INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES
[ISSN: 0975-4725; CODEN(USA): IJPS00]
Journal Homepage: https://www.ijpsjournal.com

OPEN ACCESS

Review Article

Artificial Intelligence in Infectious Diseases: Current Applications, Challenges, and Future Directions

Dr. Divya Dharshini M.*

Madhuri Medical College.

ARTICLE INFO

Published: 18 Sept. 2025
Keywords:
Despite promise, challenges remain, including data bias
DOI:
10.5281/zenodo.17149600

ABSTRACT

Importance: Infectious diseases remain a major global health threat, compounded by antimicrobial resistance, delayed diagnoses, and periodic outbreaks. Artificial intelligence (AI) offers transformative potential to enhance clinical decision-making, optimize antimicrobial use, and strengthen surveillance. Objective: To review current applications of AI in infectious diseases and outline key challenges and future directions. Observations: AI-based tools are being applied in diverse domains. Machine learning algorithms improve diagnostic accuracy in tuberculosis, sepsis, and pneumonia. Natural language processing supports antimicrobial stewardship by analyzing electronic health records. Predictive analytics models anticipate disease outbreaks by integrating epidemiological and environmental data. Additionally, AI-guided drug discovery accelerates identification of new antimicrobials. Despite promise, challenges remain, including data bias, lack of transparency in "black-box" models, infrastructural limitations, and ethical concerns regarding patient privacy and equity. Conclusions and Relevance: AI has demonstrated significant value in infectious disease care, from bedside clinical support to global outbreak prediction. However, successful translation requires high-quality data, explainable models, interdisciplinary collaboration, and equitable deployment, especially in low- and middle-income countries.

INTRODUCTION

Infectious diseases account for a substantial proportion of global morbidity and mortality, particularly in low- and middle-income countries. The rising threat of antimicrobial resistance (AMR), coupled with the challenges of timely diagnosis and effective outbreak control, demands innovative solutions. Artificial intelligence (AI)—encompassing machine learning, natural language

***Corresponding Author:** Dr. Divya Dharshini M.
Address: *Madhuri Medical College.*
Email ✉: 07divya00@gmail.com

Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

processing, and deep learning—has emerged as a powerful tool to address these challenges. By processing large datasets, AI can support clinicians, inform public health policy, and accelerate drug discovery. This review explores current applications of AI in infectious diseases, barriers to adoption, and future opportunities.

Applications of AI in Infectious Diseases

1. Diagnostics

AI improves accuracy and efficiency of infectious disease diagnostics.

Tuberculosis: Deep learning models interpret chest radiographs with accuracy comparable to radiologists, enabling large-scale screening in resource-limited areas.

Sepsis and pneumonia: Predictive algorithms analyzing vital signs and laboratory values identify patients at risk of sepsis earlier than standard scoring systems.

Pathogen identification: Machine learning assists in rapid interpretation of genomic sequencing data to detect novel pathogens.

2. Antimicrobial Stewardship

Natural language processing (NLP) applied to electronic health records identifies inappropriate antibiotic prescriptions. AI systems provide real-time alerts to guide clinicians toward narrow-spectrum, evidence-based antimicrobial choices. Predictive models help forecast resistance patterns in hospital settings, improving empiric therapy selection.

3. Outbreak Prediction and Surveillance

During the COVID-19 pandemic, AI-powered platforms integrated global health data, mobility patterns, and social media reports to predict outbreak clusters. Similar models are now applied to dengue, malaria, and influenza, enabling pre-emptive allocation of healthcare resources. Climate-linked models predict shifts in vector-borne disease patterns under changing environmental conditions.

4. Drug Discovery and Development

AI accelerates drug repurposing by screening vast compound libraries against microbial targets. Deep learning platforms have identified novel antimicrobial peptides with activity against multidrug-resistant bacteria. Pharmaceutical pipelines increasingly rely on AI to shorten discovery timelines and reduce costs.

Challenges and Limitations

Despite progress, significant barriers hinder widespread adoption:

Data Quality and Bias: AI performance depends on large, representative datasets, which are often unavailable in low-resource settings.

Interpretability: Many models function as “black boxes,” limiting clinician trust and regulatory approval.

Infrastructure: Limited access to high-speed internet, computational power, and trained personnel restrict implementation in many regions.

Ethical Concerns: Patient privacy, consent, and potential algorithmic bias raise important ethical issues.

Cost and Equity: Without equitable deployment, AI may widen the gap between high-income and low-income countries.

Future Directions

The future of AI in infectious diseases lies in:

Development of explainable AI systems to improve transparency. Strengthening One Health approaches, integrating human, animal, and environmental data for holistic outbreak prediction. Expanding AI-driven telemedicine platforms for rural and underserved areas. Public–private partnerships to ensure equitable access to AI tools globally. Regulatory frameworks balancing innovation with patient safety.

CONCLUSION

AI is reshaping the landscape of infectious disease care. From diagnostic imaging to antimicrobial stewardship and outbreak prediction, its applications are increasingly impactful. However, careful attention to ethical, infrastructural, and equity challenges is necessary to realize its full potential. Collaborative efforts across clinicians, data scientists, and policymakers will be essential in ensuring AI serves as a tool for advancing global health.

REFERENCES

1. Rajpurkar P, Irvin J, Zhu K, et al. CheXNet: Radiologist-level pneumonia detection on chest X-rays with deep learning. arXiv. Published online December 25, 2017.
2. Topol EJ. High-performance medicine: the convergence of human and artificial intelligence. Nat Med. 2019;25(1):44-56.
3. Rao ASRS, Vazquez JA. Identification of COVID-19 can be quicker through an artificial intelligence framework using a mobile phone-based survey in the populations when cities/towns are under quarantine. Infect Control Hosp Epidemiol. 2020;41(7):826-830.
4. Esteva A, Robicquet A, Ramsundar B, et al. A guide to deep learning in healthcare. Nat Med. 2019;25(1):24-29.
5. Jumper J, Evans R, Pritzel A, et al. Highly accurate protein structure prediction with AlphaFold. Nature. 2021;596(7873):583-589.

HOW TO CITE: Dr. Divya Dharshini M.*, Artificial Intelligence in Infectious Diseases: Current Applications, Challenges, and Future Directions, Int. J. of Pharm. Sci., 2025, Vol 3, Issue 9, 1950-1952 https://doi.org/10.5281/zenodo.17149600