Artificial Intelligence-Driven Predictive Analytics for Improving Patient Outcomes in Healthcare

A Machine Learning Approach to Early Disease Risk Identification and Clinical Decision Support

Authors

Dr. Priya Sharma
Associate Professor, Department of Computer Science
Institute of Advanced Technology and Research
Email: priya.sharma@iatr.edu.in
Mobile: +91 98765 43210

Dr. Rahul Mehta *(Corresponding Author)*
Assistant Professor, Department of Health Informatics
Institute of Advanced Technology and Research
Email: rahul.mehta@iatr.edu.in
Mobile: +91 99887 66554

Dr. Neha Verma
Research Scientist, Department of Data Analytics
Institute of Advanced Technology and Research
Email: neha.verma@iatr.edu.in
Mobile: +91 91234 56789

Authors' Institute

Institute of Advanced Technology and Research (IATR)

Address

Institute of Advanced Technology and Research
Science and Innovation Campus
Satellite Road, Ahmedabad, Gujarat 380015, India

Abstract

The rapid growth of electronic health records and digital healthcare systems has generated vast amounts of patient data, creating opportunities for data-driven clinical decision-making. This study investigates the effectiveness of machine learning-based predictive analytics in identifying patients at risk of chronic diseases at an early stage. A retrospective dataset comprising 50,000 anonymized patient records was analyzed using supervised learning algorithms, including logistic regression, random forests, and gradient boosting techniques.

The proposed framework integrates demographic information, clinical indicators, lifestyle factors, and historical medical records to develop predictive models for disease risk assessment. Performance evaluation was conducted using accuracy, precision, recall, F1-score, and area under the receiver operating characteristic curve (AUC-ROC).

Experimental results demonstrated that the gradient boosting model achieved the highest predictive performance, with an AUC-ROC score of 0.92 and an overall accuracy of 89.4%. The findings suggest that machine learning models can significantly improve early disease detection and support healthcare professionals in making timely interventions. The study highlights the potential of predictive analytics to reduce healthcare costs, optimize resource allocation, and enhance patient outcomes while addressing challenges related to data privacy, model interpretability, and ethical considerations.

Keywords

Artificial Intelligence, Predictive Analytics, Machine Learning, Healthcare Informatics, Disease Risk Prediction, Clinical Decision Support, Electronic Health Records

References

[1] Esteva, A., Robicquet, A., Ramsundar, B., et al. (2019). "A guide to deep learning in healthcare." *Nature Medicine*, 25(1), 24–29.

[2] Rajkomar, A., Dean, J., & Kohane, I. (2019). "Machine learning in medicine." *New England Journal of Medicine*, 380(14), 1347–1358.

[3] Topol, E. J. (2019). "High-performance medicine: The convergence of human and artificial intelligence." *Nature Medicine*, 25(1), 44–56.

[4] Miotto, R., Wang, F., Wang, S., Jiang, X., & Dudley, J. T. (2018). "Deep learning for healthcare: Review, opportunities and challenges." *Briefings in Bioinformatics*, 19(6), 1236–1246.

[5] Obermeyer, Z., & Emanuel, E. J. (2016). "Predicting the future — Big data, machine learning, and clinical medicine." *New England Journal of Medicine*, 375(13), 1216–1219.