ELECTROMECHANICAL BIOREACTOR FOR VOLUMETRIC MUSCLE LOSS TREATMENT

THE IMPACT OF SOCIAL MORES ON VACCINE DEVELOPMENT AND DISTRIBUTION DURING PUBLIC HEALTH CRISES

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SOCIOTECHNICAL SYNTHESIS

Biotechnology has always been a topic of controversy. Both scientists and laypeople alike have their own valid concerns regarding altering human biology for the ultimate advancement of society. However, some of the widely spread concerns may also be attributed to misinformation and poor communication from experts on more advanced biological topics. There are many concerns, though, that are scientifically valid and should be addressed in the development of novel biotechnologies, as doing so will bolster public confidence in those products. Such considerations were taken over the course of a year-long Capstone project that produced an electromechanical bioreactor as a novel method to repair large-scale skeletal muscle loss. Convincing patients to trust in this novel treatment will require more than just scientific data, it will require personal trust. The issue of trust in science is an overarching theme for the STS research described in this paper. The Covid-19 pandemic highlighted the widespread breakdown of public trust in scientists, as demonstrated by resistance to the novel vaccine technologies developed in response to the pandemic. Ultimately, the success of biotechnologies like vaccines is dictated by public trust, and when this trust is broken, scientists must try to rebuild this trust through whatever means possible

The technical report focuses on the design and fabrication of a custom bioreactor, which will be used in a larger project whose goal is treating patients with severe and debilitating skeletal muscle loss. Since skeletal muscle function is highly dependent on coordinated electrical stimulation and muscular contractions, providing growing tissues with this similar environment will hopefully encourage them to regrow more like natural human biology. The bioreactor developed in the Capstone project is intended to house multiple tissue engineered skeletal muscle constructs while they incubate and grow into functional tissues. It will also provide these

constructs with both electrical and mechanical stimulations over the course of their incubation. The design process for this project was heavily research-focused and required a high respect for the necessity of FDA rules and regulations for biological devices.

Because this project may ultimately translate to mouse models for initial clinical studies, great consideration and research went into choosing the best materials with which to construct the device. Computer aided design modeling techniques were used for initial product design, then a rapid 3D printed prototype was produced and analyzed by design experts. The final product consists of a bioreactor chamber 3D printed out of a biocompatible resin, stainless steel motion components, a stepper motor-driven linear actuator, and a full electrical circuit system for stimulating each individual muscle construct. Future work will be required to utilize some manufacturing equipment that was unavailable during the duration of this project.

The Covid-19 pandemic has revealed many flaws in the U.S. public health response, and these flaws have led to the loss of human life. Because pandemics are nearly inevitable, scientists and public health officials alike must learn from the past and present to improve outcomes in the future. In light of this, the STS research report begs the question: How can scientists regain the trust of an increasingly divided and misguided public? Examining previous case studies of public health crises and their successes and failures, as well as the social factors that may have contributed to these outcomes, highlighted several avenues through which future pandemic responses may be improved. These case studies, when contextualized within the Handoff model as well as the Technology and Social Relationships model, illuminate two key aspects of improving the trust between the public and scientists. The methods that were determined are clarifying communication and utilizing respected community leaders as scientific ambassadors.

When the smallpox vaccine was invented, not everyone was onboard with the new method of virus protection. Successful public vaccination experiments carried out by passionate doctors, however, garnered trust within hesitant communities. In the case of influenza, complacence about the virus has hindered vaccination efforts in the United States. This is likely due, in part, to poor communication regarding benefits of vaccination versus the possible impacts of the flu if contracted. Working in tandem with sociologists and communication experts may provide improvements to the current public health messaging and improve participation in vaccination efforts. Many of the best examples for improving pandemic responses, however, have arisen during Covid-19. Despite initial hesitance and low vaccination rates in many minority communities, the outreach of local clergy and trusted leaders was effective in increasing vaccine trust and acceptance. In some rural, conservative communities with low vaccination rates the silence from widely trusted pastors may have played a part in community disregard for the vaccine. There was a culture of silence around the vaccine that may have caused some to choose against vaccination for fear of ostracization. The successful utilization (or lack thereof) of integral community members as people who can speak to their peers with an already established trust, may dictate the success of public health measures in future crises.

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