Using Conditional Autoregression to Model Tuberculosis Dynamics in Ca Mau Province

Conditional Autoregression to Model Tuberculosis Dynamics in Ca Mau

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Abstract

This is the abstract.

Keywords: CAR, TB

1. Introduction

Tuberculosis (TB) remains a critical concern in global health [1]. Its transmission typically occurs within close communities, such as families, emphasizing the need for a deep understanding of its dynamics at a local level to devise effective interventions [2].

In the southernmost province of Vietnam, Ca Mau, TB remains a major health issue. The notification rate of approximately 120 cases per 100,000 individuals underscores the substantial difficulty in controlling the disease. Despite ongoing efforts, TB continues to impact the health of the local population, influenced by factors like socio-economic conditions, healthcare accessibility, and environmental elements. Gaining a comprehensive understanding of TB dynamics in Ca Mau is vital for formulating more effective disease management and control strategies.

Originating from Besag, York, and Mollié's 1991 research [3], CAR models are particularly adept at handling spatial dependencies, a frequent aspect in the spread of diseases. This capability makes them highly valuable in epidemiological studies where understanding spatial disease patterns is crucial. CAR models are particularly relevant in modeling infectious diseases such as TB, where geographical and social proximity plays a crucial role in transmission. Research by Lee in 2011 highlights the capability of CAR models in pinpointing high-risk areas and deciphering spatial disease patterns [4]. Their application in TB epidemiology is gaining recognition for its ability to tackle the complexity of TB transmission [5]. These models provide insight into the interaction between TB spread and spatially-structured social and environmental factors.

2. Research objectives:

Primary Objective: To apply a Conditional Autoregressive (CAR) model to analyze and understand the spatial dynamics of Tuberculosis (TB) in Ca Mau Province, Vietnam. This includes:

1. Mapping TB incidence to identify high-prevalence areas.
2. Investigating socio-economic, environmental, and healthcare factors influencing TB distribution.
3. Utilizing CAR models to predict TB transmission patterns.
4. Providing data-driven insights for local TB control and prevention strategies.

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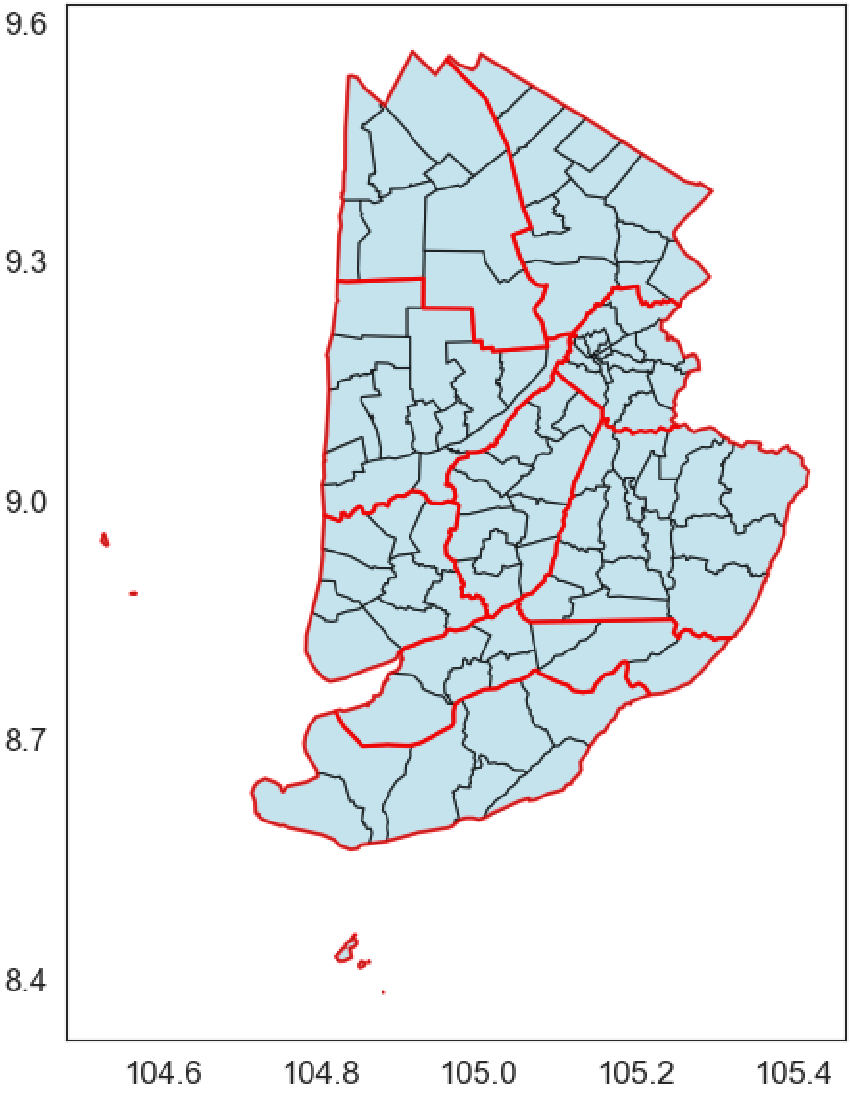

Figure 1: A map of Ca Mau Province

3. Methodology

1. Data Collection:

- Data Sources: TB Notification will be collected from the NTP, demographic and population will be collected from Camau Statistical Office. Map will be collected from GADM website.

- Time Frame: From 2011 - to 2022.

2. Model Development and Implementation:

- Conditional Autoregressive (CAR) Model: Develop a CAR model tailored to the spatial epidemiology of TB in Ca Mau Province.

- Variable Selection: Include variables such as population density, socio-economic status, healthcare access, and environmental factors.

- Model Calibration: Fine-tune the model parameters using a subset of the data to ensure accurate representation of local TB dynamics.

3. Statistical Analysis:

- Software: Use statistical software R for data analysis and model implementation.
- Spatial Analysis: Conduct spatial analysis to identify hotspots and patterns in TB occurrence.
- Sensitivity Analysis: Perform sensitivity analysis to assess the robustness of the model against variations in input parameters.

4. Model Validation:

- Validation Techniques: Use cross-validation methods to test the model's predictive accuracy.

- Comparison with Traditional Models: Compare the CAR model's results with those obtained from traditional epidemiological models to evaluate performance improvements.

5. Interpretation and Application:

- Insight Generation: Interpret the model outputs to identify key drivers of TB in Ca Mau Province.

- Policy Recommendations: Formulate recommendations for TB control and prevention based on model findings.

4. Expected results:

Identification of localized spatial clusters indicating high and low TB incidence rates within An Giang Province using CAR models. Exploration of fluctuations and potential patterns in TB transmission over time, offering insights into temporal dynamics. Analysis of associations between TB incidence rates and demographic factors sourced from the An Giang statistical yearbook.

5. Data Governance and Ethics:

The dataset that contains the aggregated data of patients of new and relapse patients with all forms of TB, notified in Nam Dinh, in the 5-year age group and sex at communal level from 2011 to 2022 will be obtained from the Vietnam NTP. Acquisition of this data is expected to require a low-risk ethics approval from Monash University, ensuring compliance with ethical guidelines. The aggregated nature of the dataset mandates its secure storage, in accordance Monash University's guidelines.

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