ORCHID-BIO: ORGANS ON A CHIP WITH INTEGRATED DETECTION OF BIOLUMINESCENCE

NAVIGATING BARRIERS IN MALE FERTILITY CONTROL

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SOCIOTECHINCAL SYNTHESIS

Medical research is nonlinear, with the development of new treatments often stalled by various obstacles – both technical and societal. The underlying cause of these practical barriers presents itself through ineffective modeling techniques as traditional cell culture and lab animals lack accuracy in replicating human biology. The technical research involves the fabrication of a device to allow for increased reliability in organ and disease modeling, ultimately driving the idea of precision medicine. A novel product's efficacy is not only tied to how its manufactured, but also in its implications towards social groups involved in the use and development of the device. The science, technology, and society (STS) research takes specific aim at the field of male fertility control (MFC), analyzing the barriers in production and providing a framework for the successful implementation of a male contraceptive in a global context. The research topics are loosely coupled, as the technical project has a particular focus on modeling intestinal organs, though both have direct implications in medical technology development and potential use.

The creation of a device capable of *in situ*, real-time measurement of bioluminescent expression is documented in the technical report. Entitled "OrChID-Bio", or Organs-on-a-Chip with Integrated Detection of Bioluminescence, the device involves the integration of a microscale photoluminometer onto an Emulate organ-on-a-chip system. The micro luminometer is intended to track emitted bioluminescent oscillations from cultured intestinal enteroids on the chip, reducing the risk of contamination from external gathering of chip data. Along with a printed circuit board to supply power to the OrChID-Bio system, an incubator provides livable conditions to the intestinal cells while the software records photon measurements. The greater significance of this project lies in its ability to enable robust models of organ physiology, eventually bolstering drug development.

A prototype of the device was successfully constructed with all components integrated to create the larger system. The OrChID-Bio was tested and confirmed to be functional through oscilloscope calibration and voltage supply evaluations. Though time constraints and supply chain delays inhibited testing of the device for bioluminescent monitoring, the electronic trials proved that micro luminometers are compatible with organ-on-a-chip systems and that the integrity of both components remained intact. Results indicate that the proof-of-concept is primed for *in situ* trials. It is important to note that this technical research differs from the independent project outlined in the Prospectus, as problems in time and funding arose.

The STS research stems from a worldwide growing problem in unintended pregnancies, with a lack of a widely available male contraceptive contributing to this issue. Through identification and analysis of social groups involved in male fertility, the question to the lagging development of a male contraceptive is effectively answered. An evaluation of quantitative data, ethical discussions, and research assessments depict the faults in current headway regarding male fertility control. Post-research analysis using Pinch and Bijker's Social Construction of Technology theory provided a framework of all social groups for the engineer to consider before implementing a novel contraceptive.

This research began by assessing biological obstacles in male fertility and red flags from an investor's perspective, ultimately identifying a cycle that results in ineffective prototypes. The same circular consequences present themselves through an analysis of sexual health initiatives and contraceptive use worldwide. Pointing to widely assorted views on male familial roles and fertility, the research concludes that the engineer must have an understanding and connection with varying interpretations of a device's need and use.

The development of a male contraceptive has the potential to be rushed, exclusionary, and ineffective. However, with a holistic consideration of those who have the power to influence and change the interpretation of this technology, a male “birth control” could instead be beneficial towards ending the family planning crisis. Research extends far beyond the laboratory, and translational discoveries are only made through collaborative efforts.

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