REDESIGNING THE LOOP CONNECTOR FOR PATIENTS OF SIZE

WEARABLE TECHNOLOGY: THE RISE OF PERSONALIZED TECHNOLOGY IN OBESITY CARE

A Thesis Prospectus
In STS 4500
Presented to
The Faculty of the
School of Engineering and Applied Science
University of Virginia
In Partial Fulfillment of the Requirements for the Degree
Bachelor of Science in Biomedical Engineering

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November 5th, 2024

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

How is healthcare adapting (or not) its technology to the rising obesity crisis facing the world?

Obesity and its comorbidities, for the past several decades, represent the leading causes of death around the modern world. In the United States alone, over 700,000 people died from heart disease in 2022 (CDC, 2024). Not only heart disease, but the conditions of chronic kidney disease, diabetes, hypertension, and even cancer can be traced back to obesity. In Switzerland, it was found that almost all of the medical costs related to obese patients had to do with the diseases that come about from being in such a weight class (Steinl, et al., 2021). One key aspect striking healthcare today, however, is not just that obesity is on the rise; obesity itself only raises the likelihood of these diseases. It does not cause them. It is the inadequacy present in dealing with obesity as the spectrum that it is. Some patients are barely obese, while others can weigh over a thousand pounds. Others want treatment for diabetes, chronic kidney disease, and heart disease, while some merely seek to lose weight or positively impact their mental health by weight loss. As the prevalence of obesity in all forms continues to grow, research must be done regarding the treatment and care of this increasingly populated, and varied, group of people.

The current technology meant to accommodate obese patients in healthcare settings can prove strikingly inadequate, despite obesity being one of the fastest growing epidemics worldwide. At the forefront of this, among other similar projects, is my technical research project. This project involves the redesigning and improvement of the loop connector, a strap-like device that is used in several forms to extend or alter a genre of medical slings titled repositioning sheets. Currently, the device cannot house patients above a certain weight limit without fear of fracture. The lack of care given in designing a load-bearing device associated with obese patients that cannot hold heavier patients is unacceptable in the modern world,

necessitating its alteration. Aside from this project, I plan on researching the other side of the medical scene when it comes to obesity. Wearable technology, such as smartwatches and phone health apps, have risen to prominence over the past decade alongside the popularization of personal technology. Particularly, these technologies have been used in some cases by physicians to assist obesity patients in weight loss treatments. I will determine the sociotechnical factors that have led to this emerging technology's growing popularity, with a focus on the different groups that produce, proliferate, and use them.

Technical Topic: Redesigning The Loop Connector for Patients of Size

What can be done to redesign inadequate assistive technology meant for obese patients?

The Loop Connector, or loop extender, is a polyester device used as an extension for medical repositioning sheets. Found in hospitals and physical therapy settings, these repositioning sheets lie below patients and feature six to eight fabric loops that can be hooked up to lifting devices to move patients who cannot move themselves. They are often used to sit patients up, get them on their feet, or move them to different beds. Obese patients require more space than those of normal weight, and so are often subject to the use of loop extenders to give them more space on these sheets. The motions used with these loop connectors are the same, but the weight-bearing load is transferred from the fabric loops to the connector itself. Therein lies the crux of the problem. The current designs of the loop connector cannot accommodate patients of above 330 pounds (Hill-Rom, 2020). With obesity growing more widespread by the day, this seemingly high weight limit has become obsolete, and a more modern user base requires a more modern design.

I intend to research intensively different material alternatives that could double or even triple the current weight limit, utilizing 3-D modeling software and spare medical lifts to test out various designs until a better loop connector for America's growing obese population can be found. Research will be done in material engineering, to figure out what alternatives could be used rather than the lackluster polyester currently applied. Alternative designs, such as the use of a chain or other unconventional materials will be considered as well. While imperfect, the advantage of this project's smaller size and simpler design is that it can be tested repeatedly. If one design that accommodates a sufficient load in the simulations does not accommodate this load practically during in-person testing, another design can be easily pivoted to without sacrificing the months worth of time it would take other projects in doing the same.

In a perfect world, the redesigned loop connector will fit perfectly and identically to the current design into hospital and physical therapy settings. Its improvements to weight capacity, among other design potentials such as adjustability, will benefit the patient and practitioner, ensuring safety and security to patients of all sizes subject to its use. That said, most patients hardly notice the loop connector to begin with. It is a small, fabric loop used on rare enough occasions to warrant UVA Health only owning five of them. It is not my intention to create something flashy, or something revolutionary. By redesigning the loop connector, my only hope is to ensure that safety for all patients is a standard, not an exception, for even the smallest, simplest devices used in everyday medical practice.

STS Topic: The Rise of Wearable Technology in Obesity Care

What factors have led to the contemporary popularity of wearable devices in weight loss?

In modern medicine, treatments for obesity most often lie in one of three categories: drugs, diets, or surgery. Each group is full of myriad tried and true treatment methods that allow physicians a degree of freedom and personalization when it comes to assigning their patients a care plan. Bariatric surgery, for example, is maintained as one of the most consistent methods of obesity treatment, even being "endorsed by many international societies to be an effective treatment for weight loss" (Ruban, et al., 2019). These surgeries, however, are truly final. Bariatric surgery cannot be undone, permanently altering the gastro-intestinal tract of patients in one way or another (Ruban, et al., 2019). For many, these methods are only recommended if other treatments prove ineffective. With the popularization of personal digital technology in the 21st century, particularly over the course of the COVID-19 pandemic, one technology group has emerged to assist the less drastic measures of obesity treatment. This comes in the form of wearable technology such as smart watches, smart belts, or even just a regular iPhone. Inside of this emerging technological niche lies the potential for care that is not only tailored to patients using their exact health statistics, but also constantly evolving as these wearable devices observe and transmit health data directly to patients' healthcare providers. For my STS project, I endeavor to investigate this emergent technology, utilizing actor-network theory (ANT) to understand the different groups that interact with wearable technology and the factors that contribute to their shaping and popularization of it.

Current State and Relevant Literature

Dietary and lifestyle changes have always been the simplest way for people to lose weight, but they are far from the easiest. Some researchers found that, out of a sample, only 20% of patients pursuing these methods of weight loss maintained a weight deficit over a 5 year period (Fawcett, et al., 2020). With statistics such as this permeating weight loss programs, it is

no surprise that companies like Apple and Google created devices, the Apple Watch and FitBit respectively, that, among numerous other purposes, attempt to remedy the lack of success obese individuals were seeing with their own weight loss journeys. Others attempted to make more unconventional pieces of attire into "smart" devices, with one group even proposing the design of a Smart Belt that would encourage better posture, a more niche associated cause of obesity (Nam, et al., 2016). Others still, Apple included, attempted to turn the ever-popular smartphone into a wearable health device with the implementation of health and diet apps that still subsist within the app store to this day. High levels of engagement with these apps has even been associated with more successful weight loss (Hinchliffe, et al., 2022). Previous research groups have attempted to assess the statistical impacts of these technologies. Fawcett, et al., performed an analysis of over a thousand different research articles on the subject, but the sheer diversity present in even their final 16 articles post-screening proved too much to properly analyze the effects of the devices themselves. Another group, Jo, et al., performed a similar study, though ultimately came to the conclusion that the innate positive benefits of these devices are uncertain. They did determine that these devices can be associated with motivation and accelerated fitness in some (Jo, et al., 2019). These studies give insight into the numerical side of wearable technology in obesity, providing statistical reasons, or a lack thereof, regarding why these technologies could be gaining traction in recent years. They do not address the other sides of this rise, the motivations behind the groups engaging with its rise.

Theoretical Framework

For this research project, actor-network theory (ANT) takes center stage. Using this framework, the implementation of wearable technology in obesity patients can be assessed not as single cases of successes or failures, but as a network of groups that interact and mold each

other. As put by Dolwick in his 2009 paper "'the social' and beyond: Introducing actor-network theory", every actor is a network, and every network is an actor. The idea gleaned from this is that this research is not simply about wearable devices, but how the interactions of these patients with the technology has popularized it over time. Not only that, but the designers of the devices, the companies that sell them, the doctors that recommend them, and the patients that use them are all a part of the contemporary network shaping this treatment supplement. A technology designed for a singular purpose and all that engage with it for that purpose are bound to alter each other mutually.

Methods

The research for this project will be conducted through the analysis of wearable technology using ANT. I will establish and flesh out the different actors that play roles surrounding these devices using three different stages. The first stage will delve into a literature review surrounding these devices as they are prescribed to determine the technologies themselves. This will generate an understanding of both the types of devices being used and their respective rises or falls in prominence in weight loss treatment. The second stage will then compartmentalize the actors using the research from the first stage to find the companies that produce these devices, the physicians that prescribe them, and the patients that use them. Unmentioned actors that arise through research will be included. Finally, the third stage will connect these actors to wearable technology through an attempted understanding of the factors driving them to popularize it. All actors in this network are contributing the the rise in wearable technology's popularity, whether directly or indirectly, and their motivations can be discerned through observations of what they gain through its popularity, such as wealth, success, and health.

Conclusions

In an ideal world, the connection between wearable devices and weight loss treatment plans will be proven or disproven by the end of the research period. Potentially, some insight will be given as per how these devices have changed since their implementation, and how those that use them have changed along with them. On the other end of the spectrum, the technical project will ideally be completed with a replicable, improved design on the loop connector that will ensure obese patients feel the same level of security in healthcare environments as other patients do. Ultimately, both projects seek to answer the question, one through research and the other through design, of how healthcare is adapting to the rise of obesity throughout the world as we know it. That answer will, hopefully, be that in one way or another the medical community is trying their best to efficiently save the people that need their help. Why else is healthcare necessary, if not to ensure the health and happiness of all the people that it can?

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