

**HOW WEARABLE SENSING CAN BE USED TO MONITOR PATIENT RECOVERY
FOLLOWING ACL RECONSTRUCTION**

FUTURE OF TELEHEALTH

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By

Drew Hamrock

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SOCIOTECHNICAL SYNTHESIS

Healthcare is an ever-evolving landscape that is fueled by technological development. Beginning at the clinical level, the technical project aims to leverage the use of wearable sensors to continuously monitor a patient recovering from an anterior cruciate ligament reconstruction. Currently, patients who have previously had an ACL repair are at a six times greater risk of a subsequent knee injury compared to uninjured athletes and with the use of this technology early detection of altered movement patterns and other functional deficits are made possible. Similar remote monitoring devices such as the technical project exist in many different specialties of healthcare and have provided an alternative way of accessing medical care. The science, technology and society (STS) topic provides an analysis of the societal impact that telehealth practices have as its development and usage accelerates. The loosely coupled technical and STS topics illustrate the process of creating a remote rehabilitation device, as well as the social influences that telehealth can bring upon a variety of groups.

The technical report outlines the development and testing of wearable sensors on ACL patients in order to examine its functionality towards a fully remote monitoring system. Current methods of detection in recovery require unconventional movements and are only administered in clinics, lacking a day to day picture of the patient's recovery progress. The proposed design includes wireless electromyography and accelerometer sensors placed on the vastus lateralis of both the ipsilateral/ACLR and contralateral knees of the patient. In alignment with IRB protocols, twelve ACLR patients and ten healthy patients from the University of Virginia Exercise and Sports Injury Laboratory were recruited to participate in data collection. These patients performed five different movement activities and data analysis was performed and compared between groups to identify features indicative of ACL recovery.

The study resulted in multiple features showing statistically significant values between groups; however, two of the five activities were deemed to be poor predictors of patients' recovery. Though the results presented in our work are promising, a few limitations still exist. The limited number of patients in the study as well as unequal class sizes likely contributed to the limited number of statistically significant results and the ability to make claims across groups. Additionally, participants ranged from being two to eight months post-surgery and these differences in recovery time likely caused data discrepancies for the unhealthy patients, which would be exacerbated by the small sample size. Our work is best interpreted as an initial exploration of how electromyography data can be used to assess patient recovery. With the features identified in the technical report, future researchers can build solutions that incorporate these findings to reduce time, effort, and inaccuracy associated with remotely assessing patient ACLR recovery.

Telehealth methods such as remotely monitoring patients outside of the healthcare setting have been pivotal in limiting the spread of Covid-19 during the pandemic. As devices similar to the technical project continue development, remote healthcare has the possibility to extend to many different healthcare specialties and social groups. This posed the STS research question of if the healthcare industry has the capabilities of moving into a more remote, virtually connected environment. The research then shifted towards answering the question of how to eliminate social disparities in regards to accessing advanced healthcare. Pacey's Triangle of Technology Practice as well as a Handoff Model, a subset of Pinch and Bijker's Social Construction of Technology theory, were used to create a framework outlining telehealth's societal impacts and diffusion through society. The framework was developed through a collection of prior studies, ethical readings, policy, and economic forecasting.

Economic research showed that the market size of telehealth is expected to more than quadruple over the next decade. In addition, strong continued uptake and favorable consumer perception have contributed to the continued growth of telehealth. However, disparities between social groups have emerged as individuals of color are using telehealth considerably less than white individuals. There is no doubt that telehealth practices will be ongoing in the future, and the core question for the healthcare industry will be how to make it efficient, effective, and available to everyone. Through the analysis, it became apparent that connectivity, affordability, and inclusiveness would be the major points of emphasis by telehealth groups moving forward. Three major solutions were developed regarding this issue: Improving infrastructure in rural and low-income areas, promoting congressional policy changes, and calling upon stakeholders to improve the culture in the health environment.

The development of telehealth devices such as the technical project is evident. As more of this technology emerges in the health industry, it will be increasingly important to eliminate any social disparities that may arise.

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with Kevin Cox, Sydney Lawrence, Sean Lynch, Jane Romness, Jonathan Saksvig, and Alice Warner

Technical advisor: Mehdi Boukhechba, Department of Engineering Systems and Environment

FUTURE OF TELEHEALTH

STS advisor: Catherine D. Baritaud, Department of Engineering and Society

PROSPECTUS

Technical advisor: Mehdi Boukhechba, Department of Engineering Systems and Environment;

STS advisor: Catherine D. Baritaud, Department of Engineering and Society