Thesis Project Portfolio

Engineering a Resilient Healthcare System: Development of an Agent-Based Model to Improve Heart Attack Outcomes in Pennsylvania

(Technical Report)

An Analysis of Healthcare Disparities Among Different Demographic Groups using Social Construction of Technology

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

A large influx of patients, which often occurs during a regional disaster or pandemic, can cause emergency departments to become crowded, which increases wait time and results in emergent patients receiving inadequate care. Therefore, the goal of the technical report was to use an operations research approach to assess patient flow in three Pennsylvania hospitals and determine the effects of adding telehealth and a co-located primary clinic to alleviate the burden on emergency departments. In particular, the goal was to improve outcomes for heart attack patients, as cardiovascular disease is the primary cause of death in the United States. Agent-based modeling in Netlogo was used to create three models for each of these individual hospitals, and the outputs measured were average wait time in the emergency department, the percent patients treated, the percent patients turned away, the number of heart attack deaths, and the number of other emergent deaths. The first model was a standard model that represented the normal hospital system, the second model introduced tele-triage and telehealth treatment components, and the third model introduced a co-located primary clinic. Then, statistical analysis was completed to determine if either of the two improved models produced a statistically significant improvement in heart attack outcomes compared to the standard model. While additional analysis is needed, it was determined that the addition of telehealth and a co-located primary clinic can produce a statistically significant improvement in hospital flow and heart attack outcomes, especially in urban and suburban hospitals. The major limitations of this research project included limited access to specific hospital data to input into the models, a low sample size of output measurements, and limited flexibility of the model interface to accommodate some of the hospital parameters.

While the technical report studied how to improve overall outcomes for patients, it did not consider how many hospitals and other healthcare facilities show disparities in care between different demographic groups. Many minority and marginalized groups face poorer health outcomes due to lower utilization of healthcare services among other factors. While physical causes of healthcare disparities, such as high cost for some demographic groups, have been extensively documented, there need to be additional studies on how perceptions of healthcare among these groups further maintains those disparities. The goal of the STS research paper, therefore, was to propose the Social Construction of Technology (SCOT) as a suitable framework to analyze how negative perceptions of healthcare and healthcare professionals contribute to healthcare disparities. The three demographic factors that were studied in this paper were race, age, and income. Additional research is recommended for other demographic factors as well, such as gender and sexual orientation. In this research, it was found that African Americans, older people, and people with low income experienced negative perceptions of their ability to access or receive adequate healthcare and as result placed a lower value on the healthcare system. The decreased perceived value of the system lowered their usage and widened the disparities that were observed. However, there were some limitations in the study that could be improved in future work. For example, the relationships that were found were correlational and not necessarily causal (although the SCOT framework was used to provide a causal explanation). Additionally, this research paper does not consider the effect of intersectionality, or the perceptions of people who belong to multiple marginalized or minority groups.