

Thesis Portfolio

3-D Bioprinting Pancreatic Tumor Spheroids
(Technical Report)

The Struggle for Control in Childbirth Practices
(STS research project)

An Undergraduate Thesis

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Bachelor of Science, School of Engineering

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Sociotechnical Synthesis

The United States' medical system is a wide enterprise, ranging in scope from the policy desk to the research laboratory bench to the patient bedside. In such a sprawling system, there are several flaws. Criticisms that have been levied against the medical system include the high cost of health care, the lack of healthcare providers, and the challenge of navigating the system. My capstone projects focus on two specific criticisms of the US medical system. The overarching research question is *in the United States, how has the medical profession responded to its critics?* My technical capstone portion addresses a flaw in standardized research models. Current experimental models of pancreatic cancer often fail to faithfully recapitulate the complex environment found inside the human body. Biologically relevant models are significant in the context of studying cancer cell behavior or testing emerging therapeutics. The sociotechnical capstone portion considers the criticism that pregnant patients lack autonomy in the childbirth process. Physicians have been criticized for pathologizing what was considered prior to be a normal, physiological process.

My technical project is entitled *3D Bioprinting Pancreatic Tumor Spheroids*. Medical and biological researchers study cancer mechanisms in the lab to inform drug treatments and better understand the progression of tumors. Cancer cells *in vivo* are affected by surrounding sources such as neighboring cell populations, extracellular matrix, and blood vessel networks. Current experimental models often fail to faithfully recapitulate the complexity of the *in vivo* environment. We proposed 3D bioprinting technology to improve on current models. Our design incorporates heterogenous cell populations into a cancer core, stromal shell pattern. Our work has focused on optimizing a protocol for bioprinting such models. Ink viscosity and cellular composition are variables that influence the success of bioprinted models. We have also studied

cellular phenotypes within the model that have influenced its stability. In the future, the model may be used as a platform to further interrogate the mechanisms by which pancreatic cancer progresses.

My STS research report is entitled *The Struggle for Control in Childbirth Practices*. The childbirth experience has changed significantly since the late 1800's, with physicians gaining increasing control. Childbirth changed from a social, female-dominated experience to a medicalized, male-dominated experience. Through this period of change, there have been several avenues by which pregnant patients have sought to regain autonomy in the childbirth process. They have advocated for access to experimental anesthetics, sought a separate birthing environment, or participated in education advocacy. The ability to use birth advocates or draw from education allows women to be active members in the birthing process. Health professionals such as physicians stand within a large spectrum of beliefs. Some physicians advocate for proactive interventions while others defend evidence-based care that views childbirth as a normal process. These changes in the childbirth experience are especially significant in the context of the modern healthcare system. Compared to other western, developed countries, the United States lags in maternal mortality. Understanding the care and autonomy of the childbirth process may allow professionals to identify avenues of improvement.

Studying laboratory innovations and the common event of childbirth simultaneously has shed light on the larger healthcare system. Often, the medical system is slow to change. It has standardized, ingrained practices that have been used for years on end. Introducing new concepts or methods is a lengthy process and requires rigorous approval. However, change and improvement is a necessary process. Although the timescale may stretch towards decades, medical consumers are essential agents to generating change. Similarly, although the

development process is long, it is important to test and validate improved experimental models. Change and improvement will continue to occur to better the standard of care and research that exists in the United States.