Developing a Spatial Vulnerability Index for Infectious Diseases of Poverty in the Caribbean

Background: Infectious diseases of poverty (IDoP) disproportionately affect marginalized and resource-limited populations, creating spatial patterns of vulnerability across and within countries. Yet, no standardized spatial index exists to quantify this vulnerability at fine geographical scales—such as municipalities or provinces—limiting policymakers' ability to allocate resources and target interventions effectively. This study aims to develop and validate a spatial vulnerability index tailored to the Caribbean, using the Dominican Republic (DR) as a case study.

Methods: The framework includes three components. First, a scoping review and expert consultation were conducted to identify key spatial determinants of IDoP vulnerability. Second, the Fuzzy Analytic Hierarchy Process (Fuzzy AHP) will be used to assign weights to these factors, incorporating expert judgment while accounting for uncertainty. These weights will inform the construction of a spatial composite index using open-source geospatial and national survey data for the DR. Third, the index will be validated using surveillance and seroprevalence data for at least three IDoPs at the municipal level, including data from a 2021 national field survey.

Results: The review identified six primary categories of vulnerability factors: (1) socioeconomic conditions (e.g., income, GDP, female literacy, health spending); (2) environmental exposures (e.g., temperature, precipitation, Oceanic Niño Index, water coverage, drought intensity); (3) healthcare access (e.g., walking time to public facilities); (4) household conditions (e.g., water source/treatment, mosquito control, housing materials, open sewer proximity); (5) macroclimatic variables; and (6) a gap in demographic indicators. Associations included higher Hepatitis C and HIV risk in low-income areas, and an inverse relationship between public health spending and TB incidence. Environmental factors like precipitation and Oceanic Niño Index were linked to dengue, giardiasis, and other arboviral diseases. Index development and evaluation are ongoing.

Conclusions: This spatial vulnerability index will support the identification of high-risk areas and guide equitable public health responses in the Caribbean. Its flexible structure allows adaptation to other settings based on local data and disease profiles.