Development of an Ethyl Cellulose-Ethanol Ablation Device for Cervical Precancer Treatment in Low and Middle-Income Countries

BIOE486 Capstone Team #2
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Cervical cancer is the fourth most common cancer among women worldwide, with over 85% of cervical cancer-related deaths occurring in low and middle-income countries (LMICs). The disproportionate burden of cervical cancer in LMICs is largely due to limited access to trained providers and the biomedical technologies needed to diagnose and treat cervical pre-cancer before it becomes cancer. Current therapies for cervical pre-cancer, including procedures like Loop Electrosurgical Excision Procedure, cryotherapy, and thermocoagulation, are expensive, require trained doctors to perform, and are ultimately inaccessible at the point of care. Ethyl cellulose-ethanol (ECE) ablation has recently emerged as a low-cost, portable, and effective alternative treatment for cervical pre-cancer. However, in order to deliver ECE and reliably cover precancerous lesions of the cervix, a handheld injector that can control the needle placement and injection of ECE through a typical speculum is needed. To meet this need, we propose a low-cost, portable, handheld device to enable the use of ECE in LMICs while limiting room for user error. This device uses a rechargeable battery-powered injection system, a mechanical needle actuation system, and a dual needle design to decrease treatment time. Major prototyping results include the construction of a low-cost, fully operational prototype that meets all necessary operational requirements including flow rate, needle insertion rate and depth, volume of delivery, and needle orientation. Final device printing will be completed using acrylonitrile butadiene styrene (ABS) in order to ensure the sterilizability of the device, and future work will include pre-clinical and clinical testing to achieve regulatory approval. The development of this device is a major step in providing affordable, effective, and accessible treatment options for cervical precancer to women in LMICs with the ultimate goal of decreasing cervical cancer mortality.