# Combating Emerging Infectious Diseases Using AI and Big Data

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## Introduction

Emerging Infectious Diseases (EIDs) represent a constant threat to global health, particularly in regions with limited healthcare infrastructure. The rapid transmission and unpredictability of diseases such as COVID-19, Ebola, and Zika highlight the urgent need for innovative surveillance systems. This project examines how Artificial Intelligence (AI) and Big Data technologies can revolutionize disease detection, monitoring, and mitigation in population and public health.

## Relevance to Public Health

Traditional surveillance methods often suffer from delayed reporting, fragmented data, and under-resourced response systems. AI-based systems can analyze real-time data from Electronic Health Records (EHRs), social media, climate sensors, and mobile devices to identify patterns that indicate emerging outbreaks. In underserved regions, these systems can be a game changer—supporting faster interventions and better resource allocation.

## Technology Overview

Artificial Intelligence enables machine learning models to detect early signs of disease spread and predict future outbreaks. Meanwhile, Big Data platforms gather vast datasets from diverse sources and harmonize them for analysis. Geospatial technologies are integrated for location-based tracking of disease incidence.

## Applications in High-Risk Populations

Our focus includes:  
- Rural areas in the United States  
- Sub-Saharan Africa and Southeast Asia  
- High-density urban populations  
- Vulnerable groups such as the elderly, immunocompromised individuals, healthcare workers, and refugees

## Challenges and Barriers

Key challenges include:  
1. Data Privacy: Managing sensitive health data in compliance with global standards  
2. Interoperability: Integrating diverse data formats and healthcare systems  
3. Infrastructure: Inadequate connectivity in low-income settings  
4. Ethical Issues: AI decision-making bias and lack of transparency

## Case Studies and Related Work

- Jones et al. (2008) identified ecological and demographic drivers for EIDs.  
- Alamo et al. (2020) utilized data science and control theory to model COVID-19.  
- Kaur et al. (2021) explored the integration of AI in real-time pandemic response strategies.

## Future Research Opportunities

1. AI-augmented syndromic surveillance networks  
2. Federated learning to enable decentralized EHR analysis  
3. Use of wearables and Internet of Medical Things (IoMT) for real-time symptom tracking  
4. Ethical AI models that minimize bias and improve equity  
5. Global data-sharing frameworks to promote real-time collaboration

## Conclusion

The integration of AI and Big Data provides an opportunity to transform the global response to EIDs. These technologies enable early detection, data-driven interventions, and long-term prevention strategies. Moving forward, global collaboration, transparent data governance, and investment in ethical AI frameworks are critical to achieving effective and equitable public health resilience.