Thesis Portfolio

Redesigning the Incentive Spirometer
(Technical Topic)

End-of-Life Healthcare in the U.S.
(STS Topic)

An Undergraduate Thesis

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Introduction

The incentive spirometer (IS) is an important medical device used to prevent postoperative and respiratory complications like pneumonia. Moreover, an IS can be used by intensive care unit COVID patients to help strengthen the muscles that help you breathe. Despite the importance of using an IS, patient adherence is poor.

The U.S. healthcare system is expensive, inefficient, and unsustainable. A disproportionate amount of healthcare resources is spent on the elderly, and considering the aging American population, there is expected to be an increase in demand for palliative care (PC) due to longer life expectancy and more chronic disease. Additionally, the structure of our current healthcare system often does not act according to patient preferences.

The goal of both my technical and STS research is to improve patient care. The IS, though usually used in a postoperative capacity, often acts as a preventive care tool to mitigate the development of various pulmonary complications. End-of-life care in the U.S. has much room for improvement and needs to change, as the current healthcare system is unsustainable. By synthesizing literature from various fields (healthcare, economics, philosophy), this research aims to improve our overall understanding of why our current healthcare system needs to change, why end-of-life care has much room for improvement, and why having a patient-centric view is vital to creating effective medical devices.

Technical Topic: Redesigning the Incentive Spirometer

The goal of my technical capstone project is to design and create a gamified, user-friendly, and patient-oriented IS that is simple, intuitive, fun, and gives the user instant reward/gratification. We hypothesize that effective incentive spirometry relies heavily on the patient's own motivation and interest in using an IS, since the majority of patients using an IS are alone in their rooms for most of the day. Our goal is to design an IS that is engaging enough that patients will want to use it on their accord. We hope to create a patient-oriented device by collecting patient feedback on our IS throughout the design and production process. Continuously receiving and implementing user feedback into our product will hopefully create a device with clinical value – a device that patients will enjoy and be motivated to use.

STS Topic: End-of-Life Healthcare in the U.S.

My STS research aims to demonstrate why our healthcare system should shift our notion of care from treatment to prevention and focus on preventive and PC. Such a shift would not only align better with patient preferences but also benefit the healthcare system by becoming more sustainable and cost effective. Compared to other high-income countries, the United States spends nearly twice as much on health care yet has worse medical outcomes and the lowest life expectancy. Hospitalization and using high technology health care resources at the end of life likely account for the U.S.'s uniquely high healthcare spending. Instead of focusing on treatment and pressuring older patients to undergo treatment, we should shift our focus to preventive and PC services. Preventing disease is much more favorable to treating people after they get sick. However, most providers do not prioritize preventive care services – although they know how

such services can reduce the incidence of chronic diseases, hospitals and physicians alike are currently paid more to treat disease rather than prevent them.

Conclusion

The IS is a medical device that can help prevent postoperative pulmonary complications. However, it is often not used properly due to various patient factors, of which we hypothesize patient engagement and self-motivation to be the most important. The current healthcare system in the U.S. is inefficient, expensive, unsustainable, and needs to become more cost-efficient by shifting the focus from aggressive treatments to preventive and PC. After completing my technical project and STS paper, I have a better understanding of our healthcare system and why it currently functions this way. I have also learned much about designing and prototyping medical devices.

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