Thesis Portfolio

Dual Injection Syringe for Ultrasound-Guided Musculoskeletal Injections
(Technical Report)

3D Printing Innovation in Healthcare
(STS Research Paper)

An Undergraduate Thesis

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

University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering and Applied Science

Trent Jerome Levy

Spring, 2021

Department of Biomedical Engineering

Table of Contents

Sociotechnical Synthesis

My technical capstone project focused on development of an augmented syringe device for the sports medicine department of the UVA Hospital. The critical requirements of our novel medical device were that the device must exhibit the ability to inject and aspirate two separate medicines with ease and independence from each other. By creating this device with Dr. Jeremy Kent from the UVA sports medicine department, my group underwent iterative prototyping utilizing various 3D printing (3DP) techniques. 12 prototypes were developed, printed, and tested. Improvements of design were made based on testing results and user feedback. Although many improvements were made, a sufficient prototype that meets all desired design requirements has yet to be developed and development of the device will continue under the guidance of Dr. Kent.

Innovations such as 3DP have expanded rapid and accessible prototyping technologies to a larger portion of the population. The lowering of barriers to entry for prototyping is relevant to my capstone project to develop an augmented syringe. In this instance, a physician identified a need not met in his profession and subsequently tasked a group of students to aid in meeting this need with a medical device. Due to accessible prototyping technologies such as 3DP, healthcare professionals interested in creating improvements in their field can now easily utilize cheap and effective means of product development in order to test prospective solutions while not risking major investments in capital. Overall, new technologies such as 3DP are giving individuals power over the means of production and allowing for a distribution of innovation. 3DP in the healthcare industry has allowed physicians and others to propose innovations and to potentially change their field given adoption from other stakeholders in the healthcare industry. In order to further explore how 3DP is impacting healthcare, I decided to focus my research to track the

emergence of 3DP in healthcare, evaluate an opportunity space for 3DP to intervene, and provide advice and requirements for 3DP to reach its maximum potential in augmenting healthcare.

The project undertaken was a valuable initial development of an injection device to aid in musculoskeletal injections. Lack of access to 3D printing resources and the inability to meet physically as a group early in our project provided obstacles to our progress. Although a complete and sufficient prototype was not developed, the progress made is considerable and will be helpful for Dr. Kent's development of the device going forward. Future recommendations for development of this device are to further optimize printing procedure to prevent defects and for more frequent meetings to discuss design and function of the device.

I would like to thank our capstone advisor Dr. Kent for his consultation and advice throughout the project. Of course, I would also like to thank Dr. Allen, Dr. Barker, Professor Ferguson, and the entire UVA BME faculty for their support and guidance throughout our project.