SURVEILLANCE OF THE EPIDEMIOLOGY OF INFECTIOUS DISEASES USING ARTIFICIAL INTELLIGENCE

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Abstract. Effective surveillance of infectious diseases is essential for early detection, prevention, and control of outbreaks. Traditional epidemiological methods, while reliable, are often limited by time delays, large volumes of data, and the complexity of disease dynamics. Artificial Intelligence (AI) offers innovative solutions for real-time monitoring, prediction, and analysis of infectious disease patterns. This review examines current applications of AI in epidemiological surveillance, including machine learning models for outbreak prediction, natural language processing for data extraction from unstructured sources, and AI-assisted geographic information systems for mapping disease spread. The integration of AI into infectious disease surveillance enhances the accuracy and timeliness of public health interventions. However, challenges such as data privacy, algorithm transparency, and model validation remain critical considerations. The article highlights the potential of AI to transform epidemiological surveillance and improve global health preparedness.

Keywords: infectious disease surveillance, epidemiology, artificial intelligence, machine learning, outbreak prediction, public health, disease mapping.

Introduction. Surveillance of infectious diseases is a cornerstone of public health practice, enabling timely interventions to prevent epidemics and pandemics. With the increasing complexity and globalization of disease transmission,

traditional surveillance systems face challenges in managing large datasets and predicting outbreaks [1]. Artificial Intelligence (AI) technologies provide promising tools for addressing these limitations.

Applications of AI in Infectious Disease Surveillance

Machine Learning for Outbreak Prediction. Machine learning algorithms can analyze historical and real-time epidemiological data to forecast potential outbreaks. Models such as random forests, neural networks, and support vector machines have been used to predict influenza, dengue, and COVID-19 trends [2,9]. These predictive tools allow health authorities to allocate resources efficiently and implement preventive measures.

Natural Language Processing (NLP). NLP enables extraction of epidemiologically relevant information from unstructured text sources such as news reports, social media, and scientific publications. This accelerates early warning detection and provides insights into emerging infectious threats [3,7,8].

AI-Assisted Geographic Information Systems (GIS).

Integration of AI with GIS supports spatial analysis of disease spread, identifying hotspots, and visualizing risk areas. AI algorithms can process satellite imagery, population density data, and mobility patterns to enhance situational awareness [4,10,13].

Advantages and Limitations

Advantages:

Real-time data processing and early outbreak detection

Enhanced predictive accuracy compared to traditional statistical models

Ability to analyze large, complex datasets from multiple sources

Limitations:

Data privacy and ethical concerns

Requirement for high-quality and standardized data

Need for algorithm transparency and model validation [5,11,12]

Conclusion. Artificial Intelligence represents a transformative approach to infectious disease surveillance, improving the timeliness and accuracy of outbreak detection and response. Machine learning, NLP, and AI-assisted GIS tools provide powerful solutions for managing complex epidemiological data. Integration of AI into public health systems, accompanied by ethical and methodological safeguards, has the potential to strengthen global disease monitoring and preparedness.

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