EXPANDING ARMREST MODULE FOR BARIATRIC ELECTRIC CHAIR

UNDERUTILIZED: AN ACTOR NETWORK THEORY ANALYSIS OF BARIATRIC SURGERY IN THE 21ST CENTURY

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Introduction

Bariatric surgery refers to a variety of procedures aimed at managing obesity and obesity-related conditions. Examples of these procedures include sleeve gastrectomy, gastric bypass, and gastric banding. The goal of most of these procedures is to shrink the size of the stomach or bypass parts of it so that the recipient feels full when eating smaller amounts of food. Due to the complex nature of these surgeries and the general dangers that surround surgery of any kind, these procedures are reserved for the severely obese. 9.2% of adult Americans and 6.1% of children and adolescents have a BMI over 40 classifying them as severely obese. This number continues to grow as the obesity problem in America continues to worsen (Tiwari & Balasundaram, 2024). Most chairs for bariatric patients are currently designed to support a width around 61 cm to 76 cm, which is not wide enough to accommodate a lot of patients (Hitka, 2023). Physicians have found degradation and breakage of the skin in patients that used the chair even if they did not fit. Pressure sores caused by the chairs can increase the likelihood of complications before and after surgery so it is paramount that the patients are kept as healthy as possible before their operations.

I propose the development of an expanding armrest module that will attach to existing bariatric chairs. In order to accommodate patients of the most extreme sizes, the armrests will be able to expand from 76 cm to 127 cm. As I have researched more about bariatric chairs, I have found that in addition to the technical factors, there are also social, political, and economic factors that influence the network of bariatric surgery. Bariatric surgery is very underutilized even though most procedures are considered very safe. I will draw on the STS framework of actor-network theory analyze the failures of the current network of bariatric healthcare. More specifically, I will investigate how interactions between technical and social factors such as the

development of bariatric equipment and the interactions between patients and physicians contribute to the underutilization of the surgery.

If the largest bariatric surgery patients do not have access to a chair suited for them, they are put at a greater risk for complications after surgery. Because the challenge of redesigning the bariatric chair is sociotechnical in nature, it requires attending to both its technical and social aspects to accomplish successfully. In what follows, I set out two related research proposals: a technical project proposal for developing an expanding armrest module for existing bariatric chairs and an STS project proposal for examining shortcomings in the healthcare field when it comes to obesity treatments.

Technical Project Proposal

Rising obesity numbers in America have developed the need for medical equipment that is able to accommodate patients of larger sizes. Chairs and beds need to be wider and able to support more weight. Specialized lifts are used to help patients unable to get up on their own. One of the failures of this equipment is lack of accommodation for all sizes. For example, the electric bariatric chairs from Hilrom rated for 500 lbs and 1000 lbs are the same width. Patients in the 800-1000 lb range have to fit into the same size chair as patients half their weight (*Powered Bariatric Recliner*, n.d.). One of the reasons for this limit on chair width is storage. Due to the size and sturdiness that is required of these chairs, they are not able to be collapsed for easy storage. Many hospitals have a storage room to keep these large pieces of equipment out of the hallways. These storage rooms have a standard size door that is not wide enough to fit a chair that meets the needs of the largest patients. Therefore, companies are constrained in the width of the chairs that they can design.

The goal of this technical project is to address the deficiencies in the armrests of current bariatric chairs by designing an expanding armrest module that will attach onto and replace the armrests of current bariatric chairs. With this new design, patients and physicians will be able to customize the width of the chair to avoid patient discomfort, pressure sores, or other complications, while also being able to store the chair easily. The target minimum and maximum widths of the chair are 76 cm and 127 cm respectively. The specific model of chair that we are developing around is the Shuttle B chair from Agiliti (*Shuttle™ A and B Stretcher Chair | 1,000 Lb. Capacity - Agiliti*, n.d.). This is an electric bariatric chair equipped with adjustable capabilities at the push of a button. The aim for our device is to integrate the electronics required for our expanding armrest with the existing ones that provide power drive and reclining adjustments. Ideally, an agreement would be made with Agiliti to allow our device to be used commercially with their product. If not, a new chair would have to be designed around the expanding armrest module.

The armrest module will be designed using computer aided design. We will first test the strength and viability of the module using computer generated simulations that will show the stresses on the structure of the device when weight is applied. We will simulate a person sitting in our device by placing simulated weights in critical places such as the original seat, armrests, and on the expanded seating area. Once a valid computer generated model is created, we will 3D-print a prototype to text the expansion aspect of our project. After successful validation that we can use the existing battery in the chair to expand and contract our device, a prototype with the proper materials must be produced. Research into the types of metal typically used in bariatric equipment will determine the best fit for our device. Sturdiness is the main concern

when designing for the amount of weight we must hold but comfortability must also be considered.

To ensure our device can be used commercially, there are certain standards and regulations it has to meet. The International Organization for Standardization (ISO) and the Food and Drug Organization (FDA) each have many regulations on medical electrical equipment that we will have to follow if our device is to be used in a clinical setting (International Organization for Standardization, 2015-2019) (Medical, 2018). An in depth look into the regulations will reveal if any adjustments need to be made to our prototype before a final product can be delivered.

STS Project Proposal

According to historical reports, the first bariatric surgery was performed in Spain in the 10th century (Temple, 2022). The King of Leon was reportedly too large to walk, ride a horse, or pick up a sword. A doctor sutured his lips together so he could only be fed liquids through a straw leading to a reduction of caloric intake and causing weight loss. Historical accounts suggest that even in the 10th century, societies were attempting to address obesity, as seen with the King of Leon's liquid diet. Such early procedures demonstrate that while the understanding of obesity was primitive, there was already recognition of the health challenges it posed. Over the centuries, as medical science progressed, obesity was increasingly seen as a complex medical issue rather than just a personal failing. From 1976 to 2000, obesity rates in Westernized countries doubled causing the medical community to turn to surgery for answers (Faria, 2017). As the prevalence of obesity increased, the need for specialized bariatric furniture and mobility aids, such as wheelchairs, became evident. Traditional furniture and equipment were often inadequate, lacking the structural integrity and comfort necessary to support patients with higher

body weights. By the late 20th century, manufacturers began designing furniture and wheelchairs specifically for bariatric patients, with enhanced durability, stability, and comfort in mind.

Although bariatric surgery has been expanding as a treatment for obesity, it is underutilized in the healthcare field as only 1% of the eligible population undergoes surgical treatment for obesity (Gasoyan et al., 2018). The current understanding behind reasons for its limited use include inconsistent insurance coverages, bad public perception, and misalignment of treatment paradigms (Varban & Dimick, 2019). While all these factors definitely play a role in the underutilization of bariatric surgery, they do not fully explain why it is still underutilized. The blame does not solely lie on the individual entities that compose the bariatric treatment space but also on the interactions between those entities. The current discourse overlooks these facts and treats them as isolated issues that contribute to the issue. They ignore the complex interactions between patients, physicians, insurance companies, and medical device companies that lead to the shortcomings of this treatment.

Focusing on these interactions offers a more complete understanding of the shortcomings of bariatric treatment. I argue that poor equipment development, inconsistent equipment availability across hospitals, differing insurance and treatment practices, and the perception surrounding the surgery, taken together, are causing the underutilization of bariatric surgery. The interaction between these various factors intensifies the problem with equipment issues leading to inconsistent treatment and insurance practices which then lowers the public perception around the surgery.

To analyze the underutilization of bariatric surgery, I will draw on the science, technology, and society (STS) framework of actor-network theory (ANT). Developed by STS scholars like Michael Callon, Bruno Latour, and John Law, this theory claims that all technical

projects can be viewed as a network of human and non-human actors assembled by a network builder to accomplish a particular goal (Cressman, 2009). The strength and success of a network is determined by the interactions among the various actors. In addition, I will utilize Michel Callon's concept of translation, which describes the process of network formation, to analyze both the patient and healthcare actors that contribute to the underutilization of bariatric surgery (Callon, 1984). The evidence I will draw on to support my argument will be primarily taken from scholarly articles such as the ones previously cited.

Conclusion

Obesity in America has been a rising issue since the 1970s. In response, treatments to manage obesity such as bariatric surgery were popularized. As a result, medical equipment had to be designed to be more wide, sturdy, and stable to accomodate larger people. Even with the development of this new equipment and treatment, severe obesity remains a growing problem due to the treatment for it being underutilized. My STS and technical projects investigate the interactions that caused this underutilization and the ways that we can design better technology to improve the quality of treatment. In my STS project I will draw on the STS framework of actor-network theory to analyze the failures of bariatric treatment protocols. In my technical project I will design and build an expanding armrest module that will attach onto and replace the armrests of an existing bariatric chair. Understanding the social, technical, and political implications behind both of these projects will help me ensure the best possible outcome for the users of my design.

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