Undergraduate Thesis Prospectus

Modeling to Mitigate Infection In Anesthesia Induction
(technical research project in Systems Engineering)

The Struggle over Medical Privacy in the United States
(sociotechnical research project)

By

Austin Campbell

Technical project collaborators:

Sergio Darquea
Bella Holloman
Gabriel Lawrence
Neha Pavuluru

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

Austin Campbell

Technical Advisor: Matthew Bolton, Department of Systems and Information Engineering
STS advisor: William Davis, Department of Engineering and Society

General Research Problem:

How can the US healthcare system best serve the public?

Conflicting interests between the healthcare system and the public have long existed, especially when considering that 9% of the US was uninsured in 2020 (Census Bureau, 2021). Faith in the system seems questionable at best as a poll of independent voters in 2019 showed that 90% of them believe that the current healthcare system should be improved or replaced (Quinnipiac University Poll). It appears that their needs are not being met as only 4% of those polled believed that the system should be kept as is. With such low faith in the system it raises the question as to how the healthcare system can best protect the interests of the people it serves considering healthcare spending in 2019 reached approximately 17.3% of US's GDP (CMS, 2020).

Modeling to Mitigate Infection in Anesthesia Induction

At the University of Virginia Hospital, how can computer modeling be applied to optimize the anesthesia induction process?

This is a Capstone project with Matthew Bolton as the advisor and a team consisting of Systems and Information Engineering students including me, Bella Holloman, Neha Pavuluru, Gabriel Lawrence and Sergio Darquea. We are analyzing the induction procedure to determine critical points for cross contamination and building a computer model that best represents the operating room environment.

Hand hygiene is critical to preventing the spread of infection around the hospital, especially regarding healthcare associated infections (HAIs) and cross contamination that humans and equipment both are at risk of. The CDC estimates that 1 in 31 patients has at least

one HAI a day that could've been prevented (2021). Cross contamination is a key cause of HAIs in hospitals, and proper hand hygiene compliance is a preventative measure against the contamination risks, although studies show that compliance rates could be as low as 40% (Erasmus et al., 2010). The anesthesiology induction process is a potential source of issues because it involves interactions between multiple people and equipment to achieve a state of unconsciousness before the surgery (Stoelting & Miller, 2014). This leads to many risks of cross contamination in the operating room for HAIs to occur, so attempting to better optimize this procedure is beneficial for all parties involved.

The goal of our project is to define a formal computer model to replicate the induction process and verify it to predict how infections can spread during the procedure. This will be done by communicating with UVA health to observe the procedure in order to develop models and identify problems in existing procedures that may allow cross contamination. These models will be tested for all different scenarios that could occur in the operating room such as forgetting to wash your hands, skipping a step, using the wrong hand for a step, or touching your hands together. Currently UVA follows a general procedure during anesthesia induction although the same steps are not always taken by everybody. With the model validation software we will conduct experiments to model the process and at the end of it we will have verification results, a published conference paper, and a presentation for our sponsor as well as for the conference with recommendations and findings.

The Struggle over Medical Privacy in the United States

In the US, how do professional societies in medicine, hospitals, researchers and patient advocacies compete to influence the privacy standards governing patient medical records?

With social groups in the US competing to influence medical privacy standards, conflicting interests lead different types of groups to use alternative methods to impact the policies in place (Kayaalp, 2018). According to Cohen and Price (2019), digitization of medical files was to lead to "Increased accountability, quality, efficiency, and innovation" but inevitably generated more patient data and thereby more privacy risks. Certain companies and groups look for technology driven solutions for the protection of medical records in order to ensure privacy, while others aim to influence the rules and regulations itself as the health records keep on stockpiling up (Chen, Luo, & Bian, 2021). All of these competing interests highlight what strategies specific groups use and to what end.

Spotlighted groups are the American Medical Association (AMA) as the lobbying that it does will be on the national level with congressional reform to advance their agenda (Robeznieks 2019). The AMA is the largest association of physicians in the US and states in its code of ethics that privacy is a central value for the medical community and is a "prerequisite for trust". Another is the National Academy of Medicine (NAM) as part of its core beliefs is the continuous learning of the medical community and adapting, which entails public data collection going against increased privacy (Okun et al, 2013). The NAM is an independent scientific advisor both nationally and globally and the influence it has is produced by the advice and the work that it puts out. Another is the Medical Society of Virginia (MSV) as they solely focus on medical issues and advocacy in Virginia and their lobbying will be aimed toward state governmental change and privacy (Weathermen 2023). They accomplish this by lobbying specific legislators in the state government to educate them on the needs of better healthcare in Virginia. Another group is the Institute for Healthcare Improvement (IHI) and operates at a smaller scale than the others but holds conferences and seminars worldwide. The IHI aims to ensure the safety of

telemedicine and wants the digitalization to be done correctly (Perry, Federico, & Huebner, 2021). All these groups try to advance their varying agendas in different ways, and with different motives behind them, and it is important to try and understand how they use their resources and people to influence policy.

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