Thesis Project Portfolio

How wearable sensing can be used to monitor patient recovery

following ACL reconstruction

(Technical Report)

Investigating the Implementation of Automated Technology in the Healthcare Industry

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

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Spring, 2022

Department of Systems Engineering

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Sociotechnical Synthesis

The work completed in this technical project focused on mitigating the widespread risk of reinjury to the anterior cruciate ligament (ACL) following surgery and rehabilitation for a previous injury. In its current state, ACL rehabilitation patients work with physicians to complete supervised activities gradually increasing in rigor until they are deemed ready to resume high-impact sports again. However, this process can be subjective, relying on human judgement to determine the progress made by patients, and each case is unique to the patient and nature of the injury. An improper or incomplete rehabilitation increases the risk of reinjury. As a potential improvement to the current rehabilitation process, this technical project utilized wearable sensors that collected surface electromyography (sEMG) and accelerometer data of patients while completing routine rehabilitation exercises. This data was collected on two groups: patients who had ACL surgery 4-8 months prior and a control group of healthy participants. From the data collected, features were extracted to determine the primary differences between healthy participants and those who had torn their ACL. A predictive machine learning model was then constructed using these features with the goal of determining the success of a patient's rehabilitation.

While a successful utilization of automation in the healthcare industry such as this may lead to better healthcare for patients, it can also lead to disruptions in the current social environment of the healthcare industry. With the increasing implementation of automated technology, the roles of healthcare workers and norms of the healthcare industry must adapt. This implication of interactions between new automated technologies such as wearable sensors and the current roles of healthcare works was analyzed using the *Interactive Sociotechnical Analysis* framework, specifically focusing on the interactions between four groups: new

automated healthcare technology, current roles of healthcare workers, the physical infrastructure of healthcare facilities, and existing healthcare technology. To conduct this research, a combination of surveys and case studies were used. The surveys found the opinions of individual healthcare workers to the increased implementation of automated technology in their workplaces, while case studies were utilized to investigate overall trends in the healthcare industry on a macro level. Through this research, the reaction from individual healthcare workers were mixed, some seeing the benefits of automation and others concerned with issues of privacy and the potential disruption to their jobs. From an overall industry perspective, the healthcare industry highly values the potentials of automation and will seemingly continue to increase investments in this field. In a broader sense, this technical project and the survey research offer a glimpse at both the potential benefits of increasing the use of automation in healthcare facilities and how this increased implementation may change the current social roles and norms in the industry.