Thesis Project Portfolio

PARVA: Patient Augmented Reality Vibroacoustic Array

(Technical Report)

Using Precision Medicine to Improve Prevention and Reduce the Cost of Healthcare

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science

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In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

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Sociotechnical Synthesis

Modern technological advances are having a profound effect across all areas of medicine. Treatment plans are becoming more precise and data-driven, and procedures are becoming less invasive. However, implementing these new technologies comes with its own challenges. For example, precision therapies can be extremely expensive, and minimally invasive in-office procedures can be more stressful for patients. The technical project and STS thesis presented here both revolve around solving some of these implementation challenges of new medical technologies in order to harness their full potential.

The technical component of this portfolio involves the development of a multisensory stimulation device intended to reduce patient perception of pain during in-office otolaryngology procedures. The term in-office refers to procedures that are conducted in a regular doctor's office – as opposed to an operating room – where the patient is only given local anesthetic and kept awake throughout the entire procedure. As one might imagine, remaining coherent throughout these procedures can be incredibly stressful for the patient. The device my team and I developed uses augmented reality immersion and vibratory stimulation to distract the patient and ease anxiety, making in-office procedures more comfortable and accessible.

My STS thesis discusses the feasibility of precision medicine within the context of the American healthcare system, and proposes an implementation of precision medicine that focuses on preventative care in order to reduce costs. While precision medicine promises to revolutionize medicine and lead to significantly better patient outcomes, developing precision therapies can be quite costly, and reduction in uncertainty through genomics threatens to undermine the business model of private healthcare. However, America also currently lacks a focus on preventative care, even though increasing the use of preventative measures has been shown to reduce healthcare costs. As my thesis argues, precision medicine is well equipped to

fill this gap in preventative care, which could provide an avenue for mitigating the other cost increases that are expected to come with this new model of health care.

Given the virtual nature of this year, our technical capstone project was fraught with delays and difficulties. We lacked access to many of the prototyping facilities that are generally available to BME students, we were not allowed observe patients in the clinic, and had to pass hardware back and forth between different team members. We were still able to create fully-functioning prototypes, but much testing still needs to be done to validate our designs. Similarly, my thesis work identifies some promising avenues for exploration in linking precision medicine to preventative care, but it primarily serves as a jumping off point for further inquiry and analysis.

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