

Thesis Project Portfolio

**Engineering a Resilient Healthcare System:
Using Heart Attack Outcomes and Treatment Methods in Pennsylvania**

An Analysis of the Effect of Patient-Doctor Communication on Health Outcomes

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science
University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree
Bachelor of Science, School of Engineering

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Americans do not receive care that is proportionate to their fellow citizens, rather, their identity makes up a large factor in their health outcomes. This is problematic to having a healthcare system that prioritizes every patient regardless of their background. Every year, 805,000 Americans have a heart attack with 12% being fatal (Benjamin, 2019). Factors that can cause a greater probability of having a heart attack include: gender, race, and income (Mayo Clinic, 2020) (Ford, 2007). It is necessary to note that the morbidity rate is much higher depending on these social determinants.

My Capstone's technical problem was heart attack outcomes in the state of Pennsylvania and analysis of delivery resources. This was completed by applying an operations research approach to evaluate and remodel Pennsylvania's healthcare system for heart attack patients to improve efficiency and resiliency. We used Agent Based Simulation to mimic the flow of patients through the hospital to measure the efficiency of the system. In the system, alternative healthcare resources were added, such as telemedicine, teleradiology, and a clinic to test which variables had the greatest impact on improving patient morbidity outcomes.

The social factor plays the biggest role in the connection to my socio-technical research paper as the paper evaluated how cultural differences, in particular, language differences between patients and their clinicians has an impact on the care that they receive. The starting point of this paper was the recognition that physician cultural and racial demographics is vastly different from the composition of America's racial percentages, with there being a disproportionately higher percentage of white physicians. Additionally, data shows that when physicians have a different cultural background than their patients, the patients suffer with worse outcomes. Those two points form the basis of why my socio-technical research paper was necessary to develop to dive deeper into this topic.

This year, I completed a research paper that I could feel proud of as I believe that it is an important topic for all incoming health professionals to be aware of. Additionally, it is a topic that I have grappled with since dealing with health issues as a young teenager and seeing fellow patients affected by cultural and language barriers with their physicians. Regarding my capstone project, we ran into significant challenges with finding data. We were working with Indiana data for half of the year and had to pivot to Pennsylvania fairly late as they had much more transparent open source data. To fellow researchers continuing my socio-technical research, I suggest developing a protocol for standardization of teaching CLAS standards in an educational setting such as medical school.

I would like to thank my capstone teammates and MITRE advisor, Nathan Edwards. I also would like to thank my Socio-technical advisor, Sean Ferguson, for guiding my research this past year and reinforcing the importance of ethics within engineering. Lastly, I would like to thank my parents for providing me the support to finish my degree at U.Va and instilling in me a passion for healthcare research.

Resources

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2. Mayo Foundation for Medical Education and Research. (2020, June 16). *Heart attack*. Mayo Clinic. Retrieved October 14, 2021, from <https://www.mayoclinic.org/diseases-conditions/heart-attack/symptoms-causes/syc-20373106>.
3. E. S. Ford et al., “Explaining the Decrease in U.S. Deaths from Coronary Disease, 1980–2000,” *N. Engl. J. Med.*, vol. 356, no. 23, pp. 2388–2398, Jun. 2007, doi: 10.1056/NEJMsa053935.