DEVICE FOR AUTOMATED SELECTION AND PLACEMENT OF CELL CLUSTERS WITHIN BIOFABRICATED TISSUE CONSTRUCTS

SOCIOTECHNICAL CAUSES OF ORGAN SCARCITY AND EFFORTS TO RESOLVE THEM

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SOCIOTECHNICAL SYNTHESIS

What if obtaining a new organ were as simple as replacing a part on a car? Presently, there exists a scarcity of transplant organs worldwide. Within the United States alone, 10,000 patients are seeking transplants, yet only 39,000 operations were conducted in the year 2020 and conditions are generally worse in other regions. The technical and STS topics are centered around two different methods devised to combat the paucity of donor organs. Bioprinting, one of the two methods, is an emerging field seeking to create new *de novo* organs using small samples from a patient rather than sourcing preexisting organs for transplant. The technical project addresses inefficiencies in experimental design by automating cell cluster placement which hinder research. The STS research topic analyzes the underlying reasons behind why deceased donor programs have not been implemented using the Diffusion of Innovation model proposed by Rogers and Systems in Context outlined by Carlson. The topic will then propose a system that would be more readily adopted worldwide, focusing particularly on cultural values and education. The two topics are tightly coupled, as innovations to both bioprinting and deceased donor programs will show positive impacts on donor scarcity worldwide. By pairing these two topics together, this research paper aims to address how new medical technology can more readily diffuse into areas of reluctance.

DEVELOPMENT OF A LOW-COST MICROMANIPULATOR

The intention of the technical project is to design a device that would increase the throughput of bioprinting research and accelerate the development of practical technology. This intent was narrowed further to facilitating experimental design processes by incorporating automation. Fulfilment of the goal was accomplished through the development of a low-cost

micromanipulator. The device is capable of being controlled with computer inputs and aspirating polymer microspheres with a diameter of 500 microns.

The device created is a micromanipulator that meets aforementioned specifications, though it lacks key automation components. Manual control of the device shows promise and meets requirements for resolution set at 10 microns in design specifications, and the device was deemed a success. Future directions for research include adapting the existing coding framework to allow for additional layers of automation to include a coordinate system and potentially computer vision. The micromanipulator designed in this technical project serves as the cornerstone to future design projects. Creation of a framework assembly and code serve as the bed upon which further innovation is built upon. The design used in this technical project will allow for the acceleration of bioprinting research toward a practical method to combat organ scarcity.

DESIGNING A MORE ACCEPTED DECEASED DONOR PROGRAM

The STS topic answers the question of how deceased donation practices can be made more acceptable to hesitant cultures. Applying one of the key factors identified by Rumsey, namely education, the STS component proposes a system of education targeted toward healthcare providers with the intention of increasing both competency and opinion toward deceased donation. This proposition is based in both primary sources in the form of survey data and secondary review sources.

Creating an educational system was inspired by the work of Rumsey, who outlined 4 key factors determined one’s opinion on deceased donation: education, religion, and knowledge of a deceased donor or recipient. Education was chosen because of its relative flexibility compared to religious views. Studies by Siddiqui et al. demonstrate that secular concerns held by healthcare

providers fall into one of two major categories: mistrust and status quo. Studies by Lin et al. show that educational methods were capable of influencing providers to instead act in patients' best interests and advocate for deceased donation in spite of cultural stigma. Thus, the STS research proposes an educational system to include educational methods grounded in technical knowledge and opinion-ameliorating methods as described in the studies by Lin.

SUMMATION AND FUTURE DIRECTIONS

New methods must develop in order to combat the growing worldwide organ transplant scarcity. While the STS topic is grounded in extant methods and more immediate solutions, the technical project seeks to innovate and facilitate more permanent future solutions to the organ crisis. Continued work within this field will greatly reduce human mortality across the board for years to come.

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