Optimizing Clinic Patient Flow during the COVID-19 Pandemic
(Technical Paper)

COVID-19's Impact on Telehealth and the Virtual Delivery of Healthcare
(STS Paper)

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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

Introduction

The COVID-19 pandemic has put unprecedented strain on healthcare systems throughout the United States, but with the crisis comes the potential for significant advancements in the delivery of care. In March of 2020, states across the US instituted stay-at-home orders, and the Centers for Medicare & Medicaid Services released recommendations to postpone all non-essential medical procedures ("State Data and Policy Actions," 2020; "CMS Releases Recommendations," 2020). These actions were taken to preserve personal protective equipment and devote more medical personnel to COVID response; but they also created an enormous financial burden for health systems and made it difficult for medical professionals to see patients (Gooch, 2020). Enter telehealth and telemedicine. Telemedicine and telehealth are used interchangeably to refer to the remote provision of healthcare services using digital information and telecommunication technologies (Roh, 2008). Telehealth in the US dates as far back as the Civil War when the telegraph was used to report casualties and coordinate medical resources (Nesbitt & Katz-Bell, 2018). 150 years later, telemedicine has made great strides, but various barriers to adoption have limited its application primarily to rural or underserved areas (Hare et al., 2020). The proposed STS project will characterize how the COVID-19 pandemic has expedited the adoption of telehealth, and with it, emboldened the potential shift to a virtual model for healthcare delivery that could change medicine forever.

As previously stated, the COVID-19 pandemic has overwhelmed the US healthcare industry. The University of Virginia Health System—including its hospital, centers, and clinics—has not been impervious to its effects. In response to the public health emergency, its clinics have instituted new patient admittance and scheduling processes that promote and require social distancing, mask wearing, patient screening, and more. These requirements make it

difficult for the health system to achieve pre-COVID patient flow levels. Without efficient patient flow, the wellbeing of the UVA Health System and of its providers and patients is at risk. The technical project proposed in this prospectus focuses on how to optimize the UVA Internal Care, Primary Care clinic's patient flow while accommodating COVID-19 restrictions.

Technical Topic

Health systems worldwide have been disrupted significantly as a result of the COVID-19 pandemic. An article from the University of Virginia Health System Newsroom details its impact from March to April of 2020: ". . . hundreds of inpatient beds have been regularly unoccupied, surgeries have declined by 70%, and clinic visits have been reduced by 90%. The result has been a fall in revenue from clinical care and related services that is producing a deficit of $85 million a month" (Swensen, 2020). As the pandemic has progressed, there has been an increasing need to determine how to maximize patient flow in healthcare systems under new guidelines and requirements meant to mitigate community spread of the disease. Specifically, the UVA Internal Medicine, Primary Care Clinic has faced this challenge in its patient admittance process. Prior to the pandemic, the admittance process for the clinic began when the patient entered the building and checked in at central registration, as illustrated in Figure 1 (K. Dowdell, personal communication, September 10, 2020). As seen in Figure 2, the patient then travelled to the clinic floor, checked in at the front desk in the clinic's suite, and sat in the waiting room until a nurse retrieved them (K. Dowdell, personal communication, September 10, 2020). Although sufficient for handling patient arrival under normal circumstances, the process was inadequate for supporting patient admittance during a pandemic.

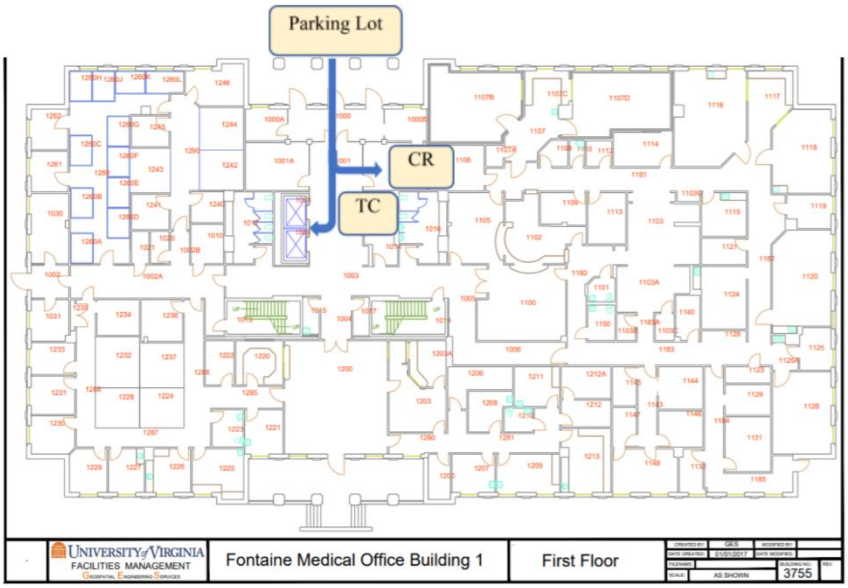

Figure 1. Diagram denoting patient flow process for patients going into Primary Care Clinic & locations of the parking lot, entrance of the building, central registration (CR), and temperature check (TC) (Geospatial Engineering Services, 2017).

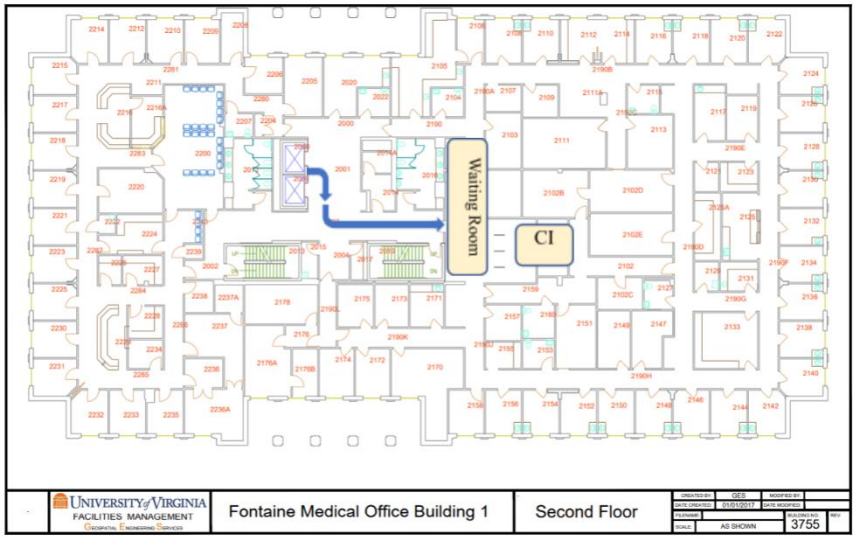

Figure 2. Diagram denoting patient flow process for patients going into the Primary Care Clinic & locations of the waiting room for the Primary Care Clinic and check-in to the clinic (CI) (Geospatial Engineering Services, 2017).

In response to COVID-19, the UVA Health System enacted new guidelines for ambulatory visits to reduce the number of patients in buildings and ensure a safe environment for patients and providers. These guidelines included prioritizing the use of telemedicine appointments for non-urgent visits, and implementing COVID mitigation procedures for in-

person appointments, such as requiring social distancing, mask wearing, and patient screening (O'Donnell et al., 2020). Under the new process, patients are able to use remote registration from the parking lot, where the patient waits in the parking lot until clinic staff call them to their suite (K. Dowdell, personal communication, September 10, 2020). Once called, the patient enters the building, has their temperature checked, and proceeds to their clinic's reduced-capacity waiting room, as illustrated in Figures 1 and 2 (K. Dowdell, personal communication, September 10, 2020). This new patient admittance process is meant to maximize the safety of patients and providers, but it makes it difficult for the UVA Health System to operate efficiently and maintain pre-COVID patient flow. The consequences of not optimizing such a process include worker furloughs and lost revenue as well as general patient and provider frustration and safety.

The goal of this technical project is to refine and optimize patient flow in the Internal Medicine, Primary Care clinic – including its current patient admittance and scheduling processes – to help the clinic return to pre-COVID patient levels while accommodating public health restrictions. To achieve this goal, the research team will use a top-down approach wherein the descriptive scenario will be compared to the normative, and recommendations will be developed to reconcile the two. More specifically, the team plans to conduct event simulations and statistical analysis techniques in R, Excel, and SAS on various data sources to analyze factors relating to patient flow during the pandemic. These data sources include timestamp data from Epic, a healthcare software used for storing electronic health records; observational data gathered by the team; and survey data gathered from clinic staff. The project will be divided into two phases: the first phase will primarily consist of observation, data collection and analysis, and development of a plan of how to use these materials, while the second phase will include data modeling, prototyping, test implementation, and final recommendations.

STS Topic

Telehealth has the potential to transform healthcare delivery in the United States. For centuries, the reigning paradigm for care delivery has emphasized the need for physical contact to diagnose and treat health conditions as well as establish a strong provider-patient relationship (Rosen et al., 2020). Over time, this reliance on face-to-face interaction in medicine has been further reinforced by the construction of cutting-edge facilities and the training and education of medical personnel (Jaffee, 2020). With the development of telehealth technologies, however, an intimidating alternative has emerged. Telemedicine and telehealth refer to the remote provision of healthcare services using digital information and telecommunication technologies (Roh, 2008). The World Health Organization distinguishes between the two terms "with the former restricted to service delivery by physicians only, and the latter signifying services provided by health professionals in general"; but now, they are used interchangeably (*Telemedicine: opportunities and developments in member states*, 2010). For patients, telehealth entails lower costs, greater access to care, and more convenience (Roh 2008). For providers, it can reduce overhead, improve continuity of care, and enhance training and education (Roh, 2008). Despite its promise, though, various barriers have slowed adoption: inter-state licensing, insurance coverage, access to technology, integration into practice, privacy, and more (Frieden, 2019).

The application of telehealth historically has been primarily limited to rural or underserved areas (Hare et al., 2020). That is, until the COVID-19 pandemic in 2020, putting an unprecedented strain on US healthcare systems. From March to April 2020, local stay-at-home orders and the suspension of non-essential procedures resulted in a nearly 60% decline in the volume of visits to ambulatory care practices and in millions of lost jobs and furloughs in the healthcare industry (Gooch, 2020; Mehrotra et al., 2020). Although the industry has started to

recover, efforts to conserve resources, promote social and physical distancing, and reduce exposure has limited medical professionals' ability to see patients (Gooch, 2020). In response, insurers, governments, and regulatory agencies across the nation have eased restrictions for telehealth, and the Centers for Disease Control and Prevention has recommended telemedicine as a critical alternative to in-person visits ("Using Telehealth to Expand Access to Essential Health Services," 2020). Telemedicine is now seeing widespread use among providers and patients alike. For many professionals in the medical field, the pandemic presents an unprecedented opportunity to prove the merit of telehealth (Bashshur et al., 2020). If they are successful, telemedicine could change the model for healthcare delivery forever.

STS Theory

Hailed as one of the most influential philosophers of the twentieth century, American Thomas Kuhn developed the concept of a paradigm shift to describe how new paradigms come to upheave old ones (Bird, 2018). Kuhn defines paradigms as "universally recognized scientific achievements that for a time provide model problems and solutions to a community of practitioners" (Kuhn, 2012). The development of paradigm shifts is summarized by the phases of what is known as the "Kuhn Cycle:" normal science, model drift, model crisis, model revolution, and paradigm change ("The Kuhn Cycle," n.d.). This cycle depicts how new scientific models deviate from, challenge, and eventually replace the reigning model. A common criticism of Thomas Kuhn and his framework is that the division he draws between normal science and revolutionary science oversimplifies how science develops. Kuhn asserts that paradigm change does not occur during normal science and is instead restricted to a revolutionary phase (Bird, 2018). According to the Stanford Encyclopedia of Philosophy, critics argue that such changes to science are common, that they are not limited to a revolutionary phase alone, and that they are

not merely “a consequence of the appearance of anomalies” (Bird, 2018). Despite its criticism, the benefits the theory provides in explaining the shift to virtual care delivery outweigh any shortcomings it might have. This paper will characterize the paradigm shift in healthcare delivery represented by the uptake of telehealth according to and in terms of the phases of the Kuhn Cycle. The analysis will begin with normal science and the prevailing paradigm of in-person care and proceed to the anomalies that have built the foundation for telehealth. The bulk of the investigation will then focus on the crisis presented by the COVID-19 pandemic, and on how it necessitated the adoption of telemedicine and fueled a revolution in care delivery. The research will conclude with a discussion of the potential for virtual care to become the reigning paradigm and of what such a shift could mean for healthcare in the future.

Research Question and Methods

In this proposed paper, the following research question will be addressed: How has COVID-19 expedited the adoption of telehealth, and how might said adoption lead to a permanent shift in the paradigm for healthcare delivery going forward?

To pursue said question, this paper will employ a number of research methods. First and foremost, this paper will rely on documentary research methods to collect and organize research as well as construct a plan for leveraging said research in its analysis. Said methods will be crucial in gathering and analyzing evidence relevant to all phases of the Kuhn Cycle and its application to the topic in question. The majority of the research will rely on articles from reputable journals. For example, the journal *Telemedicine and e-Health* contains an article outlining how COVID-19 has struck down many barriers to telemedicine and how lessons learned from telehealth in the pandemic could determine the future of virtual care (Bashshur et al., 2020). To capture the current state of various barriers to adoption and telehealth usage during

the pandemic, the research will also rely on statements released by national public health institutes and agencies. For example, the Centers for Medicare & Medicaid have released statements regarding changes in telehealth visit coverage ("President Trump Expands Telehealth Benefits," 2020). Additionally, the Centers for Disease Control and Prevention has released statements regarding the use of telemedicine to preserve medical resources and reduce exposure ("Using Telehealth to Expand Access to Essential Health Services," 2020).

This paper will also employ historical case study methodologies to provide background regarding the reigning in-person model of healthcare and the development of telehealth. Said case studies will focus on instances when in-person healthcare was insufficient, the beginnings of telehealth to address such issues, and the evolution of telemedicine over time. Drawing upon primary and secondary sources, this paper will analyze the history of telemedicine and its status leading up to the COVID-19 pandemic. The first chapter from the textbook *Understanding Telehealth* provides a comprehensive, decade-by-decade overview of the development of telehealth (Nesbitt & Katz-Bell, 2018). Additionally, an article from the journal *Comparative Technology Transfer and Society* will aid in understanding the changing rate of telemedicine adoption in the US throughout history (Roh, 2008).

Lastly, due to the strong connections between this STS paper and the author's capstone project, this paper may incorporate interviews with experts such as ambulatory clinic managers from the UVA Health System. Interview questions will focus on the effects of the pandemic on the health system's operation and the integration of telehealth into its medical practices. Said interviews will be integral to confirming telehealth trends, answering questions regarding why telehealth is being adopted, and predicting the future of care delivery.

Conclusion

The final product of the technical project will be the implementation of a comprehensive plan for the optimization of patient flow in the UVA Internal Medicine, Primary Care clinic while accommodating COVID-19 restrictions. Improved patient flow will help the clinic to maintain higher patient levels, provide superior healthcare services, and ensure patient and provider safety. The STS component will draw upon Thomas Kuhn's concept of paradigm shift and the corresponding Kuhn Cycle to analyze how the COVID-19 pandemic has expedited the adoption of telehealth and emboldened the potential shift to a virtual model for healthcare delivery. If the progress generated by the pandemic is sustained, this paper could hold particular significance in understanding and predicting the future of medicine and the delivery of care.

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