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Artificial Intelligence in Pharmaceutical Care Management for Anxiety, Depression, and Schizophrenia: A Narrative Review

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Abstract

Background: Mental health disorders like anxiety, depression, and schizophrenia are one of the leading causes of disability globally, causing a considerable global health and financial burden. Pharmaceutical care planning (PCP) is important in optimizing medication treatment, improving medication adherence, and reducing adverse therapeutic outcomes. However, traditional therapies often have challenges such as disintegrated care, inadequate personalization, and disparities in availability. Artificial intelligence (AI) offers innovative opportunities & address these limitations by supporting analytical model predicting the disease, personalized therapy selection, and delivery of integrated care.

Objective: The aim of this review is to analyze the implementation of AI in pharmaceutical care management of anxiety, depression, and schizophrenia, emphasizing innovations, improved clinical outcomes, and future opportunities for improving delivery of mental health care.

Methods: Literature review was conducted across PubMed, Scopus, Web of Science, and Google Scholar to identify studies. Eligible publications

included cohort studies, randomized controlled trials, reviews, case studies, and guideline documents that includes AI-based tools or pharmacist-based AI programs in mental health pharmaceutical care plan.
Results: Applications of AI in PCP include accurately predicting & early diagnosing of psychiatric disorders, pharmacogenomics-based medication optimization, use of digital phenotyping to track symptoms & monitor treatment, AI-based telepsychiatry, and technologies supporting adherence. Evidence from clinical trials & case studies suggests that these AI tools augment treatment accuracy, improve medication adherence, limits hospitalizations, and support management of severe mental health disorders. Despite these developments, challenges regarding data privacy, algorithm transparency, uniform implementation across varied health systems & regulatory frameworks persists.
Conclusion: AI-driven technology to pharmaceutical care management hold substantial potential to transform mental health care by providing personalized medication treatment, improving patient outcomes, and reducing inconsistencies. Future research should prioritize integrating AI technology with electronic health data, rigorous real-world validation, ethical safety, and pharmacist-led program to enhance their societal & clinical impact.

Introduction

The mental disorders have been growing and become a global health concern & estimate 970 million people are affected by it. It is ultimately associated with severe consequences like disability & mortality. Depression & anxiety accounts to up to 37.4% and 23% of the burden of global diseases, followed by schizophrenia which is 12% These disorders are prevalent among older adults but it is also emerging as a serious issue in younger people (1). As per report from WHO, every 1 in 4 families will eventually have a member who will develop mental illness (2).

The role of pharmaceutical care in psychiatric treatment emerged in early 1970's. By reviewing the studies, Finley had concluded that development of a key pharmaceutical plan would result in improvement in various domain including treatment outcomes, patient satisfaction and efficient use of resources (3). Recent review studies have also found that there is positive impact of a strong pharmaceutical plan on drug related problems, enhancing medication reconciliation, providing drug-related information comprehensively & improving overall treatment outcomes(4) (5).

Despite the availability of antidepressants and antipsychotics, the proportion of depression rises to 350 million annually(6). The traditional approaches & the predominant mental healthcare model is no longer adequately address the complexities of the challenges of mental illness treatment. It takes on an average of up to 10 years to initiate the treatment after the symptoms of depression arises and two-third of them never receive the treatment adequately(7). The current methods for the treatment of mental disorders include cognitive behavior therapy (CBT), Trans cranial magnetic stimulation & electroconvulsive therapy. Psychotropic medications are available widely and pharmaceutical investments for development of new antipsychotics are rising. However, after investment of billions of dollars in this industry, the efficacy of these treatments are limited (8),(9),(10). These traditional diagnostic criteria rely on clinical signs and self-reported patient symptoms and due to their subjective nature, they are prone to get biased results in diagnosis(11).

In addition to other fields, Artificial Intelligence (AI) has emerged as transformative tool in the diagnosis, management and treatment of mental health disorders(12). AI treatment model can efficiently analyze the data from patient health records, their social media usage and interactions. For example, National Language Processing (NLP) algorithms are capable to assess text and speech which is helpful in detection

of early signs of depression & suicidal thoughts(13). Similarly machine learning (ML) models can help in the preparation of optimized treatment plans by assessing genetic markers & patient data and predict the response of the patient to the treatment(14). AI chatbots are effective in providing psychological assessments to patients (15).
The aim of this review is to investigate the potential of the use of AI in pharmaceutical care plan & management of anxiety, depression & schizophrenia. Early detection & diagnosis of these disorders along with personalized treatment & pharmaceutical care plan by the use of AI.

AI-Driven Pharmaceutical Care for Anxiety

Early Detection and Risk Stratification with AI

Individuals with anxiety can manage their day to day activities but they struggles by concealing their struggles with elevated anxiety levels(16). These symptoms are difficult to diagnose & they are not officially under the categories of DSM-5(17). Since many mental illnesses starts with anxiety including post-traumatic stress disorder & generalized anxiety disorder, it is important to detect it as early as possible. AI can help in early detection of anxiety by analyzing the patterns of data in the patient health records including psychological-l signals and behavioral data as well. This helps in early interventions and personalized treatment. The study is performed by using social media (Tweets on Twitter) of cancer survivors to detect post-traumatic stress disorder. Convolutional Neural Network (CNN) is a deep learning algorithm to analyze these representations and detects post-traumatic stress disorder (18). The results of this study clearly highlights the potential of that deep learning algorithms like CNN can be used along with social media to identify early symptoms of anxiety disorders.
The study is performed using machine learning (ML) technique to quantify human anxiety level. This is a non-intrusive approach and ML based technique was able to measures anxiety -fluctuation levels of users over time and mean anxiety traits. The ML technique is created by making a hybrid of human rating of anxiety on social media posts and train the machine to rate and score the tweets (19).
Another study uses CNN and deep neural network (DNN) to combine attributes of social media content of individual user with statistics to detect psychological stress levels of individuals. The results from experimental phase show that this model can be used as stress detection tool in mental healthcare facilities (20).

Personalized Antianxiety Therapy Optimization

The study involving 50 participants is conducted to evaluate the effectiveness of chatbot (AI powered) in managing anxiety symptoms in patients undergoing cognitive-behavioral therapy (CBT). The result show an improvement in anxiety level with average of 20% and it is concluded that this type of AI based technique can be incorporated to achieve quicker results(21).

AI Integration in Tele psychiatry and Pharmacist Interventions

Tele psychiatry services facilitate patient centers & integrated care to provide quality healthcare services. It is one of the high impact technologies that require software, scheduling & bandwidth. Email & telephone are usually low impact technology & they are helpful in providing technical assistance for healthcare providers(22). Clinical pharmacists working in psychiatric clinics are able to identify any potential drug related issues associated with antipsychotics. The cohort study is conducted retrospectively in a psychiatry clinic to examine medication interventions initiated through clinical pharmacist telepsychiatry setup. Patient education regarding medication adherence is improved to 16.2%. Drug-drug interactions were intervened

(13.5%). Adverse reactions by antipsychotics were identified and managed accounting to 12.35%. Ineffectiveness of antipsychotic therapy (11.59%) was also addressed (23). This study evaluates the effectiveness of clinical pharmacists in psychiatric setting ranging from highlighting drug related issues, adverse reactions, drug-drug interactions & counselling for medication adherence.

Another study was conducted to evaluate the efficacy of clinical pharmacist's involvement in mental health clinics in providing comprehensive medication management in North Carolina & Virginia. These mental health clinical pharmacists have prescriptive authority of controlled substances and they provide advanced psychiatry care resulting in decrease patient visits to clinics & increased telemedicine consultation on video call(24).

AI-Driven Pharmaceutical Care for Depression

Early Detection and Risk Stratification with AI

Deep integrated support vector machine (DISVM) algorithm is used to classify the college student's input data and identify depression(25). Depression is classified based on severity of disease (mild, moderate & severe), number of attacks (single episode or recurrent episodes) & age (children & teenage with depression, adult & senile depression). CNN is most commonly used model for depression recognition(26). XGBoost algorithm, Decision tree classifier and logistic regression is used to classify depression based on severity(27).

Personalized Antidepressant Therapy Optimization

Machine learning (ML) can be used to predict the response to antidepressant therapy by integrating clinical, genetic & demographic patient data. The study is conducted in which the response of patients who were on antidepressant therapies were measured & ML is used to generate an algorithm to predict the response. Validation of the results are also performed in a pilot study. The findings support the application of ML technology on patient data to improve accuracy in prescribing antidepressant and to personalize and optimize the therapy (28).

In another study, inpatient treatment of major depressive disorder patients were optimized using ML approach. The prediction models were calculated for different phenotypes after stratification of patients by symptoms & treatment (SSRIs, TCAs, antipsychotic & lithium). They implemented 88 predictors in total. The results support an important decisive role of ML in managing antidepressant therapy. Treatment specific algorithms & symptom-specific algorithms are helpful in prediction and improving accuracies(29).

AI-Driven Pharmaceutical Care for Schizophrenia

AI Models for Diagnosing Early schizophrenia

Schizophrenia is a chronic mental health condition and is diagnosed by either Diagnostic and Statistical Manual of Mental Disorders, 5th edition (DSM-V) or International Classification of Diseases 11th Revision (ICD-11). The symptoms are classified as positive (delusions, hallucinations), negative (alogia, avolition, social withdrawal) and cognitive (poor attention, working memory issues). AI can be used to detect Schizophrenia. This include MRI scans, PET scans, prediction using EEG, psycho-physio abilities, & by protein & gene classification(30). ML algorithms are used to compare the MRI scans and detect schizophrenia cases. Support vector machine (SVM) classifiers and regression models are also one of the ML technique used to detect schizophrenia.

In adults older than 65 years, very late onset schizophrenia like psychosis (VLOSLP) is common but difficult to diagnose due to other overlapping medical challenges due

to old age. AI, including deep learning (DL) and ML, can be used to detect these cases using advanced imaging techniques. These images are classified using support vector machine (SVM). The findings show more accuracy in diagnosis and better therapeutic management of this condition in older adults(31). Schizophrenia can be diagnosed by AI using EEG patterns(32).

Personalized Antipsychotic Therapy using AI

By implementing AI in the treatment of mental illness, not only it helps in reducing time for the physicians but it also helps to organize patient's data including their clinica,genomic & allergic data set helping in more individualized, personalized and optimized antipsychotic therapy that can help in reducing mortality & morbidity and improve overall therapeutic efficacy. Moreover, it can help the researchers to develop novel antipsychotics. AI, combine with ML and DL, creates a form of algorithm that can ultimately help in early detection as well as prevention of psychosis(33).

The study conducted on Taiwanese patients diagnosed with schizophrenia to develop optimized antipsychotic medication using ML based approach. Using this ML based technique, the success ratio was achieved of up to 52%. The success ratio was calculated based on not requiring any hospitalization and not switching medications for up to 12 months. Individualized treatment rule developed by ML technique is helpful in increasing treatment success rates (34).

Computational algorithm can be applied by utilizing patient centered approach. This is helpful in analyzing and identifying those patients who will respond best to certain antipsychotic medication. The data was obtained and algorithm was applied on that data set. The four predictor-outcome combinations were applied on five antipsychotic medications (Perphenazine, Ziprasidone, Olanzapine, Risperidone & Quetiapine). The findings suggest that this algorithm used patient data for clinical, genetic and allergy related information to predict patient's response to the antipsychotic medication(35).

AI based technique not only can predict the response to antipsychotic medication, it can also help in predicting adherence to antipsychotic medication. This is assessed in a study by using data from smartphone application which is basically a record or journal of medication consumption events. The ML based algorithm was able to calculate adherence.

ChatGPT is one of the form of AI based approach used to manage treatment resistant schizophrenia of 22 year old patient. It includes identifying the disease, analyze psychiatric & medical workup & development of therapeutic treatment plan. The result conclude that ChatGPT accurately diagnose treatment resistant schizophrenia. Moreover, it guides on ordering lab tests to rule out other cases of psychosis. Afterwards, it suggests appropriate personalized treatment based on patient demographics & history including use of clozapine along with adjuvant medications & non pharmacological approach like repetitive transcranial magnetic stimulation, electroconvulsive therapy (ECT) & psychotherapy. It also guides about adverse effects related to antipsychotics & mood stabilizers. This indicates AI is helpful in accurately diagnosing schizophrenia, it helps in evidence based decision making for personalized treatment, reducing time for the physicians to understand and manage specific patient & improve overall patient care(36).

AI Support in Long-acting Injectable Therapy Plans

Long acting injectable (LAI) used in the treatment of schizophrenia are effective in improving adherence, however, they have their own challenges. AI-based assistance program is developed to provide comprehensive information & help schizophrenic patients on LAI to start the treatment and maintain it after getting prescribed by their physician. The effectivess of this program was evaluated to determine its impact in

improving adherence for patients who were prescribed paliperidone palmitate, an atypical antipsychotic. The findings suggest it provides assistance to patients who were prescribed LAI (37).

Table 1: Summary of Studies on the use of AI-Driven Models to Detect Anxiety Disorders

Study Reference	Type of Disorder	Type of Algorithm used
Deep learning approach for identifying cancer survivors living with post-traumatic stress disorder on Twitter (18).	Post-traumatic Stress Disorder	Convolutional Neural Network (CNN)
Perceiving anxiety in tweets using machine learning (19).	Anxiety levels	Regression Model ML
User-level psychological stress detection from social media using deep neural network (20).	Stress Levels	CNN & deep neural n---network (DNN)
A Depression Recognition Method for College Students Using Deep Integrated Support Vector Algorithm(26)	Depressive Disorder	CNN
A Machine Learning based Depression Analysis and Suicidal Ideation Detection System using Questionnaires and Twitter (27)	Depression	XGBoost Algorithm
Schizophrenia: A Survey of Artificial Intelligence Techniques Applied to Detection and Classification (30)	Schizophrenia	ML algorithms, SVM
AI-enhanced diagnosis of very late-onset schizophrenia-like psychosis: A step toward preventing dementia in older adults(31)	Schizophrenia	AI, DL, ML, SVM
Empowering precision medicine: AI-driven schizophrenia diagnosis via EEG signals(32)	Schizophrenia	AI using EEG signals

Future Directions and Research Gaps

Need for AI training in pharmacy education

Lack of appropriate training for pharmacists & other health care providers is one of the important barrier in adopting AI technology. There is a need to include AI tools

like ML, predictive analytics & similar topics in pharmacy curricula. This will help in improving awareness of clinical application of AI. It is need of the hour to incorporate AI tools in both undergraduate & postgraduate programs. It will not only helps in developing competent training models & promotes professional collaboration between pharmacists & data scientists.

Integration of AI with Electronic Health Records (EHR)

Despite the strong analytic and predictive capabilities of AI algorithms, their practical utility is restricted by poor integration with EHR systems. Proper integration of AI technology into digital information systems and electronic health records would enable evidence based real time decision support, automatic medication reconciliation, and improved integrated care. Research is required to create standardized frameworks for data sharing, addressing regulatory barriers & ensure AI based systems are uniformly adapted across diverse healthcare settings, especially in low resource environments.

Potential for predictive pharmacotherapy

AI tools have the ability to bring revolution in psychopharmacology by predicting specific patient individual treatment response based on clinical profiles, patient genetics & digital biomarkers. However, current predictive models often rely on limited datasets, which limits their generalizability. Future studies should focus on multi-ethnic datasets, large-scale, longitudinal monitoring, and integrating pharmacogenomics with AI algorithms to deliver precise dosing and early detection of adverse effects. This will allow pharmacists to proactively adjust therapy and optimize outcomes.

AI-human collaboration in clinical decision-making

Despite growing capabilities of AI, human expertise is still essential in building trust, interpreting algorithmic outputs & ensuring culturally sensitive & ethical care. Future research should focus on human–AI collaboration frameworks, where pharmacists and other healthcare professionals use AI-based evidence to as a guidance, rather than substitute of clinical judgment. Studies are also needed to evaluate AI based workflow models without overstraining clinicians, while also addressing patient acceptance and perceptions of AI-based mental health care.

Future research should focus on building AI technology in pharmacy practice, integrating this tool systems into existing healthcare infrastructure, and developing such predictive models that complement pharmacist expertise. Addressing these gaps will be essential to connecting AI's full potential in improving treatment precision, reducing disparities, and advancing collaborative care for psychiatric disorders.

Conclusion

This review highlights the growing role of artificial intelligence (AI) in pharmaceutical care management for anxiety, depression, and schizophrenia. Current evidence suggests that AI-based tools like predictive analytics, digital phenotyping, pharmacogenomics-based therapy and adherence monitoring technology can help in enhancing precision in selection of treatment, improved medication adherence, and reduction in hospitalization rates. AI also offers noteworthy potential to address challenges in traditional models of care, including disparities in access fragmented services and the limited individualization of therapy.

AI should be regarded as a supplement to, rather than a substitute for clinical expertise. Pharmacists and other health care professionals remain essential in building

patient trust, interpreting algorithmic outputs and applying contextual knowledge to deliver safe and culturally sensitive care.

The future of AI-based psychiatry treatment lies in technology-based care models where AI supports in evidence based decision-making, optimizes medication therapy, and improves patient clinical outcomes. Continued investment in literacy of AI, clinical integration, and ethical safeguards will be vital to ensuring that these innovations transform into meaningful, equitable improvements in mental health care delivery worldwide.

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