**Constructing a Solution Oriented Design Network**

(Technical Paper)

**Understanding the Role of Various Actors in the U.S. Opioid Epidemic**

(STS Paper)

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**Introduction**

In 2019, a study conducted by the National Center for Health Statistics on United States (U.S.) drug use and health, reported that approximately five people die every hour (translates to 120 deaths per day) due to opioid-related overdose. The Centers for Disease Control (CDC) reports that since 1999, there have been an estimated 450,000 lives lost due to opioid-overdoses ("Products - Data Briefs - Number 356 - January 2020", 2020). What is being described above is the epitome of an epidemic and in 2017, national health organizations communicated just that to the public, the U.S. was dealing with an opioid epidemic. The narrative behind the rise of the opioid problem is not exactly what one would expect. There are many different actors that contributed and are still contributing to the issue, some of those being: the addictive nature of opioids, the agendas of large pharmaceutical companies, mis-guided physician practice, and organized crime groups. As U.S. policy makers, engineers, and public health officials aim to implement solutions to solve this opioid epidemic, one might find value in a "roadmap" that helps them identify points and places of vulnerability within the country. The basis of the STS (Science and Technology in Society) portion of this portfolio will be centered around analyzing how certain components of this network affect the problem and the other components around it. By doing this, insights on how to combat the opioid epidemic could potentially be found.

Troubleshooting solutions to the opioid epidemic requires consideration of an extensive list of actors. Technology, infrastructure, policy, laws, healthcare, societal norms, money, and ideas could all play a role in the network that enables the opioid problem to persist. A way to impact this problem is by creating an actor in the network that promotes positive change. The technical portion of this research, although unrelated to the STS portion, is about creating one of those positive actors. The University of Virginia's (UVA) Health System is placed directly next

to the School of Engineering and Applied Sciences at UVA. There is a great deal of interaction between these two entities, yet, there is still a part of this network left untapped. Forming a network between the UVA Health and research system and engineering undergraduates to solve real world problems is a step towards adding another positive actor in the mix of the network defining health problems like the opioid epidemic. Not only does this provide healthcare workers with solutions to their problems which will then improve the way they can treat patients, but it also improves the career trajectory for the students that will eventually be the problem solvers focussed on the most pertinent health problems in our world. The goal of the technical portion of this portfolio is to design, develop, and implement a sustainable infrastructure for this network between health professionals and undergraduate engineering students.

**A Network Providing Solutions to Design Problems**

At the University of Virginia, there exists various programs and organizations that promote career growth in the STEM field. These include the Undergraduate Research Network (URN), Undergraduate Student Opportunities in Academic Research (USOAR), Engineers Going Global, and HackCville. URN and USOAR facilitate student-faculty interaction in a research based setting ("Student Organizations", 2020). Engineers Going Global have project based innovations scoped outside of the immediate UVA community ("Engineers Going Global", 2020). Lastly, HackCville (a.k.a Forge) offers lessons and projects in the realm of computer science and user-experience design ("Forge", 2020). However, none of these programs focus primarily on team design thinking with projects spanning across all disciplines of engineering to produce innovative solutions that directly impact the UVA community. This limits experience in designing, prototyping, developing, and testing a product, which are important skills to refine before entering the workforce. All students learn engineering principles and gain

problem-solving skill sets from class, but may not see the real world application in class assignments. When the research team asked a student majoring in biomedical engineering with career aspirations in medical devices, what they felt was lacking from their undergraduate experience they noted,"there are limited resources to seek exposure and hands on experience in a setting that is not research lab-based" (Anonymous, personal communication, October 9, 2020). On the other hand, the research team also asked a healthcare professional what limited her interaction with students on projects and she stressed that she had a wealth of projects, but not enough students to work on them (S.Berres, personal communication, October 22, 2020). This lack of transparency and connection between professionals and undergraduate students limits workplace efficacy as well as hinders student experiential learning.

The goal of this technical project is to develop a network between the UVA Health and academic system and engineering undergraduate students that focuses on design based projects, where students are given the opportunity to solve real world problems and receive hands-on experience. These design projects can range from constructing medical devices to configuring website user interface to designing collaborative work spaces. The research team aims to have at least three projects with student teams of about four to five people, to develop team based design thinking, client relation skills, and product management skills. The research team will facilitate client meetings and assist with the engineering design process to formulate feasible solutions. Completion of the project will result in a tangible solution and implementation strategy that students will present to the professionals. The goal is to implement this network in the UVA engineering department in the spring of 2021 and closely track team dynamic and progress through frequent team check ins, client evaluations, and deliverable benchmarks.

By facilitating the development of this network, it is predicted that there will be downstream effects, even if subtle or hidden. A significant focus is the health system component of this network as there is much potential for meaningful impact. It is our desire to bring solutions that will improve the lives and efficiency of healthcare professionals, which will indirectly improve patient care ("Keep health workers safe to keep patients safe: WHO", 2020).

**Analyzing the U.S. Opioid Problem**

The U.S. opioid epidemic impacts rural regions of the U.S. disproportionately compared to urban/metropolitan regions (Hancock, 2017; "HEALing Communities Study", 2020). There are factors that cause this problem, those that perpetuate it, and those that do both. When allocating blame for the opioid epidemic, a U.S. citizen might point towards pharmaceutical companies, imprudent physicians, or organized crime groups. Now, there is merit to these appointments, evidenced by the recent $8 billion dollar settlement that Purdue Pharma recently made with the U.S. government for their injudicious advertisement of their opioid product, Oxycodone, in the early 2000s which significantly contributed to opioid addiction rates ("NPR Choice page", 2020). Alarming statistics show that in 2012 there were 255 million opioid painkillers prescribed in the U.S. by physicians, which is sufficient to supply every single adult in the country with a bottle ("What Caused the Opioid Crisis?", 2020). Furthermore, in the last decade the illicit opioid industry has exploded, presenting drug trafficking problems across borders and issues with users transitioning from prescribed to illicit opioids ("StoptheDrugWar.org", 2020).

Although these actors do play a significant role in the rise of the opioid addiction in the U.S., they do not adequately address the phenomenon that rural regions of the country are suffering more from the epidemic than urban centers. With a deeper look into the problem, one

encounters numerous other functional components such as shortcomings in education and education funding, healthcare infrastructure, transportation infrastructure, economic prosperity, law enforcement, policy makers, and drug use practices ("2017 North American Freight Numbers", 2020; Currie, 2020; Gerominus, 2019; Hancock, 2017; Ho, 2017). The stories behind each of these components can provide an example of how they are detracting from society's fight against this epidemic. What can be troubling for proponents of progress in this context is that this is such a complex system of components and it can be daunting to try to make sense of it all.

The Actor-Network Theory (ANT) is a perspective from a realm of thought referred to as Science and Technology in Society (STS). This framework is useful for assessing the many different actors, which may be networks themselves, that influence and are influenced by the other actors in the network (Cressman, 2009). Furthermore, ANT is unique in that it considers both human and non-human actors, when addressing a phenomenon. This is in-line with the idea of the heterogeneous engineering of an actor-network, which entails the combination of both social and technical components (Cressman, 2009; Latour, 2005). This concept is based on the belief that in order to understand the processes that aided in the rise of a particular phenomenon, there should not be a particular perspective left out (Cressman, 2009). ANT further distinguishes itself from other frameworks by asserting that all actors in the network are equal in significance. Any perceived size, power, and influence of an actor is the effect that is attributed to the actors that are associated with it. In other words, the degree of influence a particular actor has on the network is dependent on the extent of associations it has with the other actors in the network (Cressman, 2009).

There are some criticisms surrounding this framework that argue the leveling of actor significance detracts from the value of the social aspect of a sociotechnical network, as well as

detracts from the utility of ANT analysis overall (Cressman, 2009). Critiques counter that ANT becomes vastly more useful when each node is evaluated individually, and when the connections between independent nodes are given value (Callon, 1987). Another popular belief is that ANT fails to synthesize a final verdict or analysis of a phenomenon. That by assessment of the problem this way, there can be an endless number of actors identified, which could make the research aims counter-productive (Ivsins & Marsh, 2018).

This research will call upon ANT and analyze the identified cultural, physical, and contextual dimensions of the U.S. opioid crisis. By tracing the associations between these actors, perhaps society will better understand the situation of drug abuse as more than just users and addictive opioids. Hopefully this research will bring to light the complex system of actors influencing each other and bringing rise to the opioid crisis.

The pharmaceutical companies, rash physicians, and crime organizations (the big three), are indeed a reason for the rise and continuation of the opioid problem. While true, this perspective overlooks other actors that also contributed and are continuing to contribute to the opioid crisis. If society does not widen its scope of the situation beyond the big three actors, then there cannot be proper evaluation of the problem. Utilizing the ANT framework, I argue that the opioid epidemic is the making of these big three actors in conjunction with other associated actors such as policy makers, public health educators, and healthcare infrastructure. In my research I aim to address the question(s): Why did the U.S. encounter an opioid epidemic? What actors are contributing to this problem and preventing opioid abuse prevalence from decreasing?

In order to explore this topic, research will be conducted using discourse analysis coupled with statistical data. Information surrounding this topic will likely be from a multitude of sources

including news articles, journals, interviews, documentaries, surveys and more. The data collected will be assembled categorically, as to allow each actor to be analyzed in detail by themselves or in conjunction with similar actors (i.e. physicians and rehabilitation centers). Assembling data chronologically did not seem as appropriate in this situation as there has not been much change over time. Some keywords such as healthcare, opioid, heroin, prescription, malpractice, treatment, rehabilitation, infrastructure, epidemic, pharmaceutical, and abuse, will be used to collect information.

**Conclusion**

Construction and management of a design network between healthcare related professionals and undergraduate students at the University of Virginia, will be mutually beneficial with an inherent positive impact on patient lives. We aim to have at least three projects either up and running or completed by the spring of 2021. These projects will be identified, organized, and led by myself and my capstone project team members. Group and project details will be presented in a web format to facilitate the growth and success of the network. A significant health problem in the U.S. is the opioid epidemic. A problem like this could be solved by the introduction of a new actor or manipulation of the current network. Before society can remedy this problem, there needs to be clarity on what exactly is the problem, who or what is causing it, and how can it be fixed. I will apply ANT to further understand the role of individual actors in the opioid crisis, and to be able to highlight certain actors that provide an opportunity for positive manipulation of the problem.

<div style="text-align: center;">*References*</div>

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