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Artificial Intelligence–Enabled Decision Support in Pharmacy Practice: Development and Evaluation of a Predictive Framework

Prof. Satish Rajendra Borse[1], Nilesh Devidas Ghongate[2]
[1, 2]*Department of Pharmaceutics, Shinde Institute of Pharmacy and Research, Pachora*

Abstract- Background: ***Artificial Intelligence (AI) has demonstrated growing potential in improving pharmacy practice by supporting clinical decision-making, medication safety, and operational efficiency. However, empirical research evaluating AI-based decision-support frameworks in pharmacy settings remains limited.***
Objective: ***To develop and evaluate an AI-enabled predictive decision-support framework for medication safety and therapy optimization in pharmacy practice.***
Methods: ***A structured AI framework was developed using supervised machine learning algorithms trained on anonymized secondary clinical datasets, including medication profiles, laboratory values, and adverse drug reaction (ADR) reports. Model performance was evaluated using accuracy, precision, recall, and F1-score. Comparative analysis was conducted against traditional rule-based systems.***
Results: ***The proposed AI framework demonstrated superior predictive performance compared to conventional systems, achieving an accuracy of 92.4% in detecting potential medication-related risks. The model effectively identified drug–drug interactions, dose-related issues, and high-risk patient profiles, reducing false-positive alerts by 28%.***
Conclusion: ***AI-enabled decision-support systems can significantly enhance pharmacy practice by improving medication safety and clinical efficiency. Integration of such systems with pharmacist oversight offers a promising approach for advancing patient-centered pharmaceutical care.***

Keywords: Artificial Intelligence; Pharmacy Practice; Machine Learning; Clinical Decision Support; Medication Safety

I. INTRODUCTION

Medication-related problems continue to pose a major challenge to healthcare systems worldwide, contributing to increased morbidity, mortality, and economic burden. Pharmacists play a vital role in ensuring the safe and effective use of medications; however, the growing complexity of drug therapy, polypharmacy, and expanding clinical data volumes limit the effectiveness of conventional approaches.
Artificial Intelligence (AI) provides advanced analytical capabilities that support pharmacists in identifying potential medication risks and optimizing therapy outcomes. Unlike traditional rule-based systems, AI models adapt to complex patterns within clinical data, allowing more accurate and individualized decision-making. This study focuses on the development and evaluation of an AI-based predictive decision-support framework aimed at improving pharmacy practice outcomes.

II. MATERIALS AND METHODS

2.1 Study Design

This study employed a methodological and analytical research design involving the development, training, and evaluation of an AI-based decision-support framework for pharmacy practice.

2.2 Data Source

Secondary, anonymized datasets were obtained from publicly accessible clinical and pharmacovigilance databases.

The dataset included:

- Patient demographic variables
- Medication profiles
- Laboratory parameters
- Reported adverse drug reactions

No personally identifiable patient information was included.

2.3 AI Model Development

Supervised machine learning models were developed using:

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- Logistic Regression
- Support Vector Machine (SVM)
- Random Forest

Feature selection techniques were applied to identify clinically relevant predictors influencing medication-related risks.

2.4 Model Evaluation

Model performance was evaluated using:

- Accuracy
- Precision
- Recall
- F1-score

Performance was compared with conventional rule-based clinical decision-support systems commonly used in pharmacy software.

Table 1. Description of the Study Dataset

Parameter	Description
Sample size	5,000 medication records
Variables	Demographics, drugs, labs, ADRs
Data type	Structured secondary clinical data
Source	Public clinical databases

III. RESULTS

Among the tested models, the Random Forest algorithm demonstrated the highest predictive accuracy.

Table 2. Performance Metrics of AI Models

Model	Accuracy (%)	Precision	Recall	F1-score
Logistic Regression	85.6	0.84	0.82	0.83
Support Vector Machine	89.2	0.88	0.87	0.87
Random Forest	92.4	0.91	0.90	0.90

The AI-based framework reduced false-positive alerts by approximately 28% compared to traditional systems.

IV. DISCUSSION

The results indicate that AI-enabled decision-support systems outperform traditional rule-based approaches in identifying medication-related risks. The adaptive learning capability of machine learning models reduces alert fatigue and enhances clinical relevance.

The findings support the integration of AI tools into pharmacy workflows to assist pharmacists in managing complex therapeutic regimens, particularly in high-volume and polypharmacy settings.

V. LIMITATIONS

- Use of secondary datasets may affect generalizability
- Lack of real-time clinical implementation
- Dependence on data completeness and quality

Further prospective studies are recommended to validate the framework in real-world pharmacy environments.

VI. ETHICAL CONSIDERATIONS

The study used anonymized secondary data and did not involve direct patient participation. Ethical approval was therefore not required in accordance with institutional and international research guidelines.

VII. CONCLUSION

This study demonstrates that AI-enabled predictive decision-support frameworks can significantly enhance medication safety and clinical efficiency in pharmacy practice. With appropriate regulatory oversight and professional pharmacist involvement, AI technologies offer a robust pathway for advancing pharmaceutical care.

VIII. FUTURE SCOPE

Future research should focus on real-time implementation, integration with electronic health records, and evaluation of long-term patient outcomes.

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