THE IMPACT OF INDIVIDUAL DECISIONS ON THE EQUITY OF H1N1 VACCINE DISTRIBUTION

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Public Health Problem/Policy Issue: During the initial stages of the 2009-2010 H1N1 vaccination campaign, the demand for vaccines significantly outpaced supply. The federal government divided this limited vaccine among project areas (states, territories, the District of Columbia, and three large metropolitan public health departments) 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 by project areas. This policy represents an equitable allocation in proportion to state population, but it does not ensure equal access to vaccine at lower levels of aggregation or at the individual level. 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. This research integrates tools from optimization, game theory, spatial statistics, and geographical information systems in a novel way, with the goal of providing insights that lead to improved resource allocation for future public health response.

Model and Methods: 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 (as of December 9, 2009), 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 resulting allocation of vaccine. Using this output, we identify factors that are correlated with differences in access to vaccine that occur across a geographic region. Understanding these differences requires accounting for spatial correlations in both the access to vaccine distribution sites and the demographic factors. We use spatial statistics [1-4] to estimate geographically-varying associations between a response variable (access to vaccine) and a series of predictors (demographic characteristics, underlying health care provider infrastructure, geography).

We contrast the results of our decentralized model, which incorporates individuals' choices, with a traditional optimization model that assumes a centralized planner can control actions across the entire system to minimize the total distance plus congestion. Previous work [5-8] has shown that decentralized system performance can differ substantially from that of systems in which central control is possible. Furthermore, we examine the system outcomes under a range of individual decision-making parameters. We find that the overall patterns in accessibility are robust over a wide range of parameter values.

Findings: In both the centralized and decentralized models, the preliminary results of this study indicate that there were geographic inequities in vaccine allocation and accessibility. Figure 1 illustrates these differences for the state of Georgia. Moreover, these differences were more pronounced in the model that explicitly captures individuals' choices than in the centralized model. The factors associated with these inequities vary based on geographic region. Limitations of these findings include the following: shipment data may not represent the final location of the vaccine, and data on exact individual choices of vaccination sites are unavailable. This research illustrates the importance of considering the overall system and accounting for individuals' choices during planning for public health emergency response efforts.

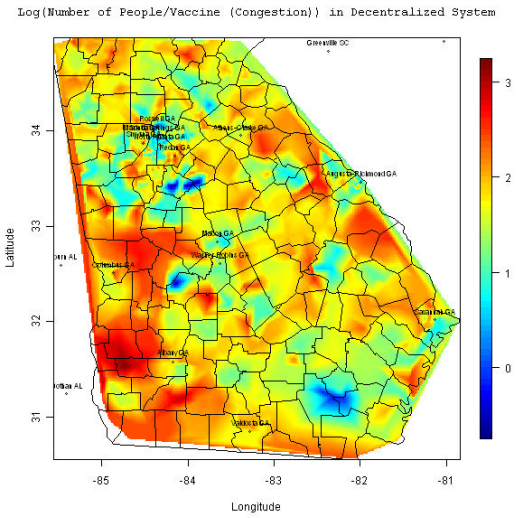

Figure 1: Log of the average congestion (or scarcity) experienced by each census tract in Georgia based on distribution of vaccine and individual choice of facilities

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