Thesis Project Portfolio

Natural and Synthetic Supporting Structures for the Perfusion of Hydrogel Constructs
(Technical Report)

Effects of Emergency Medical Care Network on Different Groups of People
(STS Research Paper)

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Sociotechnical Synthesis

Cell viability and implantation survival can be greatly improved with the addition of perfusion. A challenge within the tissue engineering field is incorporating vasculature to different tissue constructs outside of the body (in-vitro) in order to maintain a viable environment for the cells. Because of that, hydrogel constructs are used to provide an effective platform to model these vasculature systems and to create complex engineered tissues which could potentially be implanted for human use later on or for scientific research. However, different mechanical properties of the hydrogels present challenges in creating connections for perfusion (Abdul Sisak et al., 2020). As of right now, many hydrogels are perfused through the rocking technique (Song et al., 2018). A solution to this problem is to integrate a perfusion device to support the in-vitro vascular system. There are limitations to this approach as the materials being used are bound to certain characteristics and the manufacturing techniques in producing these devices lack efficiency. Therefore, further innovation is needed to improve upon the perfusion of hydrogel constructs. Additionally, perfusion devices cannot integrate blood vessels and engineered tissues within the body (in-vivo) through a complete connection. Thus, the development of a new process to create a physical connection of engineered tissues to biological tissues is needed.

The technical project aspect will first focus on creating a three-dimension (3D) printed synthetic perfusion device that will have the ability to connect to a flow generating machine, to physically support hydrogels, to create a faster manufacturing process and to enable viewing inside the device. The second focus will aim to create a physical connection between an engineered tissue and a biological tissue through based on leveraging the fact that you can possible bind microgel particles to decellularized tissue.

Healthcare system has been changing and accelerating throughout the years. As newer technology and more medical interventions become available, newer options for treatments and care become accessible to the public. Therefore, improving care within the healthcare field and increasing the population's life expectancy (Medicine (US), 2008). However, there are still shortfalls within the system causing many to believe that healthcare is a luxury for the rich and not for all who seek it. An example to display this particular problem is the use of emergency medical service (EMS) outside of the hospital. Places where EMS is widely available and healthcare insurance is accessible to the majority, will have a higher number of users than places that lack those elements (Tärnqvist et al., 2017). Because of that, some will inappropriately use this system and drain healthcare resources (Dejean et al., 2016). As pre-hospital care is increasing, the need for emergency care service has also become increasingly more important as it is vital in reducing preventable deaths and disabilities (Rocha et al., 2017; Vuilleumier et al., 2021). However, there is an imbalance of healthcare services all around the world and the gaps between different regions are expanding bigger than before (Riley, 2012). The problem presented is due to the fact that not all countries are able to successfully abide by these three fundamental functions of a healthcare system; improving the health of the population, responding to people's expectations, and providing financial protection against the costs of ill health (J. A. Razzak & Kellermann, 2002). Therefore, implementing any type of basic emergency medical care outside of the hospital will contribute to achieving those fundamentals and improving the healthcare system within that area. However, it could also cause a differentiation within the social structure and implement new changes in society.

This STS project aims to center around the use and availability of emergency medical service (EMS) for pre-hospital treatments along with the impact it has on the society. The ISTA framework will be used to compare and contrast the interaction among subcomponents of a

sociotechnical system (Harrison et al., 2007). The interactions between these groups will reveal sources of unintentional consequences relating to EMS. There are five types of interaction that will be discussed; implementing new EMS to existing social systems, technical and physical infrastructures that mediates EMS use, social systems that mediates EMS use, effects of present EMS on the social system and interaction of new EMS changes with the present EMS.

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