REDESIGNING THE NASAL CANNULA

MEDICAL MISTRUST AND DEVICE DESIGN: BUILDING NEW BRIDGES OVER DECADES OLD GAPS IN CARE IN THE AFRICAN-AMERICAN COMMUNITY

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SOCIOTECHNICAL SYNTHESIS

The project covers the creation of a medical device to aid in facial plastic surgery and the mechanisms by which fear and mistrust of such devices, techniques, and medical institutions is created in individuals and communities. The technical report was undertaken to create a biosafe, oral device to be used by facial plastic surgeons to improve safety and surgical efficiency. The technical team created the device via an iterative design process utilizing additive manufacturing techniques using thermoplastic polyurethane (TPU). The STS research was undertaken to better understand and form solutions for the prevalence of medical mistrust as analogized to device fear, particularly in the African-American community. These two topics are tightly connected in that the technical device created is something that may potentially be an object of fear and the research done for the STS topic partially informed the design process for the technical device to minimize these outcomes.

The technical report covers the ideation, design, fabrication, and testing of an oral device to secure a nasal cannula in the mouth. The testing was necessary as placement of the nasal cannula in the mouth is desirable yet unsecure. Facial plastic surgeons prefer to utilize a form of anesthesia which leaves a patient partially conscious, improving recovery, but allowing them to potentially move their lips or tongue. This movement may cause obstruction which endangers the patient and reduces efficiency as the surgeons may have to manually remove the obstruction, breaking sterility. Placement in the mouth is necessary as traditional placement or oral intubation would obstruct or distort the soft tissues of the face during surgery. The created device is placed in the mouth to provide a protective shell around the nasal cannula lines such that a patient would be less likely to obstruct them without obstructing or distorting the soft tissues of the face.

The device was created after multiple iterations that satisfies the above constraints. Device validation was performed using a crushing Instron machine to measure the impact of the cleaning method on device strength and was found to have no significant effect on the Bulk modulus of the device. Air flow testing using a novel method to determine the rate of air flow with varying weights placed on the device demonstrated that the device was able to maintain normal air flow with up to 3 kilograms of mass placed on the device, with significant differences to the naked cannula line. Given these results, the device is demonstrated to be an improvement over current surgical techniques and would improve surgical safety and efficiency.

The STS research is concerned with understanding the mechanisms that lead to and reinforce medical mistrust in the African-American community via a comparison to medical device fear and the fear-making process is analyzed via the social construction of technology framework. The paper claims that these two processes are similar and therefore the solution of exposure therapy for device fear would be applicable to medical mistrust. The paper demonstrates these similarities by describing the methods by which medical mistrust is created within the African-American community citing expert opinion, analysis, and research studies. The paper then compares this creation process to the development of medical device fear, which is similarly substantiated, and the benefits of exposure therapy discussed. The paper analyzes the development of medical device fear via Actor-Network Theory (Latour, 2005) and the social construction of technology framework as groups such as physicians, engineers, investors, regulatory bodies, and patients all influence the creation and perception of medical devices and how they are ultimately received by patients. This analysis leads to suggestions to improve this network to better serve patients.

The STS research is primarily substantiated with expert opinion attributing likely causes for medical mistrust, supporting those causes with quantitative studies, disproving a common alternate hypothesis, and expert commentary discussing medical device fear development and solutions. The likely causes for medical mistrust include inequitable treatment from medical institutions creating a justified bias against them which in turn creates distance and reinforces mistrust. Inequitable treatment comes in a variety of ways including medical professionals being misinformed about different groups of people experiencing pain differently, not referring to specialized departments, and differences in maternal mortality rates. Historically, medical mistrust has been attributed to widespread knowledge of singular events of racialized malpractice, however this conclusion is unsupported by survey research. Medical device fear is explained as having a similar mechanism of an initial negative experience being compounded by the perception of that experience in the mind of the patient, creating future negative experiences, and being solved by creating new, controlled, positive experiences for the patient.

Together, the technical and STS research characterize the creation of a medical device which is a benefit in the operating room for patients and an understanding of the mechanisms of medical mistrust and device fear is attained, allowing for greater knowledge going forward when creating devices, policies, or practices in medicine to better serve our community.

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