**Thesis Project Portfolio**

# Development of a Microplate Accessory for Improved Bacterial Growth

(Technical Report)

# A Systematic Review of Operation Smile Through Ethical Frameworks

(STS Research Paper)

An Undergraduate Thesis

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**Sociotechnical Synthesis**

My technical work and my STS research are not directly connected to each other but each have their own motivations. For my capstone project my group was tasked to develop a microplate accessory for improved bacterial growth. Cerillo, the company that we are working for, wanted us to prototype a device that could help improve bacterial growth readings that can lead to the creation of higher quality bacterial products that benefit everyone. My STS research paper explored and analyzed an international surgical organization. Operation Smile is a specific case study of an ISO and I wanted to look into why they are successful and how they got to where they are and evaluate them through duty and care ethics.

The global bacterial culture market is a growing field due to the importance of bacterial cultures in microbiological studies to investigate virulence factors, antibiotic susceptibility, and the response of bacteria to various environmental and chemical stressors (Krishnamurthi et al., 2021; Kurokawa & Ying, 2017). Accomplishing these tasks requires quantifying bacterial concentration and growth patterns over time, which is most commonly done using spectrophotometric measurements taken by microplate readers. Yet, the accuracy of these machines in representing actual bacterial proliferation has been questioned due to low oxygen transfer rates (OTRs) and poor mixability that fail to mimic natural biological environments (Fisher et al., 2021). Our goal is to create a device to increase OTR and mixability that is universal to all 96-well plates and shakers and does not interfere with spectrophotometric measurements. To address these issues we designed a universal 96-well plate lid with baffles entering each well. The lid is designed with extrusions from the bottom face that enters each of the wells, that we refer to as baffles. These baffles are designed with sharp edges that promote mixing of the wells in conjunction with an orbital mixer typically found in standard

spectrophotometers (Lattermann et al., 2014). The design of the baffles intentionally have a hole down the middle of it to make sure that it does not disrupt optical density measurements.

There is a lack of basic surgical care worldwide disproportionately affecting billions of individuals that live in low-income and middle-income countries (LMICs). To improve access to surgical care international surgical organizations (ISOs) were created, one of them being Operation Smile. Operation Smile provides free surgery and post operative care for patients with cleft lip and palate in LMICs. Organizations like Operation Smile provide surgical care for hundreds of thousands of individuals and it is imperative that they are assessed for their efficacy and with ethics in mind. My STS research paper analyzes Operation Smiles model of care using two ethical frameworks to identify and evaluate their strengths and weaknesses. The literature review will highlight current ethical concerns surrounding ISO's that involve both host and visitor parties. It will then summarize Operation Smile's current model of care and the organizations opinions of their model and their definition of efficacy. After applying duty and care ethical frameworks to Operation Smile's approaches it helps further explain strengths and weaknesses of their care. This can then be applied to other surgical NGOs to help executives think more thoroughly when designing or revising their organizations impact. When viewing Operation Smile through the scope of duty and care ethics, they provide one of the most effective and comprehensive care models.

The results of each of these projects may differ but I think there was still value in having worked on them at the same time. Working on my STS paper helped me gain a different perspective on ethical design. My analysis made me think about aspects of my capstone project that I wouldn't have thought about as much if I didn't explore this topic. It taught me how to identify criticisms and how I can adapt to them with ethical considerations. Applying duty and

care ethics specifically to the technical project would not have the same effect as in my STS section but looking through the scope of ethical frameworks when designing leads to more equitable solutions. My capstone project taught me a lot about the iterative design process and the hurdles that one faces when creating medical devices. This insight can be translatable to medical systems. I was only given less than a year on this capstone project and faced multiple challenges that required evaluation amongst my team. Operation Smile has been established for 40+ years and they work on a much larger scale but working on this team provided me a glimpse of the effort it takes to improve a technology.

Works Cited

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