Multi-agent geospatial model for predicting the spread of infectious diseases using AI Title

Name Ihor SEMIANIV

Organisation Bukovinian State Medical University

Country Ukraine

Contact details and organisation website

https://www.linkedin.com/in/ihor-semianiv-465507266/uk/

https://www.bsmu.edu.ua/en/main/

Problem

Infectious diseases continue to pose a significant threat to public health, particularly in regions with dynamic population mobility, limited surveillance capacity, and heterogeneous socio-environmental conditions. Traditional epidemiological models often fail to capture real-world complexity, including behavioural factors, spatial heterogeneity, and rapid changes in transmission pathways. Existing forecasting systems provide delayed or coarse-resolution insights, limiting their utility for early outbreak detection and timely intervention planning. As a result, health authorities lack precise, actionable, and data-driven tools to anticipate epidemic spread, allocate resources efficiently, and mitigate health-system burden during emerging infectious threats.

Main objective

To develop an AI-enabled multi-agent geospatial modelling platform capable of accurately simulating and forecasting infectious disease transmission in real-world environments. The objective is to integrate epidemiological, behavioural, mobility and environmental data into a unified predictive ecosystem that supports early outbreak detection, dynamic risk mapping, scenario development, and evidence-based public-health decision-making.

Expected outcomes

The project will deliver an AI-based multi-agent geospatial platform enabling high-resolution epidemic forecasting, early detection of transmission hotspots, and dynamic risk assessment. Expected outcomes include improved preparedness, more targeted and timely public-health interventions, optimised resource allocation, and strengthened resilience of health systems to emerging infectious threats.

What We Have Now?

We have already developed and validated a functional multi-agent geospatial model using real epidemiological data on tuberculosis transmission. The system successfully reproduces spatial spread patterns, identifies high-risk clusters, and demonstrates strong predictive accuracy, confirming its readiness for scaling to other infectious diseases and broader public-health applications.

Our Expertise in Relation to the Topic

- **Infectious disease modelling & epidemiology:**

Extensive research on tuberculosis and comorbid conditions, including analysis of transmission dynamics, risk factors, and clinical outcomes.

- **AI-driven health analytics:**

Experience applying machine learning, clustering, and predictive modelling to improve surveillance and early detection of infectious diseases.

- **Multi-agent & geospatial simulation:**

Development and successful validation of a geospatial multi-agent model for real-world TB spread, integrating behavioural and spatial heterogeneity.

- **Clinical and laboratory expertise:**

Strong background in respiratory medicine and access to high-quality patient datasets and diagnostic indicators for model calibration and validation.

- **Research coordination & training:**

Leadership in doctoral and postdoctoral programs, scientific project management, and national/international academic collaboration.

- **Public-health integration:**

Close cooperation with healthcare institutions to ensure practical applicability, policy relevance, and impact on health-system preparedness.

Thank you for the opportunity to present our project

To explore more about our team's expertise and completed work, please refer to the links below:

- https://orcid.org/0000-0003-0340-0766
- https://www.linkedin.com/in/ihor-semianiv-465507266/uk/
- https://orcid.org/0000-0003-4766-4659