

**Engineering a Resilient Regional Healthcare System: Improving Stroke Care in Shelby County, TN**

**Ethical Dilemmas Surrounding the Advancement in Cancer Therapies**

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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## **Introduction**

Current healthcare systems have fixed approaches to patient care which limits necessary adjustments in high strain scenarios such as a pandemic. Therefore, when under strain, these healthcare systems often experience bottlenecks and are unable to deliver proper healthcare to all portions of a population. A common barrier related to this problem is transportation which is most evident in low-income communities that have consistently low attendance to clinical appointments. In a 2010 study conducted on a mostly low-income suburban community in New York City, 23.5% of those surveyed reported at one point either missing or having to reschedule a clinical appointment (Silver, Blustein, and Weitzman 2012). Transportation barriers to routine primary care are just one example of how suboptimal resource organization can be detrimental to human health. To minimize these barriers, this Capstone team is proposing the development of a simulation model that can simulate approaches to healthcare resource organization and measure overall effectiveness during high strain scenarios. This model will be particularly useful for optimizing care for cardiovascular diseases such as strokes that require multiple interventions at the preventive, ongoing, and post-operative levels (Yan et al. 2016). In the United States, strokes also rank among the top leading causes of death meaning there is a clinical need for improvement in this area of health that this proposed model can address (Ahmad and Anderson 2021).

Cancer also ranks among the leading causes of death in the United States and will be the focus of the sociotechnical portion of this project. In regards to available treatments for cancer, there has been a notable development across history. Since the discovery of the first tumor in 1500 BC, the approach to treating cancer has expanded from solely surgical interventions to the use of novel therapeutics and even mixtures of both referred to as adjuvant therapies (Sudhakar 2009). This expansion is in large part due to the increased knowledge of the disease from

publications such as “The Hallmarks of Cancer” that introduced important concepts like oncogenic, or cancerous, mutations and the downstream effects these have on the proliferative cancer cells that become malignant (Hanahan and Weinberg 2000, 2011). Outside of direct interventions, palliative care and hospice, established in the United States in 1974, have become another dimension to care for chronic diseases like cancer, specifically during the end-of-life period (Roberts 2018.). With advances in treatment options, the assumption is that the patient’s quality of life would be improved, however this topic requires deeper thought after considering the ethics and actors involved in medical decision making (MDM). This involves first reflecting on questions that doctors and patients with cancer often face. What treatment plan will most benefit the patient? Is it appropriate for the patient to take part in a clinical trial? When is the right time to have the discussion regarding hospice care? To provide clarity on this subject, the sociotechnical portion of this project will focus on analyzing ethical dilemmas surrounding the advancement in cancer therapies and identifying potential solutions.

### **Engineering a Resilient Regional Healthcare System for Stroke Care in Shelby County, TN**

Simulation models have become an emerging research tool given their ability to mimic real-world scenarios. Particularly in healthcare, simulation models are being utilized to improve healthcare efficiency. By not requiring the need for the development of systems, training, or equipment purchase, these models can also conduct large-scale replication studies with minimal financial burden (Barjis 2011). Of the current healthcare simulation model methods being used, system dynamics (SD), discrete event simulation (DES), and agent-based modeling (ABM) are most common. While each method provides a system-level perspective, ABM includes examination of the micro-level interactions between agents, both human and nonhuman, within a

system (Denton 2013). Examples of agents in a healthcare system include clinicians and social workers along with treatment facilities. Given the versatility of ABM to provide a comprehensive view of healthcare systems, this is the proposed method to integrate into the simulation model.

A major component of this simulation model is the resiliency metrics used to evaluate healthcare system effectiveness during high strain scenarios. Resiliency is a term used in a wide variety of fields and refers to “bouncing back” or rather the characteristic of being adaptable to various scenarios (Alexander 2013). Relevant resiliency metrics include duration to failure, duration to recovery, and performance before and after recovery among others (Uday and Marais 2015). These three resiliency metrics were chosen for this model given their ability to represent important aspects of healthcare such as the ability to provide continuity of care for chronic diseases.

The chronic disease that this model will focus on is stroke given its high prevalence in the United States. To provide more specification, the model will base resource availability on the current healthcare system of Shelby County, TN given its size, wide variety of healthcare options, and high prevalence of strokes. For context, according to The University of Tennessee System (2017), in 2017, Shelby County, TN had a stroke rate 37% higher than the national average. Application of this model on Shelby County, TN demonstrates the dual impact this project can have both on the healthcare workers delivering care to stroke patients and the patients themselves. By optimizing healthcare resource allocation and delivery, clinicians will be more suited to provide quality care for all members of a population ultimately reducing stroke incidence and fatality.

The benefits in simulation models are a byproduct of their ability to mimic real-world scenarios without the inevitable drawbacks during initial design stages. Consequently, having a simulation model for healthcare systems can eliminate potential harm to individuals, specifically

in Shelby County, TN, who've either had a stroke or are at risk for one. In regards to project scope, this model can also be utilized in public health decisions regarding clinical decision making. Given the resiliency metrics incorporated within the model, there will be ample evidence to either support or refute a given resource configuration and plan for treating a stroke. As a result, having a greater understanding of the necessary adjustments required to improve current healthcare systems will benefit the health of communities while ensuring that accessibility is also not a barrier. Although not focused on optimizing stroke care, the sociotechnical portion of this project seeks to provide clarity to the discussion surrounding medical ethics in the context of cancer care from the initial diagnosis to end-of-life decision making.

### **Ethical Dilemmas Surrounding the Advancement in Cancer Therapies**

Second to heart disease, cancer remains a leading cause of death in the United States with approximately 10 million deaths in 2020 (WHO 2021). In response, the National Cancer Institute (NCI) and other research organizations have made commitments to improving the available funding for cancer research at institutions across the country. In fact, in 2021, the NCI budget amounted to \$6.56 billion to pursue this cancer mission (NCI 2015). Cancer research remains promising because of the potential for advancements in cancer therapies. For what can often be uncertain times, the hope that these novel treatments provide can make all the difference. The issues arise however, when these treatments become “false hope”, misleading patients and complicating the MDM process. Unproven clinical trials often fall under this category but so do already approved interventions considering the five-year survival rates for, one of the more common cancers, melanoma, and pancreatic cancer, one of the more deadly cancers, are 7.3% and 92.3% respectively (Nuffield Trust 2018). Another dimension to this problem are the ethics involved in

emerging therapies. Given the complications and ethical concerns regarding the advancement in cancer therapies, the question then becomes whether this is benefitting or worsening the care provided to cancer patients.

To understand the dynamic of MDM, an understanding of the original “creed” for doctors is a good starting place. This creed is considered by most to be the Hippocratic Oath, an ethical framework that around 48% of all medical students across the United States are required to recite before beginning their medical training (Dossabhoy, Feng, and Desai 2018). In two comprehensive chapters, the Hippocratic Oath outlines commitments doctors must make to their patients. “Therapy and ethics” and “Value of human life” are key sections of the Hippocratic Oath that discuss the need of doctors to use their instinctual medical judgement in MDM and to avoid using any treatments that would put the patient’s life in harms way (Antoniou et al. 2010). As are other parts of the Hippocratic Oath, these tenants are not as widely practiced in 21<sup>st</sup> medicine. In MDM, the opinions and concerns of the patient and the family are often weighed in with the doctors opinions forming a triad relationship. This matters given the differences in motives between each person. One example is in the way “quality of life” is interpreted. In a 2014 pediatric study with patients undergoing cancer treatments, patient’s families and doctors were surveyed on their definition of “quality of life” and the results varied drastically. It was reported that while doctors believed “quality of life” entailed minimization of pain and time in the hospital, patient parents believed that this entailed transparency in the end-of-life period (Valdez-Martinez, Noyes, and Bedolla 2014). If minimization of pain is a priority for doctors, it becomes contradictory considering the toxic drugs and clinical trials patient’s are given the option of pursuing.

To further understand the intricacies of MDM in cancer care, this requires the use of an ethical dilemma framework which will be employed in this project. By definition, ethical dilemmas

are scenarios that involve the need to choose between two or more courses of action that are both morally acceptable meaning the final decision becomes ethically unacceptable (Ong, Yee, and Lee 2012). In the context of cancer, ethical dilemmas can arise soon after diagnosis and frequently occur during the course of treatment for the patient. Given severity of cancer, this conversation is already sensitive, however the gradual rise in treatment options and unpredictableness of outcome can put more pressure on what course of action to take.

Ethical dilemmas are known to also contribute to moral distress. This term was first coined by Andrew Jameton in 1984 and is defined as stress experienced by being in a situation where one is unable to act on what is morally correct (Jameton 2017). Moral distress is often referred to in the context of nursing but is also applicable to other professions including the job of a physician in caring for patients. This is concerning not only for the health of the clinicians themselves but also the patients being treated by these clinicians. If a doctor is unable to make appropriate decisions regarding a patient's course of treatment on account of moral distress, this becomes problematic and requires urgent solution for the benefit of patient health. By investigating the ethical dilemmas that arise during the MDM process for cancer treatment, moral distress and other obstacles to serving the patient can be better understood and mitigated.

## **Research Question and Methods**

This sociotechnical portion of this project will address the following research question: how do advances in cancer therapies give rise to ethical dilemmas during MDM? Having a better understanding of this topic has significance given the ongoing pursuit of cancer research and novel therapies on the rise. One example is the use of nanomedicine which although promising for its ability to use cancer biomarkers to support early detection of oncogenic activity, has ethical

concerns related to nonspecific binding in the body (Zhang et al. 2019). In addition to the advancement in cancer therapies, a common result of ethical dilemmas, moral distress, is just as concerning both for patients and doctors.

To answer this research question, perspectives on patient and doctor values and experiences during MDM will be collected using interviews. In collaboration with surrounding Virginia hospitals, these interviews will be conducted with palliative and hospice care physicians. Interviews will include questions that ask about the physician's perspective on the process of MDM and the influence of an increasing amount of cancer treatment options. Other pertinent resources will be obtained by use of historical analysis. This approach will include a comprehensive literature review of past and current MDM models.

## **Conclusion**

Given the severity of strokes, it is concerning that certain regional healthcare systems cannot readily adapt to high strain scenarios putting a limit on the reach of patient care in a given population. With a simulation model that can intake a region's available healthcare resources, resource configurations can be optimized in a safe and efficient manner. The expected result is that this can be used by clinicians in regions such as Shelby County, TN to improve their services for stroke care. Cancer is another deadly disease that this project aims to focus on. It has had major advances in therapeutic technology since its first discovery and although inherently positive, the plethora of options, most not efficacy guaranteed, can create ethical dilemmas for patients and doctors. Worse is that these ethical dilemmas often lead to moral distress which can cause additional harm and negative impacts to MDM. With a deeper understanding of the effects of

advancing therapies, the expected result is that solutions can effectively mitigate these ethical dilemmas along with moral distress among patients and doctors.

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