Robotic exoskeletons are a developing technology that seeks to improve upon stroke rehabilitation by bridging the gap in patients current motor capacity and what is needed to complete rehabilitation. Current rehab methods vary, but a common method is constraint-induced motor therapy (CIMT). It involves restraining unaffected limbs and having the patients practice moving the affected region. Rehabilitative exoskeletons accentuate CIMT and allow for greater recovery.

This portfolio examines potential improvements to the technology from both a social and technical perspective by proposing a new soft robotic system that offers increased comfort and affordability and by examining what factors influence the successful implementation of a technology and how they can be improved for exoskeletons. Socio-technical research found that many reasons for ineffective implementation of a technology stem from affordability, an issue which the technical portion of the research helps with by using soft, cheap materials and affordable manufacturing methods such as additive manufacturing.

Soft robotics, a recent advancement in robotics systems, distinguishes itself by utilizing soft and flexible materials like silicon rubber and prioritizing safety during human interaction. Several actuators are commonly used for the exoskeleton application, but the pneumatic artificial muscle (PAM) has proved to be the best due to its high power to weight ratio, compliance, and safe operation. The pneumatic muscle assembly consists of three main elements, the outer braided sleeve, the flexible inner bladder, and two end-fittings at either end. The primary operating concept of the PAM is that the bladder expands as a result of the pressured air input, causing an outward force on the surrounding braided sleeve, transforming the force into displacement of the muscle.

After designing the muscle, a exoskeleton structure was designed that is unique in the high actuation levels it achieved. The designed PAM contracts roughly 33% of its length when pressure is applied. This only allows for about 45 degrees of actuation. By using a second muscle that stretches across the back, the actuation is doubled, allowing for complete therapeutic range of motion by the wearer. Time limitations constrained the application of this method to only 1 degree of freedom (DOF), but by adding a rotating shoulder joint in future designs the method can be extended to all 6 degrees of freedom.

Increasingly complex technologies are becoming essential to modern healthcare, to the extent that medical devices are now considered "members" of the healthcare team. Beyond the development of these new technologies, it is important to examine the effectiveness of which the device is implemented.

Implementation is composed of two parts; adoption and utilization. Adoption is the process in which more and more people begin using the device in their practice. Utilization concerns how effectively that device is then used by the provider. Utilization can be affected by factors such as patient and provider education, maintenance, and many more.

Since exoskeletons are a new technology with little research into their implementation, this paper seeks to make predictions about how effectively robotic exoskeletons will be implemented. It does this by examining the cases of other related medical devices, specifically surgical robots and prosthetics, and extrapolating from their attributes shared with exoskeletons.

Complex medical robots often face barriers to adoption from a variety of factors. Surgical robots took decades to be fully embraced by the medical community. Slow adoption can stem from factors such as cost and insurance, but a big factor for devices like this is the perceived ease of use and perceived usefulness. Both surgical robots and exoskeletons experienced a limited amount of conclusive research into their effect on patient outcomes, leading to reluctance to hospitals and providers to adopt the device. Research into the implementation of prosthetics found that cost is often a barrier to adoption. This relates to the issue of not enough research as insurance companies will not cover a personal use technology without a strong medical foundation. Even prosthetics, an arguably essential device, are not covered by a majority of public and private companies around the world.

The cost and complexity of maintenance for medical robots is a barrier to effective utilization. Poor surgical robot maintenance is one of the largest reasons for device downtime, and this issue will be more pronounced for exoskeletons as they require maintenance from patients instead of providers. This paper recommends a focus on quantitative research proving the effectiveness of the technology as well as efforts to make the technology cheaper through improved manufacturing processes.