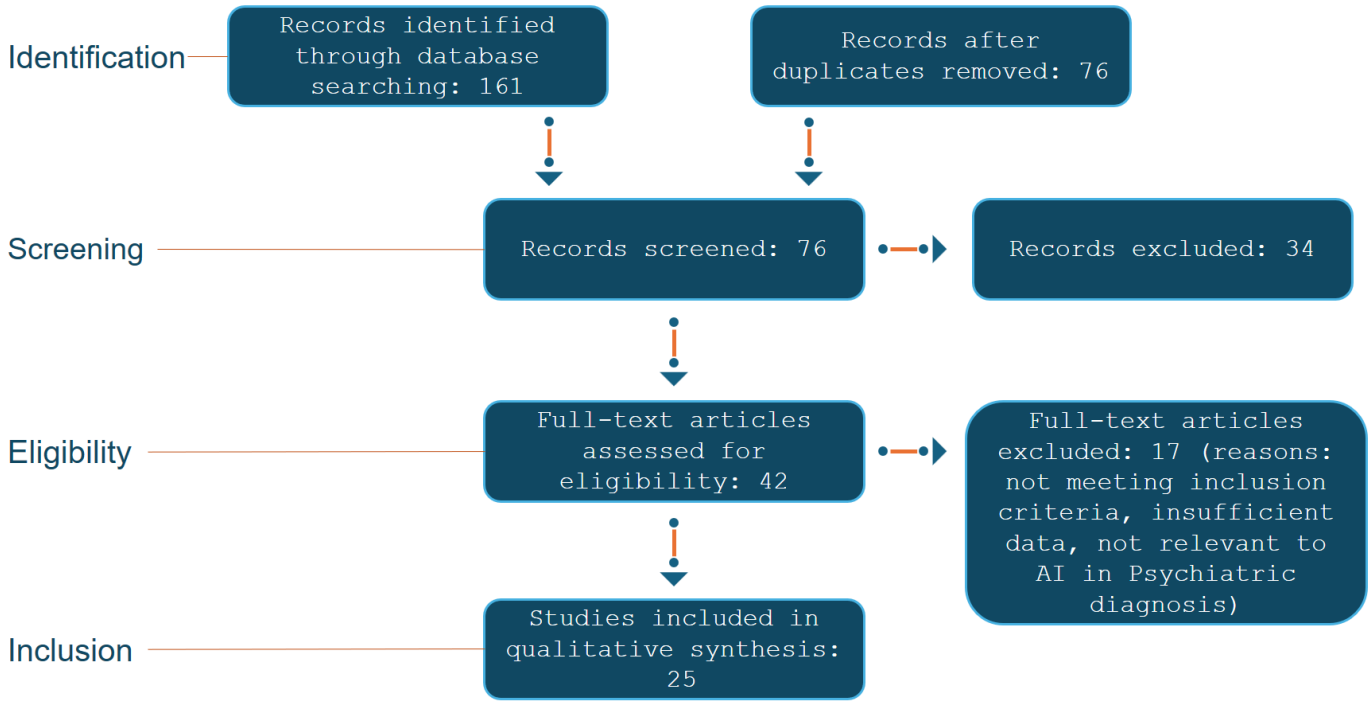

Figure 1. illustrates the PRISMA flow diagram

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