The Equity of Healthcare Accessibility: Measurement and Inference

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Research Problem: The equity of healthcare accessibility is the study of systematic disparities in access to healthcare services that are considered fundamental in improving wellness and enhancing the general quality of life of a population within a given geographic area. In this research study, healthcare accessibility is concerned with the geographic access of different groups of population, identified by location and underlying socioeconomic variables.

Case Study: During the initial stages of the 2009-2010 H1N1 vaccination campaign, the demand for vaccines significantly outpaced supply. The federal government distributed the vaccines among project areas using a pro rata method based on population. Each project area then determined how its allocation would be divided among health care providers, and a variety of allocation methods (including pro rata) were used. Our study examines the shipments of vaccine and the resulting availability at the census tract level to identify potential inequities arising from the distribution approach.

Model and Methods: As any geographical analysis of spatial equity relies on a measure of access to services, it is important to gain an understanding on the robustness of the conclusions to the conceptualization and measurement of accessibility. Typically, access measures ignore contributing factors to access such as spatial externalities, the structure of the transportation network, and measurement issues related to the geographical scale of analysis.

To this end, we introduce a model that uses integer programming and game theory to represent individuals’ decisions among sites based on distance traveled and anticipated congestion, where congestion depends both on the number of people and the quantity of available vaccine. The input for the model includes the shipment locations, vaccine quantities received, and census tract population data. The output of the optimization model is a measure of the distance and congestion that individuals experience based on the vaccine allocation. Using this output, we identify factors that are associated to disparities in access to vaccine distribution sites.

Understanding these disparities accurately requires accounting for spatial dependence in both the access to vaccine distribution sites and the demographic factors. We use spatial statistics methods to estimate and make inference on geographically-varying associations between a response variable (access to vaccine) and a series of predictors (demographic characteristics, underlying health care provider infrastructure, geography).

Findings: The preliminary results of this study indicate that there were geographic inequities in vaccine accessibility. These differences were more pronounced in the model that captures individuals’ choices (decentralized model). The factors associated with these inequities vary based on geographic region. This research illustrates the importance of considering the overall system and accounting for individuals’ choices in healthcare access.