A Systems Approach to Optimizing Patient Flow During the COVID-19 Pandemic
(Technical Paper)

Influences of Misinformation and Conspiracy Theories on the General Public
(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 novel coronavirus, also known as COVID-19, has claimed the lives of well over one million people around the world. (*WHO Coronavirus Disease (COVID-19) Dashboard*, 2020). People who have COVID-19 are reporting a wide range of symptoms, including those very similar to the common cold: fever, cough, shortness of breath, fatigue, sore throat, congestion, and more. Others sick with the virus have even lost their sense of smell and taste. While everything about the virus is not fully known, the Centers for Disease Control and Prevention (CDC) reported that "older adults and people who have severe underlying medical conditions are at higher risk for developing more serious complications from the virus" (*Coronavirus Disease 2019 (COVID-19) – Symptoms*, 2020). Battling this pandemic is one of the most pressing issues of this decade. If nothing is done to combat the spread of the virus, the time frame spent with heavy restrictions and fears of health concerns may be prolonged. Similarly, a restructuring of how people live their daily lives is imperative until a more permanent solution for controlling the virus is found.

The pandemic, and the disruption it has caused to engagements with and within healthcare systems, provides motivation for the proposed technical research. Health systems have a responsibility to create and ensure a safe and healthy environment for both patients and providers alike. New requirements and protocols must be met, including, but not limited to, social distancing, mask wearing at appropriate times, patient screening for COVID-19 symptoms, and contact tracing. These requirements have forced many health systems across the country to lose revenue and furlough employees due to changes in patient flow. During what was believed, at the time, to be the height of the pandemic, hospitals around the country were unable

to keep up with the vast number of severe COVID cases. In an article from the Washington Post in April of 2020, an emergency room physician explains how hospitals in New York needed to utilize refrigerated trucks to store the bodies of dying patients (Rose, 2020). While this trend has slowed, there has been an unchanging need since then to reallocate resources to COVID patients and victims away from other normal operations and elective surgeries. The technical research will include an in-depth analysis of the patient admittance processes by examining a particular clinic in the University of Virginia health system.

Additional research will be conducted in order to provide an analysis of how misinformation affects the views and responses of society within the purview of particular consequential events. The Institute for Strategic Dialogue (ISD) conducted research showing how the COVID-19 pandemic is being exploited and proves that "dis/misinformation pose a threat to efforts to combat the virus" (Doggett, 2020). There is an indispensable need to monitor and regulate this misinformation. Focus of the STS research paper will be placed on the COVID-19 pandemic in contrast with other historical events, such as the 1918 pandemic, using the social construction of technology and wicked problem framing.

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 Internal Medicine, Primary Care Clinic has faced this challenge in its patient admittance process. Prior to the pandemic, the admittance process for this clinic began when the patient entered the building and checked in at central registration, 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 in a pandemic.

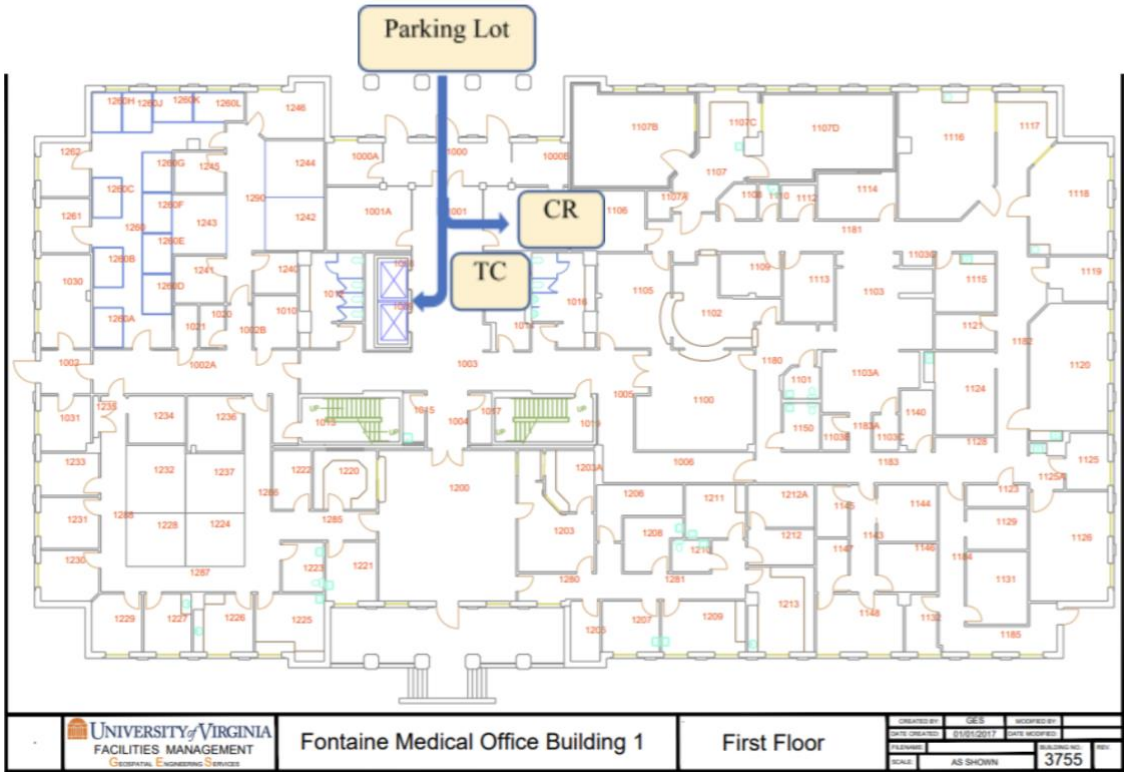

Figure 1. Diagram denoting patient flow process for patients going into Primary Care Clinic & locations of the parking lot, entrance of the building, central registration (CR), and temperature check (TC) (Geospatial Engineering Services, 2017).

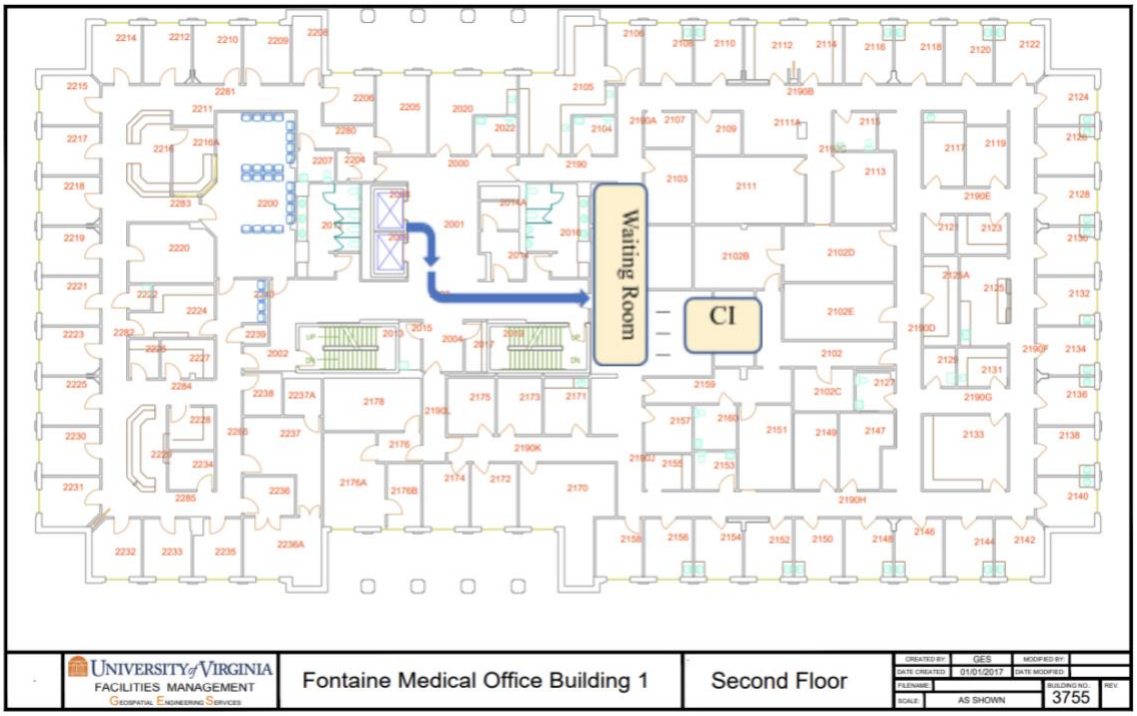

Figure 2. Diagram denoting patient flow process for patients going into the Primary Care Clinic & locations of the waiting room for the Primary Care Clinic and check-in to the clinic (CI) (Geospatial Engineering Services, 2017).

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 (refer to 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 very 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 and Microsoft Excel 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

The spread of misinformation surrounding the pandemic, both online and in the media, is one of the many reasons the United States still has a growing number of positive cases. A study by the Kaiser Family Foundation (KFF) on the relationship between the 2020 United States presidential election and coronavirus found that 48% of registered voters believe in at least one misconception about the virus (Hamel et al., 2020). The line between ‘real news’ and ‘fake news’ is thin, and there are many examples that prove that “even legitimate news sources can

produce and spread fake news" (O'Connor et al., 2019, p.166). 'Fake news' about certain events tends to lead to the creation of conspiracy theories. The proposed STS research will consider the distinction between misinformation and conspiracy theory and will use the 1918 Pandemic and the events of 9/11 as a foundation and precedent for the topic of how misinformation and conspiracy theory affect social response in the face of COVID-19. The paper aims to analyze how the general public acts when faced with certain problems, how the public views an event during and after it has happened, how these responses aid in lessening the gravity of a situation, and how these responses contribute to the importance of an event. The illusory truth effect, the tendency to believe false information after repeated exposure, is one reason for explaining "why fake news spreads and [why] retractions of misinformation don't work" (Cosenzo, 2020); this effect is germane to answering the research question. Research into the topic of misinformation is vital to understanding how the coronavirus pandemic grew to this magnitude in the United States.

One framework that will be applied to this topic is the social construction of technology (SCOT). SCOT embodies the idea of human action shaping technology; Hans Klein, Georgia Institute of Technology, and Daniel Lee Kleinman, University of Wisconsin-Madison, define SCOT as how social structures can influence the development of technology or the meanings associated with technology (Klein & Kleinman, 2002, p.28). The framework includes four main components, the most important of which is interpretive flexibility. Expressing that misinformation surrounding COVID has interpretive flexibility is to claim that it is open to more than one interpretation (Bijker et al., 2012, p.20). This framework will be used to answer the research question by using misinformation and conspiracy theory as social constructions. It is important to note that the framework is insufficient due to its pluralist view and its emphasis on

agency; the framework assumes that social groups are equal and that all relevant groups are present in the design process (Klein & Kleinman, 2002, p.30). In this particular case, the relevant social groups are the spreaders of misinformation, the people who have been led astray, and those who recognize that it is a misconception.

A second framework known as wicked problem framing will be applied to help answer the research question at hand. A wicked problem is one that cannot be solved, and is beyond the scope of normal engineering science; it is one that requires a reform of current practices in place (Seager et al., 2012, p. 467). In the *Journal of Agricultural and Environmental Ethics*, it is noted that a wicked problem can be identified by five essential characteristics: difficulties in problem formulation, multiple but incompatible solutions, open-ended time frames, novelty (or uniqueness), and competing value systems or objectives (2012, p. 469). This framework will be used to help identify the reasons for tensions and contradictions surrounding COVID-19 and provide a method of taming the problem as opposed to solving it.

The STS paper seeks to answer the following question: How does misinformation and conspiracy theory affect people's social responses in the face of consequential events? This question will be answered using documentary analysis methods by verifying and validating evidentiary sources. Information will be collected from October 2020 until April 2021 using the keywords and phrases misinformation, conspiracy theory, COVID-19, the 1918 pandemic, and 9/11. These keywords and phrases were selected due to their relevance to the research question. Sources will be gathered using online search engines; any source including texts, documentaries, and previous research materials that are deemed useful will be analyzed and organized chronologically by event.

Conclusion

To sum up everything that has been stated so far, the technical and STS deliverables jointly aim to understand COVID-19's disruption to health systems and how human behavior and response assisted this disruption. By the end of the technical project, the research team hopes to produce the following deliverables: recommendations towards an improved patient scheduling process for the Primary Care Clinic that will include both telemedicine and in-person appointments, patient inflow optimization of the entire patient admittance process, a possible discrete event simulation in order to view patient flow, and a technical report. The STS research can be used as a way of detailing how false information can affect social response and can be used as a basis of understanding for future influential events. The research, once successfully completed, will help to contribute to the amelioration of problems presented by the pandemic.

References

Bijker, W. E., Hughes, T.P., & Pinch, T.J. (Eds.) (2012). *The Social Construction of Technological Systems, Anniversary Edition: New Directions in the Sociology and History of Technology,* 1-98. ProQuest Ebook Central. https://ebookcentral-proquest-com.proxxy01.its.virginia.edu

Coronavirus Disease 2019 (COVID-19) - Symptoms. (2020, May 13). Centers for Disease Control and Prevention. https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html

Cosenzo, V. (2020, February 5.) *The Illusory Truth Effect: Why We Believe Fake News, Conspiracy Theories and Propaganda.* Farnam Street. https://fs.blog/2020/02/illusory-truth-effect/

Doggett, J. (2020, October 5). *COVID-19 Conspiracy Theories and Misinformation.* Croakey. https://www.croakey.org/covid-19-conspiracy-theories-and-misinformation/

Dowdell, K., personal communication, September 10, 2020.

Geospatial Engineering Services (2017, January 1). *Fontaine Medical Office Building 1* [Unpublished manuscript]. Facilities Management, University of Virginia.

Hamel, L., Kearny, A. Kirzinger, A., Lopes, L., Muñana, C., Brodie, M. (2020, September 10). *KFF Health Tracking Poll - September 2020: Top Issues in 2020 Election, The Role of Misinformation, and Views on a Potential Coronavirus Vaccine.* (2020, October 1). KFF. https://www.kff.org/coronavirus-covid-19/report/kff-health-tracking-poll-september-2020 https://www.kff.org/coronavirus-covid-19/report/kff-health-tracking-poll-september-2020

Klein, H. K., & Kleinman, D. L. (2002) The Social Construction of Technology: Structural Considerations. *Science, Technology, & Human Values,* 27(1), 28-52. https://doi.org/10.1177/016224390202700102.

O'Connor, C., & Weatherall, J.O. (2019). The Social Network. In *The Misinformation Age:*

How False Beliefs Spread, 147-186 ProQuest Ebook Central. https://ebookcentral-proquest-com.proxy01.its.virginia.edu/lib/UVA/detail.action?docID=5607600

O'Donnell, C., Rojas, H., & Green, T. (2020, May 21). Standard Work for Ambulatory Visits during COVID-19 Rescheduling Office Visits and Scheduling Telemedicine Virtual Visits (Prof Remote/Non Face-to-Face Encounters). [Unpublished Manuscript]. UVA Health.

Rose, J. (2020, April 11). *As an ER doctor, I fear our era's defining symbol will be the refrigerator truck.* The Washington Post. https://www.washingtonpostcom/outlook/2020/04/11/refrigerated-truck-morgue-coronavirus/

Seager, T., Selinger, E., & Wick, A. (2012). Sustainable Engineering Science for Resolving Wicked Problems. *Journal of Agricultural and Environmental Ethics, 25*(1), 467-484. https://doi.org/10.1007/s/10806-011-9342-2

Swensen, E. (2020, May 20). *UVA Health Enacting Changes in Response to COVID-19 Financial Impact.* UVA Health Newsroom. https://newsroom.uvahealth.com/2020/04/28/mitigate-financial-impacts-covid-19/

WHO Coronavirus Disease (COVID-19) Dashboard. (2020, October 6). World Health Organization. https://covid19.who.int/?gclid=CjwKCAjw8MD7BRArEiwAGZsrBeclC1V39iFX3FP2aD5fO5Q_F-QfsimLkOSlExxdg319B8i_mzS_kBoCCuEQAvD_BwE