Thesis Portfolio

Re-Designing the Nasal Cannula for Facial Surgery
(Technical Report)

The Introduction of Novel Healthcare Technologies and Methods In LDCs
(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

(Executive Summary)

Facial plastic surgery reconstructs or reshapes structures of the face such as the nose, lips, and cheeks after an injury e.g. dog bite, skin cancer resection, or to change features present from birth. In 2021, a total of 1.4 million facial plastic surgery procedures were performed. In order to see the entire face and provide the best outcome, these surgeries are often performed under monitored anesthesia care (MAC), also known as conscious sedation, rather than general anesthesia. MAC allows for the patient to be sedated, making them unaware of their surroundings, while still breathing on their own. This prevents having to perform an endotracheal intubation, or placement of a breathing tube, to perform the surgery. Using MAC avoids the risks associated with general anesthesia and endotracheal intubation such as injury to teeth, lips and gums, bleeding, and aspiration of gastric contents leading to pneumonia. However, under MAC oxygen supply and end-tidal carbon dioxide monitoring is still required via a nasal cannula. MAC is preferable to general anesthesia when possible because of reduced risk of complication, especially in younger patients and patients with significant comorbidities. As such the technical component of this project aims to target the potential costs and risks associated with facial plastic surgery by developing a device that makes MAC applicable to more surgical cases. By doing this device decreases the total-incurred cost-burden associated with these procedures as well as making facial plastic surgery a more viable option for at-risk patients. These factors alongside the focus on sustainable engineering in the design and fabrication of the device put a heavy focus on the accessibility of the device to fringe groups. The STS portion of this project takes a deep-dive into the inner workings of what causes major inequalities in healthcare accessibility in LDCs. By exploring these causes from the perspective of modern medicine techniques and technology, we are able to explore the root causes of the barriers that exist in the provision of modern medicine to these nations such as brain drain, corruption, and a lack of infrastructure.

Together the two projects helped foster a deep understanding of inequity and inequality in medicine and how that gap can be bridged from both sides. In the STS research, it can be determined that there is work to be done in the fields of how aid is delivered to nations. It was found after a literary review that deep-rooted lack of infrastructure in many of these nations is often reconciled through aid. However, it is imperative that this aid is delivered properly through methods that foster growth and avoid corruption. Additionally, incentivizing those with technical knowledge to stay to circumvent the major problem of brain drain, which greatly halts development in these nations, is key. Finally, to avoid any communication issues In the technical portion I explored what can be done by engineers to ensure that innovations continue to be accessible to as many people as possible. This was done through the use of Thermoplastic polyurethane, a cheap, flexible material with a low environmental impact and 3D printing for fabrication.