

Thesis Project Portfolio

Designing a Modified Armboard for Cardiovascular Medicine

(Technical Report)

The Opioid Crisis and Conflicts of Interest: Advocating Physicians' Roles as Responsible Agents

(STS Research Paper)

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Sociotechnical Synthesis

Translational research bridges the gap between the accomplishments of biomedical research and the aims of clinical research and practice, from the benchside to bedside.

Translational research encompasses a diverse range of biomedical and clinical practices such as laboratory studies, public health and health management, clinical demands, policies, and economics. Furthermore, translational research alludes to the connection between my STS and technical research, as both involve the process of translating scientific findings to clinical practice in medical device and drug development. My technical project developed a new armboard prototype for use in cardiovascular surgical procedures, improving upon the contemporary armboard models used at UVA. The armboard is used for proper positioning and restraint of the patient's arm during surgical procedures, and should ideally be soft to avoid potential injury. My STS research investigates physicians' roles in promoting the opioid crisis and the conflicts of interests that negatively influenced their judgments. While translational research explains the connection between these two projects in practice, they further relate through the ethics of healthcare and biomedical engineering when human subjects are involved.

In my technical project, we interviewed 25 medical professionals to gain insight into the strengths and limitations associated with armboard models currently used in cardiovascular medicine at UVA. In general, these models are constrained by their strength and materials, high-costs, and range of applicable surgical procedures. The material must be radiolucent allowing for x-rays to pass, which eliminates potential use of certain metal and ceramic materials. To address these limitations, we designed a new armboard model in CAD, and subsequently began the process of prototype iteration based on further interviews we conducted. We planned on constructing our final model using UVA's design shops and to test its comfort and efficacy in

“surgery simulations” with medical professionals, with the ultimate goal of obtaining IRB approval for clinical trials. However, the pandemic hindered our ability to accomplish these tasks. Nevertheless, future research involving human subjects must consider the rights and welfare of patients, ethical topics explored in my STS research.

My STS research paper illustrates how the roles of physicians in the opioid crisis reflects the need for a greater emphasis on their individual moral responsibilities, which will help them recognize the biases that may influence their judgements. Many physicians held financial relationships with manufacturers of opioids, establishing conflicts of interests that confounded self-interest with medical ethos. Physicians’ professional responsibilities include protecting research integrity and the welfare of patients, but secondary interests such as financial incentives often threaten these values. Companies like Purdue Pharma fueled these conflicts by sponsoring esteemed physicians to publish research and give lectures about the safety and non-addictiveness of opioids for treating pain. Consequently, practicing physicians influenced by these messages began to prescribe opioids at alarmingly high rates, reflecting a loss of personal responsibility and accountability.

While the first three years of UVA education adequately prepares engineers to tackle the design tasks in their technical projects, the concept engineering ethics is somewhat foreign. From the conception of my STS research idea until the submission of the final paper, my understanding of the ethical issues involved developed in a manner analogous to the transition from “conventional” to “postconventional” thinking in Lawrence Kohlberg’s theory of moral development, which is characterized by an internalization of moral principles. My initial thoughts on the STS research topic were that physicians contributing to the opioid crisis behaved immorally because they violated their professional responsibilities and the ethical tenets of

medicine. While this isn't entirely untrue, these perceptions were largely influenced by ethical codes in medicine, characteristic of "conventional" reasoning where morality is governed by rules and regulations. I initially proposed that enhanced policies and oversight would be beneficial in eliminating these ethical issues, which I now realize is far from the truth. Somewhat ironically, my argument became less clear to me as my knowledge on the topic increased. However, as I'm sure many other STS students encounter, I experienced a pivotal realization that changed the entire scope of my argument: because engineering problems are ill-defined, there is no optimal solution. No policy could have prevented the tragedies of the opioid crisis. With the aid of other STS frameworks, looking at this issue on a more fundamental and individual level highlighted the need for a greater emphasis on physicians' individual moral responsibilities. This was indicative of "post-conventional" reasoning, the recognition that morality comes from an internal emphasis on universal values and virtues. Codes of ethics and policies are meant to support and encourage professional moral judgement, not replace it.

The STS and technical research topics illustrate the connection between biomedical and clinical research and practices. Although translational research highlights the interrelation of these two fields in practice, working on these projects revealed the greater ethical relationship. In medical device design and drug development alike, physicians, researchers, and engineers must uphold and respect the rights of patients and stress the importance of justice, care, and autonomy. Working on these projects has been compelling because they similarly reveal the link between my educational background in biomedical engineering and career aspirations in medicine. They have encouraged a deeper understanding of the ethical responsibilities I must internalize and exemplify. My thesis will undoubtedly have a profound impact on my moral judgements and reasoning in my future career.