

FUTURE OF TELEHEALTH

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By

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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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The anterior cruciate ligament, also known as the ACL, is the primary ligament responsible for stabilizing the knee. ACL reconstructions (ACLRs) are among the most common sports medicine procedures performed in the world (Csintalan, R. P. et al., 2008, p. 17-21). Currently, there are approximately 100,000 to 200,000 ACL reconstructions per year in the United States alone and this number is increasing at a rate of 2.3% each year (Ganley, 2017, para. 1). Within the first two years following an ACLR and return to sports, young active patients are at the highest risk for re-injury both to the ipsilateral/ACLR and contralateral knees (Grindem H. et al., 2016, p. 804-808; Paterno M.V. et al., 2012, p. 116-121). These athletes are at six-times greater risk for subsequent knee injury compared to uninjured athletes (“Second ACL Injuries”, 2013, para. 1). Through the use of remote sensing technologies, the technical project hopes to provide clarity to the decision of when ACLR patients should return to unrestricted physical activity through a data driven approach.

The development of this remote monitoring technology is sponsored by the University of Virginia. Resources dedicated to the study and implementation of this project will be from UVA Exercise and Sports Injury Laboratory. The operation of the technical project will be under the guidance of Mehdi Boukhechba, a faculty member in the Engineering Systems and Environment Department, and Dr. Joe Hart, a professor of orthopaedic research in the Department of Orthopaedic Surgery. The team members on this project include Kevin Cox, Sydney Lawrence, Sean Lynch, Jane Romness, Johnathan Saksvig, and Alice Warner. Each team member is an undergraduate student studying systems engineering in their fourth year at the University of Virginia School of Engineering and Applied Science. This project will be documented in a technical report.

Alongside this technical project, the goal of the STS research is to analyze if the health industry has the capabilities of moving into a more remote, virtually connected environment. Telehealth, the provision of healthcare remotely by means of telecommunications technology, has taken a major leap during the Covid-19 pandemic. Telehealth use soared to nearly fifty million Medicare visits in 2020 compared to roughly 850,000 visits in 2019 (Span, 2021, para. 8). As remote sensing technology continues to improve, the reach of telehealth has the potential to expand into a vast amount of medical specialties and practices. Alongside this development, there is potential for disparities to arise between social groups. The technical project and loosely coupled STS research project proposed in this thesis examines the idea of remote healthcare and illustrates research towards the future of telehealth and how to eliminate social disparities in regards to accessing advanced healthcare. This sociotechnical research is explored through the use of Pacey's Triangle of Technology Practice (Pacey, 1983, p.12) as well as a Handoff Model (Carlson, 2009), a subset of Pinch and Bijker's Social Construction of Technology theory.

EXAMINING TELEHEALTH

The Covid-19 pandemic gave the world a full experience of what drastic changes look like on a global scale. The daily operations of society were flipped upside-down, leaving many businesses, organizations, and people unprepared for the future ahead of them. After a long adjustment period, the world appears to have a grip on its new way of society. Through this adjustment period, many technologies made vast advancements and their importance to society grew exponentially. With the pandemic being a health related concern, one of these transcendent technologies that provided solutions to society was telehealth. The ability to access health related services from the safety of the patient's own home became an effective way of limiting

the spread of the virus while also providing services to those in need. In this research paper, telehealth will be studied from an STS perspective to see how doing so illuminates its possibilities or hidden perils in the future. Also this research will investigate the role of telehealth in changing a very familiar social practice, healthcare, and what could be gained doing so.

THE HISTORY AND BECOMING OF TELEHEALTH

Telehealth has been around for many years in different forms. Telemedicine through telephone and video technology has been used since the 1960's in the sectors of military and space (Croome K.P. et al. 2011, p. 158). As the use of wireless broadband technology and internet expanded over the years, telehealth has improved each step of the way in providing the diagnosis of treatment, prevention of disease and injuries, research and evaluation, and education of health care providers. Most of the early practices of telehealth grew to be synchronous, such as video teleconference and high speed data transfer (Serper & Volk, 2018, para. 2). A telehealth case reported specifically in the medical setting was in 2011 as the transmission of smart phone images from surgical trainees to an attending physician in order to make a real-time decision regarding a possible questionable liver procurement, which took place 545 km away from the university hospital (Croome K.P. et al. 2011, p. 159).

The potential of telehealth has grown since these early cases and it can be seen throughout the attitudes of many medical professionals around the world. According to a 2017 survey of 184 health care executives conducted by the American Telemedicine Association, 88% believed that they would invest in telehealth in the near future, 98% believed that it offered a competitive advantage. The only caveat is that 71% of these health care executives believed that

lack of coverage and payments were barriers to implementation (Serper & Volk, 2018, para. 3). Despite telehealth's gradual increase in uptake, significant infrastructure and legal barriers remained. Problems in reimbursement, integration, data transfer, service awareness and patients' lack of technical skills, feasibility, and privacy concerns are key in determining the future implementation of telehealth practices. These issues contribute directly to the emergence of health disparities between social groups. Health disparities are not simply differences in health outcomes. They represent significant gaps in what tools and resources can be accessed by whom and when. If a social group does not have the health coverage necessary for telehealth, this puts them at a disadvantage against other groups in society. Eliminating these barriers became a major focus for health groups across the nation.

In March of 2020, the Covid-19 pandemic hit the United States. The immediate use of telemedicine practices are seen with an 154% increase in the telehealth visits during the last week of March (Koonin L.M. et al. 2020, para. 1). In response to the pandemic, the U.S. Centers for Medicare & Medicaid Services authorized waivers in March 2020 that expanded telehealth services for Medicare beneficiaries (Suran, 2022, para. 3). With the expansion of coverage, one hundred and forty additional remote services became eligible, as did more kinds of providers. This provided low income groups the access to telehealth services that would not have normally been available to them. Through the rest of 2020, telehealth use soared to nearly fifty million Medicare visits in 2020 compared to roughly 850,000 visits in 2019 (Span, 2021, para. 8).

Recently, Medicare extended its telehealth services through the calendar year of 2022 as the demand for these services still remained amongst social groups. Many experienced professionals in the health industry believe that after 2022, when the current Medicare extension

ends, the core question for policymakers will not be whether to allow telehealth, but how to make it efficient, effective, and available to everyone (Span, 2021, para. 21).

CURRENT METHODS OF TELEHEALTH

There are currently four main types of telehealth practices: synchronous telehealth, remote patient monitoring, store-and-forward telemedicine, and mobile health. Synchronous telehealth involves video calls and live chats in real time between a healthcare provider and patient and has been used for general wellness visits, mental health counseling, and many other real-time services. Remote patient monitoring leverages the use of technological devices to get vital signs needed to monitor a patient's condition such as patients with diabetes or a cardiovascular illness. Store and forward telemedicine is essentially asynchronous telehealth and involves collecting and storing patient data in a cloud-based platform and later retrieved by another medical professional often in a different location. Mobile health pertains to smart devices that are becoming increasingly popular. These devices benefit from continuous data collection in areas such as heart rate, dietary tracking, and much more (Maheu, 2020, para. 2). Each of these telehealth methods requires the user to have digital literacy and devices with access to the internet; therefore, presenting a disparity between social groups.

User reaction to telehealth has been positive. Strong continued uptake, favorable consumer perception, and tangible investment into this space are all contributing to the continued growth of telehealth in 2021. Telehealth use has stabilized at levels 38 times higher than before the pandemic (Oleg B. et al., 2021, para. 5). Consumer research shows that consumers continue to view telehealth as an important modality for their future care needs. This view varies depending on the type of care with psychiatry being the most positive (Oleg B. et al., 2021, para.

11). As it pertains to the older population, telehealth has had a huge impact as nearly a quarter of American adults over sixty-five had a video visit during the pandemic, according to a Mount Sinai study (Span, 2021, para. 16).

As shown in Figure 1 on page 7, Pacey's Triangle of Technology Practice can be used to illustrate the potential of telehealth's impact on a society as it continues to develop and take shape. Culturally, telehealth offers users to communicate with their clinicians virtually; therefore, increasing patients' ability to access health professionals from all around the world. This can create a disparity in the quality of care between groups who don't have access to telehealth or may not have the infrastructure in their area to support it. Remote monitors placed on individuals would be seen by different social groups and represent a sign of wealth due to the cost of such technology, in result, creating a larger disparity between social classes. Also, as telehealth technology grows and expands into new areas, society could develop an overreliance on technology to monitor their care instead of their natural body feedback. Organizationally, telehealth would result in less resources for patients due to a decreasing demand of in person visits. This could lead the health industry to move into a more technology-based approach which would involve increased cyber security and other organizational demands. The Pew Research Center reported that over a third of adults over sixty-five did not have broadband internet capable of telehealth visits (Span, 2021, para. 27). Advancements in infrastructure and telecommunication can help overcome some of these disparities by redistributing knowledge and expertise where it is needed in order to provide a more uniform access to care regardless of location (Nesbitt, 2012, para. 1). Consequently, the health industry would now be able to assist previously unreachable clients and would have an increased communication reliance with the interconnected health systems. Technologically, the business of health would rely on an increase

in digital literacy of its users. This can be seen as a challenge between social groups who may not have as much experience with technology. Additionally, the feasibility of telehealth devices need improvement as this will be imperative in its diffusion through social groups.

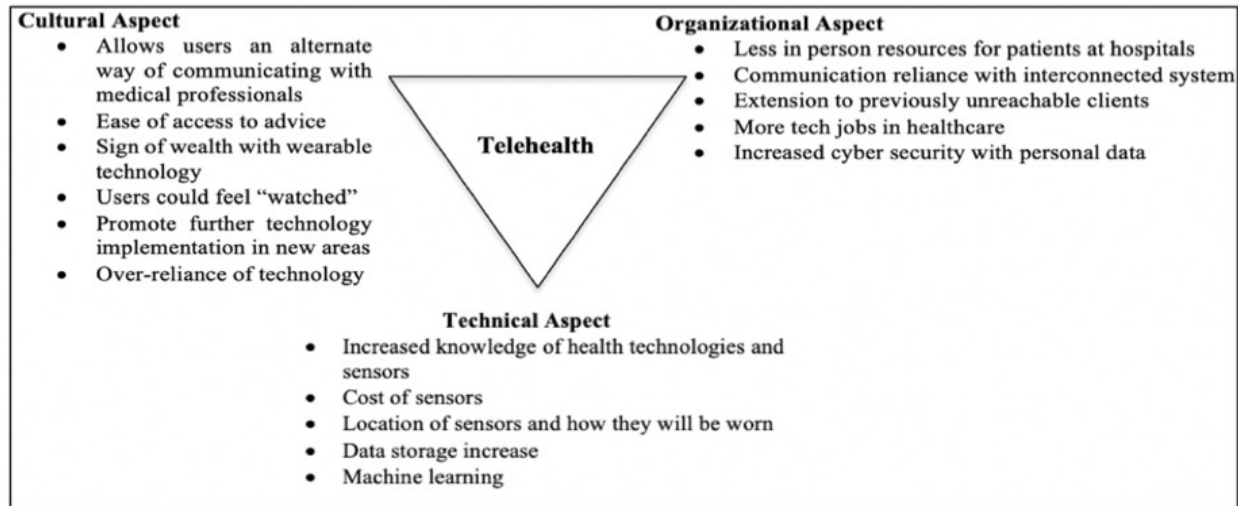


Figure 1: Telehealth Pacey's Triangle. Adapted by (Hamrock, 2021) from (Pacey, 1983, p. 12).

TELEHEALTH CARE IN DEVELOPMENT

As more healthcare technologies undergo development the market for telehealth will expand into more applications. According to current market research, “the U.S. Telemedicine Market size expected to reach to USD 25.88 Billion By 2027 from USD 6.61 Billion in 2019, at a compound annual growth rate (CAGR) of 15.8% during forecast period 2020 to 2027” (Polaris Market Research, 2022, para. 1). The opinion towards telehealth has moved towards it being a low-cost option that would result in considerable savings over that of traditional medical practices. Leading companies in this market such as Cisco Systems and GE Healthcare are focusing on presenting the comparisons of costs, time and other advantages between traditional and telemedicine practices to increase the penetration of the technology in the United States (Polaris Market Research, 2022, para. 10).

The current market is primarily segmented on the basis of component, application, mode of delivery, and end-user. The development of novel software aimed at offsetting the current disadvantages in the telehealth market have contributed to the software segment growth in recent years. This market is also driven by continuous research and development and the introduction of updated software on a timely basis. Applications are experiencing their highest growth rate over their forecast period as promising technologies such as Telestroke and Teleradiology have seen significant development and effectiveness (Polaris Market Research, 2022, para. 12). As broadband technology improves, methods of delivery will be simplified with cloud-based processes that have been developed in recent years. This illustrates a very competitive and advantageous market for telehealth in the coming years as research and development continues.

The demand for telemedicine app development is not just a consumer generated need but also one that is profitable for entrepreneurs looking to the market. According to the funding reports, “the venture capital investment in the digital health space in the H1 of 2021 counted for \$14.7 billion, which is almost twice the investments made in 2019 – \$7.7 billion” (Gupta, 2022, para. 5). These applications are created to manage registration, profile management, video conferencing, payments, and many important tasks. Depending on the number of features, the cost of building a new telehealth application comes anywhere between \$50,000-150,000 and a development time between three to twelve months (Gupta, 2022, para. 27).

This technology development can be examined through the use of a Handoff Model shown in Figure 2 on page 9. Through this process of development there are many steps that must be first overcome before its release to the community. Funding is key during the initial stages of development and also getting approval from organizations that will implement this new technology. Development of the product by the engineers is crucial in eliminating social

disparities that may arise from new technologies. Ease of access and observing the whole user population, not just particular social groups, are essential in making telehealth applications available to everyone. This is also true in the trial stages of development and redesign. As this product makes its way to the public, there is a potential for a negative social reaction by groups that feel misrepresented. This technology being expensive in some cases may signal a sign of wealth and inequality among those in possession of it. Additionally, education and training are necessary for the end-user to efficiently and effectively make use of the new product. This process is demonstrated in hopes that the technology diffuses into all of society and made available for all who qualify.

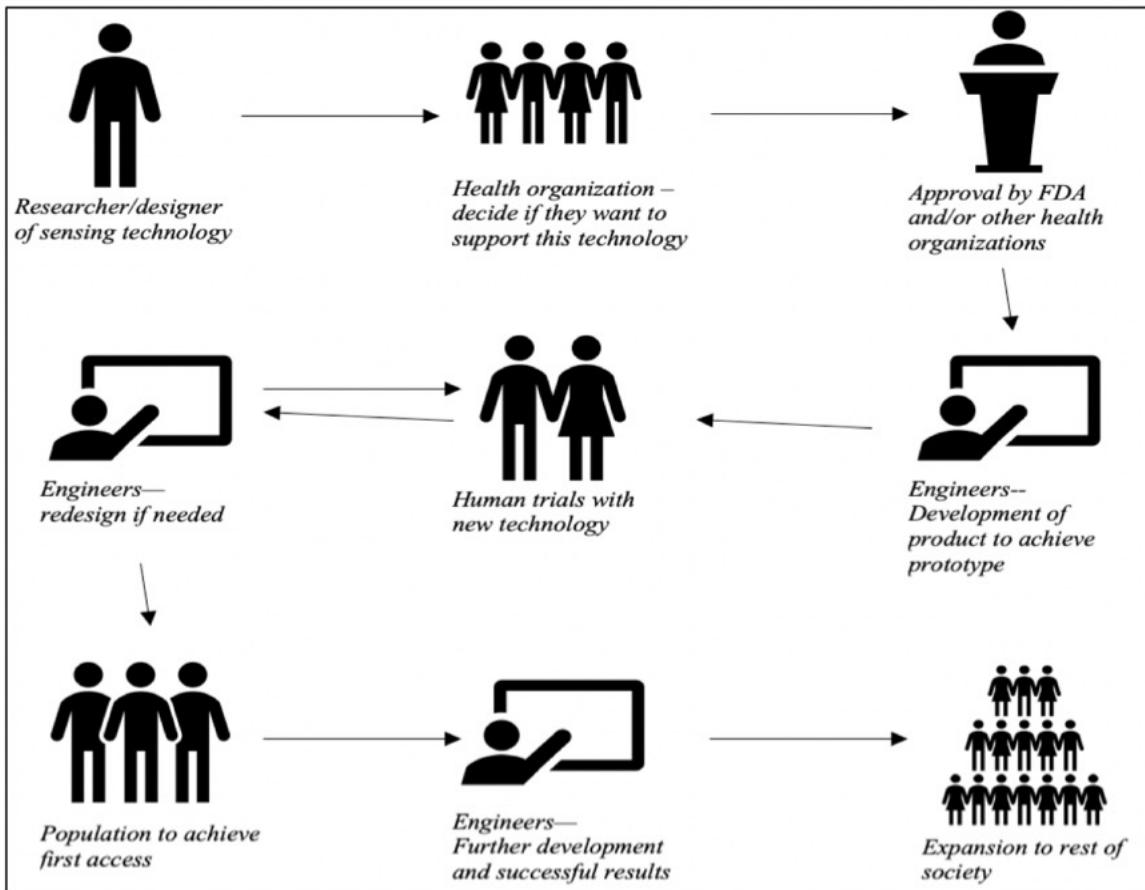


Figure 2: Telehealth Handoff Model. Adapted by (Hamrock, 2021) from (Carlson, 2009).

ACTION SURROUNDING TELEHEALTH

Policy has been a main concern for the adoption of telehealth going forward in the health industry. Although the U.S. Centers for Medicare & Medicaid Services extended coverage through 2022, there are still many policies that will see high priority in 2022. The American Telemedicine Association (ATA), the only organization completely focused on advancing telehealth, has multiple top legislative priorities that, if enacted, would ensure telehealth does not disappear in 2023. Some of these policies that are being considered in Congress currently are the Telehealth Modernization Act and Telehealth Expansion Act of 2021. These policies would make permanent the exemption for telehealth services from certain high deductible plan rules, allowing millions of Americans access to these services without the burden of meeting a deductible (American Telemedicine Association, 2021, p. 3). Recently, 336 organizations sent a letter to Congress urging their leadership in facilitating a pathway to comprehensive, permanent telehealth reform that would provide certainty to patients and our nation's healthcare providers (American Telemedicine Association, 2022, para. 1).

Even with the policy changes to Medicare, disparities still grow. Among the Medicare population in 2021, black and rural individuals used telehealth less often than whites and urban citizens (Span, 2021, para. 28). Alongside these policy efforts, the ATA has a major focus on eliminating health disparities with telehealth expansion. The group has developed an advanced framework that illustrates the different elements that the industry needs to address to eliminate these health disparities. Starting at the top of their priority list is connectivity. This involves improving infrastructure to provide internet access in areas that are lacking. Progress has been made towards this issue with President Biden's \$65 billion infrastructure bill to improve internet access in rural areas and low-income families (Span, 2021, para. 30). The next level of the

ATA's plan is affordability and increasing access to health services regardless of socioeconomic conditions. This includes the cost of data plans and services including telehealth. Following that, the ATA is aiming to increase both health and digital literacy to individuals. This will be accomplished in improving how health institutions and professionals communicate with their patients and offering services to assist in understanding the messages provided by health professionals. Finally, there will be a large focus on inclusiveness, culture, and trust as it pertains to anti-racism. Although this area is societally broader than just the healthcare industry, healthcare represents 20% of the nation's economy and therefore places a responsibility on each stakeholder to identify and rebuild the foundation on which the industry sits (American Telemedicine Association, 2021, p. 4).

MOVING FORWARD

The growing prevalence of telehealth in the United States has delivered the ability for increased access to quality healthcare. Through telemedicine applications, patients who reside in low resource areas can now reach quality care virtually. Going forward, eliminating health disparities will be the major obstacle for telehealth's diffusion through society. Connectivity, affordability, and inclusiveness prove to be the three most important areas that action groups and healthcare providers should focus on in order to keep telehealth services readily available to all. Through the analysis of this report, three main solutions have been presented to combat these areas of concern: (1) improving infrastructure in rural and low-income areas to provide internet access in areas that are lacking, (2) lobbying congress to increase affordability of telehealth services through changes to healthcare plans such as Medicare, and (3) increasing health and digital literacy, inclusiveness, and culture in the healthcare industry. Continued investigation

towards eliminating health disparities will be necessary in the future as more improvements and technologies make their way into the telehealth industry.

Technology is best when it brings people together. With telehealth development looking to set forth new standards and reach eloquent heights, it is only fair to assume and predict that it will continue to knit people closer. Providing quality, affordable healthcare to patients no matter their physical location offers telehealth the chance to propel into the future of the health industry.

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