

# A Medical Student's Perspective on the Growing Importance of Telemedicine/Telerehabilitation

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## The Experience

According to the National Institute of Health (NIH), telemedicine is defined as "the use of electronic information and communications technologies to provide and support health care when distance separates the participants."<sup>1</sup> Although telemedicine was introduced over 60 years ago, the technological revolution of the 21<sup>st</sup> century has allowed telemedicine to evolve into a standard tool for physicians.<sup>2</sup> The emergence of the COVID-19 pandemic further increased the demand for telemedicine rapidly, particularly telerehabilitation for those with chronic conditions<sup>3</sup> such as spinal cord injury (SCI).

According to the National Spinal Cord Injury Statistical Center (NSCISC), there are approximately 296,000 people in the United States living with SCI as of 2020.<sup>4</sup> Rehabilitation programs aiming to improve motor functions after SCI are important in reducing disability, promoting independence, and alleviating burden on caretakers. There is evidence that treatment intensity has a profound effect on motor recovery. High-dosage, high-intensity repetitive training of arm movements or functional tasks can provide better functional outcomes.<sup>5</sup>

An appropriate intervention requires periodic access to a location with appropriate equipment as well as a therapist to facilitate a one-on-one session to improve upper limb functions.<sup>6</sup> However, access to appropriate rehabilitation interventions is unfortunately limited due to cost, shortage of regional rehabilitation care, difficulty in traveling to the location where the therapy is provided, and poor adherence with assignments.<sup>7-9</sup> This situation has called for an increase in home-based telerehabilitation interventions, i.e., "the remote delivery of rehabilitation and home health care services,"<sup>10</sup> in order to increase access to appropriate interventions to improve upper limb functions.

## Experience with Telerehabilitation

I was fortunate to work at the summer research program in the

Department of Physical Medicine and Rehabilitation at McGovern Medical School, NeuroRecovery Research Center at TIRR Memorial Hermann. As part of the program, I assisted in the development and delivery of telerehabilitation interventions for 36 individuals with chronic incomplete cervical SCI to test its feasibility. The research project consisted of combining non-invasive brain stimulation via transcranial direct current stimulation (tDCS) and high-intensity repetitive arm/hand and finger exercises.

Preparing for the intervention was relatively time-consuming and difficult compared to conventional in-person interventions. We had to ensure that all safety criteria were met, namely, safe delivery of tDCS in a virtual setting. All observed patients had minimal fine upper motor function and were not able to operate the computer nor equipment for the telerehabilitation session without aid. Thus, for each patient, their caregiver was trained for proper set-up of tDCS electrodes on the head and delivery of stimulation, as well as donning and doffing of exercise equipment and operating exercise programs on the provided laptop. Due to the large age range and different skill levels in using technology between participants and caregivers, we also needed to ensure that they were trained properly. The training consisted of in-person training at the research center during the in-person baseline assessment session. Additionally, an instruction manual for tDCS and exercise equipment was provided to use at home. Conventional in-person interventions do not require such extensive preparations prior to treatment sessions, but it is far more inconvenient for patients and is inflexible to emergencies that may arise.

When the treatment sessions lasted longer than expected, the patient was able to begin preparing for lunch during the breaks of the interventions. Patients were able to take restroom breaks or eat snacks from the convenience of their home. Patients were also able to travel and participate in the treatment sessions from

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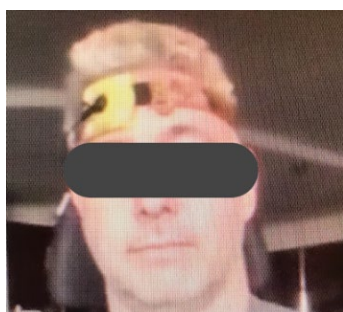
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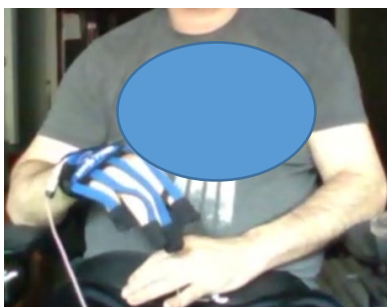
anywhere they please. Furthermore, patients were pleased with being able to keep wearing their cozy home clothes as well as having some time flexibility. Telerehabilitation also allowed many patients living hours away from TIRR Memorial Hermann to receive the intervention. Some recruited patients lived an hour or further away from the clinic but were able to participate due to the virtual setting of the treatment. Furthermore, as all observed patients were unable to drive, if the treatment sessions were in-person, they would have required a caregiver to transport them

for each session, which is a difficult process as a quadriplegic. Many patients also have different caregivers for driving and home care. By having the treatment sessions virtually, patients can decrease their need and cost for a driving caregiver. One patient in the study stated how convenient telerehabilitation was compared to in-person sessions, especially as a quadriplegic. Receiving telerehabilitation allowed the patient to save travel time and perform the intervention exercises at the convenience of their home (*Figure 1*).

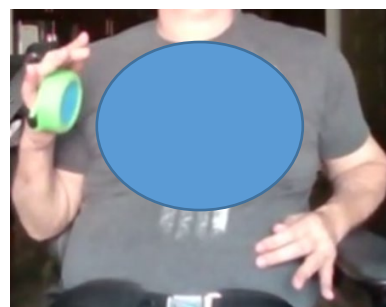
**Figure 1.** Image of a Patient with tDCS and the 2-Exercise Equipment in a Real-Time, remotely Supervised Treatment Session.



1x1 electrode montage for stimulating M1 area with tDCS



Repetitive Finger Exercises



Repetitive Arm/Hand Exercises

Telerehabilitation was convenient and flexible from the clinician point of view. Once the extensive preparation was completed, the intervention sessions were very simple, only needing to log onto WebEx/Zoom, provide instructions, and record data. The flexibility of telerehabilitation allowed us to tend to unforeseen circumstances without having to cancel treatment sessions. For instance, my father was exposed to an individual with COVID infection, which prevented me from coming into the research center until I was cleared for a negative COVID test. However, I was still able to attend the interventions via WebEx/Zoom.

### Discussion and Future Development

It is likely that telemedicine will continue to evolve and be used more widely even after the pandemic, owing to its capability of providing care from the convenience of the patient's home as well as increase access to healthcare efficiently and cost-effectively.<sup>11</sup> I see the potential that telerehabilitation and telemedicine has to be as a big part of my future as a physician. In fact, I believe that telemedicine should be part of the medical school curriculum. Each specialty within medicine could develop a standardized curriculum for telemedicine use. Perhaps, medical students' clinical rotations could include telemedicine for practice.

For telemedicine to evolve into its full potential, the following improvements must be made. There must be a development of

standardized guidelines for physicians, therapists, patients, and caregivers. Similar to the medical school curriculum, there should be standardized guidelines for each specialty. The standardization will allow the telerehabilitation sessions to be orderly and efficient regardless of the illness or other variables. There are a few published telerehabilitation guidelines. However, many are outdated.<sup>12,13</sup> The newer guidelines lack movement-related information and are not useful for those with physical disabilities such as those with quadriplegia from spinal cord injuries.<sup>14</sup> Another improvement is to further develop equipment with the purpose of telerehabilitation in mind. As of today, very few treatment devices have been designed with telerehabilitation in mind, and those that do generally have a very narrow window for application.<sup>15-17</sup> For instance, the two upper limb rehabilitation interventions used for the study cannot be calibrated nor personalized for each patient, making it less useful for certain patients over others.

Telemedicine is an exciting evolution within medicine that could greatly aid in increased access as well as reduced cost to healthcare. I look forward to seeing how it continuously evolves in the field of medicine.

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