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Improving Healthcare Quality Through Artificial Intelligence-Based Drug Interaction Prevention Systems

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ABSTRACT: Adverse drug events (ADEs), particularly those associated with drug-drug interactions (DDIs), represent a major and preventable burden on global healthcare systems. Traditional DDI detection methods, which rely heavily on static databases and human monitoring, are increasingly insufficient given the complexity of modern pharmacotherapy. Artificial intelligence (AI), especially machine learning (ML) and natural language processing (NLP), has emerged as a transformative solution for predicting, detecting, and managing DDIs. AI systems can integrate data from electronic health records (EHRs), biomedical literature, pharmacogenomic profiles, and clinical notes to provide more accurate and patient-specific risk assessments. This article examines the role of AI in enhancing patient safety, strengthening clinical decision support systems (CDSS), enabling personalized medicine, and improving healthcare efficiency. The study also discusses implementation challenges related to data quality, interpretability, ethics, and clinical integration. Overall, AI-driven DDI prevention systems have significant potential to reduce adverse drug events and improve healthcare quality and sustainability.

KEYWORDS: Artificial Intelligence, Drug-Drug Interactions, Adverse Drug Events, Clinical Decision Support Systems, Patient Safety, Healthcare Quality, Machine Learning, Pharmacovigilance.

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1. INTRODUCTION

Drug-related harm remains a major challenge for healthcare systems worldwide (Bates et al., 2022). Adverse drug events (ADEs) contribute substantially to hospital admissions, prolonged hospital stays, and increased healthcare costs. Among these events, drug-drug interactions (DDIs) are particularly concerning because many are predictable and preventable. Conventional DDI prevention methods, including rule-based screening systems and pharmacist-led reviews, often generate excessive alerts and lack patient-specific contextual understanding, resulting in alert fatigue among clinicians (Zheng et al., 2021). Artificial intelligence (AI) offers a significant advancement in DDI prevention (Reis et al., 2025; Salehi, 2025). Through machine learning (ML), deep learning (DL), and natural language processing (NLP), AI systems can analyze large-scale healthcare datasets and identify complex interaction patterns more effectively than traditional methods (Sharmila & Chandra, 2024). AI-driven systems can integrate structured information such as laboratory results and prescription records with unstructured sources, including clinical notes and biomedical literature (Salehi, 2024). This integration enables more accurate prediction and management of DDIs while supporting safer and more personalized healthcare delivery.

Recent studies have highlighted the growing role of AI in pharmacovigilance, medication safety, and clinical decision-making. AI-based models can improve clinical workflows, reduce preventable adverse outcomes, and support evidence-based prescribing practices. Therefore, integrating AI into DDI prevention systems has become increasingly important for improving healthcare quality, patient safety, and operational efficiency.

2. LITERATURE REVIEW

Traditional Approaches and Their Limitations

Conventional DDI management primarily relies on rule-based clinical decision support systems (CDSS) embedded within EHR platforms. These systems generate alerts based on predefined rules derived from drug interaction databases. Although such systems are valuable, they frequently produce false-positive alerts, which contribute to alert fatigue and reduced clinician responsiveness (Nanji et al., 2018). In addition, traditional systems often fail to account for patient-specific characteristics such as genetics, comorbidities, and organ function.

AI Methodologies in DDI Prediction and Discovery

AI approaches to DDI prevention can be divided into prediction and discovery applications. Supervised ML models trained on EHR data can predict clinically significant DDIs by analyzing demographic information, medication histories, laboratory values, and genetic markers (Dalianis et al., 2020; Ogbuagu et al., 2023). Advanced algorithms such as Random Forests, Gradient Boosting, and Deep Neural Networks can identify complex nonlinear relationships and generate patient-specific risk scores.

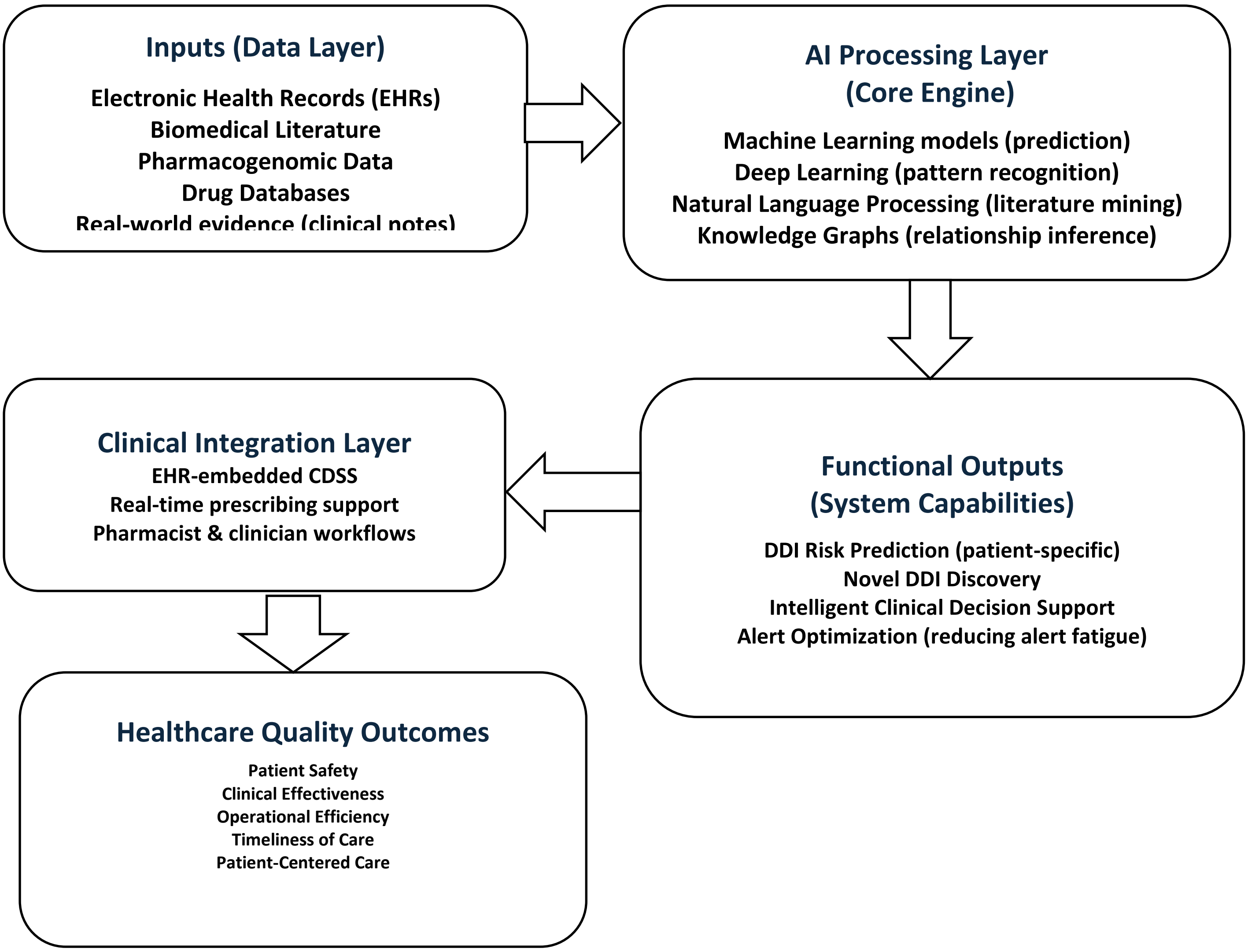
Natural language processing techniques are increasingly used to extract DDI-related information from biomedical publications, clinical reports, and adverse event databases (Percha et al., 2019). Knowledge graph approaches further enhance DDI discovery by identifying hidden relationships among drugs, biological pathways, and side effects (Zitnik et al., 2018). Additionally, deep learning models can predict DDIs based on molecular structures and biochemical mechanisms.

Impact on Healthcare Quality Dimensions

AI-driven DDI prevention contributes to multiple dimensions of healthcare quality (Sutton et al., 2020). Improved alert accuracy enhances patient safety by reducing medication-related errors. Personalized medication management increases treatment effectiveness and minimizes toxicity risks (Huser & Cimino, 2019). Automated screening processes improve operational efficiency by reducing the workload associated with medication reviews (Liao 2025; Salehi, 2022). Furthermore, real-time AI-supported prescribing systems enhance timeliness and support patient-centered care.

3. FRAMEWORK

This study proposes an integrated conceptual framework to explain how artificial intelligence (AI) enhances drug-drug interaction (DDI) prevention and, consequently, improves healthcare quality. The framework is structured across five interconnected layers: data inputs, AI processing mechanisms, functional outputs, clinical integration, and healthcare outcomes.



4. DISCUSSION

Despite its advantages, AI implementation in DDI prevention faces several challenges. The effectiveness of AI systems depends heavily on the quality, completeness, and representativeness of training data. Inaccurate or biased datasets may negatively affect model performance and healthcare equity. Another major challenge involves the limited interpretability of some advanced AI models, particularly deep learning systems (Holzinger et al., 2022). Clinicians may hesitate to trust recommendations without understanding the rationale behind them, highlighting the importance of explainable AI (XAI). Clinical integration also remains a complex issue. AI tools must be integrated seamlessly into healthcare workflows and EHR systems without increasing clinician burden. Ethical concerns related to data privacy, accountability, and regulatory oversight must also be addressed. Regulatory agencies continue to develop frameworks for evaluating AI-based software in clinical settings, but adaptive AI technologies still present ongoing challenges.

5. CONCLUSION

Artificial intelligence is transforming the prevention and management of drug-drug interactions by shifting healthcare systems from reactive approaches toward predictive and personalized care models. AI-driven systems improve patient safety, optimize clinical decision-making, and enhance healthcare efficiency through advanced data analysis and intelligent clinical support. However, the successful implementation of AI technologies requires addressing challenges related to data quality, transparency, ethics, and clinical workflow integration. Future research should focus on large-scale clinical validation studies, standardized evaluation frameworks, and the development of ethical governance models for AI applications in healthcare. With continued interdisciplinary collaboration among clinicians, researchers, policymakers, and data scientists, AI has the potential to become an essential component of safe, effective, and patient-centered healthcare delivery.

REFERENCES

1. Bates, D. W., Singh, H., & Mort, E. (2022). Two decades since “To Err Is Human”: Progress, but still a long way to go. The New England Journal of Medicine, 387(19), 1733–1737.
2. Dalianis, H., Henriksson, A., & Skeppstedt, M. (2020). Using machine learning and natural language processing to predict drug-drug interactions. Studies in Health Technology and Informatics, 270, 432–436.
3. Holzinger, A., Saranti, A., Molnar, C., Biecek, P., & Samek, W. (2022). Explainable AI methods – A brief overview. In xxAI – Beyond Explainable AI (pp. 13–38). Springer.
4. Huser, V., & Cimino, J. J. (2019). Linking pharmacogenomic knowledge with patient data to drive personalized medicine. Journal of the American Medical Informatics Association, 26(11), 1215–1220.
5. Liao Q, Zhang Y, Chu Y, et al. Application of Artificial Intelligence In Drug-target Interactions Prediction: A Review. *npj Biomed Innov.* 2, 1 (2025).
6. Nanji, K. C., Slight, S. P., Seger, D. L., et al. (2018). Overrides of medication-related clinical decision support alerts in outpatients. Journal of the American Medical Informatics Association, 25(5), 476–481.
7. Ogbuagu, O. O., Mbata, A. O., Balogun, O. D., et al. (2023). Artificial intelligence in clinical pharmacy: Enhancing drug safety, adherence, and patient-centered care. International Journal of Multidisciplinary Research and Growth Evaluation, 4(1), 814–822.
8. Percha, B., Zhang, Y., Noprianty, S., & Altman, R. B. (2019). Discovering drug-drug and drug-disease interactions using large-scale literature mining. Pacific Symposium on Biocomputing, 24, 389–400.
9. Reis, Z. S. N., Pereira, G. M. V., Dias, C. D. S., et al. (2025). Artificial intelligence-based tools for patient support to enhance medication adherence: A focused review. Frontiers in Digital Health, 7, 1523070.
10. Salehi, F. (2025). Boardroom AI: the governance of AI-assisted corporate decision-making. Global J Econ Finance Res, 4, 232-235.
11. Salehi, F. (2024). The transformative role of artificial intelligence in the healthcare industry: A comprehensive analysis. Asian Journal of Research in Medicine and Medical Science, 6(1), 62–70.
12. Salehi, F. (2022). Role of artificial intelligence on agile planning and organizational performance in the ICT industry. Asian Journal of Economics, Finance and Management, 4(1), 581–586.
13. Sharmila, K. S., & Chandra, K. R. (2024). Predicting adverse interactions: A comprehensive review of AI-driven drug-drug interaction models for enhanced patient safety. Proceedings of the International Conference on IoT Based Control Networks and Intelligent Systems, 1098–1102.
14. Sutton, R. T., Pincock, D., Baumgart, D. C., et al. (2020). An overview of clinical decision support systems: Benefits, risks, and strategies for success. NPJ Digital Medicine, 3, 17.
15. Zheng, Y., Cui, Y., & Zhang, Y. (2021). Clinical decision support for drug-drug interaction prevention: A systematic review. Journal of Healthcare Engineering, 2021, 1–11.
16. Zitnik, M., Agrawal, M., & Leskovec, J. (2018). Modeling polypharmacy side effects with graph convolutional networks. Bioinformatics, 34(13), i457–i466.