Leveraging the Coronavirus Disease 2019 Pandemic: Is It Time to Consider Incorporating Mobile Applications Into Standard Clinical Management of the Liver Transplantation Patient?

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During the past decade, major advancements in the development of mobile applications and telehealth monitoring systems have assisted health care professionals in the diagnosis and management of chronic diseases. When effectively used, mobile applications can lead to higher quality care and better patient-reported outcomes.[1] Mobile applications can also improve patient self-management of chronic metabolic disease.[2] Despite these known benefits in other chronic diseases, telehealth and mobile applications have been slow to be adopted in the standard clinical management of the liver transplantation patient in part because of the complexity of chronic liver disease, where there is often a need for physical examination, physical frailty assessment, support network determination, and rapport building.[3]

Abbreviations: COVID-19, coronavirus disease 2019; EL-FIT, Exercise and Liver FITness.

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The coronavirus disease 2019 (COVID-19) pandemic has highlighted the pressing need for alternatives to in-person clinic visits and rapidly accelerated the widespread use of telehealth by liver transplantation centers. Although most telehealth implemented in response to the pandemic uses telemedicine-based services provided from a distance to limit patient and health care provider exposure, preserve supplies of personal protection equipment, and prevent deferral of essential care, mobile applications offer additional promise in the care of the transplant patient and may serve to further bridge what are often large geographic distances. Few studies have examined mobile application use in liver transplantation patients. Feasibility, quality, and patient-centered outcome data are lacking. In this issue of *Liver Transplantation*, 2 studies explore mobile application use in liver transplantation patients.

Duarte-Rojo et al.[4] created the Exercise and Liver FITness (EL-FIT) mobile application and demonstrated short-term feasibility in 28 sedentary liver transplantation candidates. They also found a significant increase in physical activity in more than one-third of the participants, independent of physical frailty. Although participation was variable during the less than 2-month study period, the authors nonetheless demonstrated candidates are willing and able to use a virtual platform for exercise training, even in the presence of mild or prior hepatic encephalopathy. The authors also used exit interviews to identify important barriers to exercise training implementation and adherence. This can be used to both inform future study design and improve the mobile application with minor design changes.

This study is timely as liver transplantation candidates are older, sicker, and more physically frail than ever before, and there is a minimum physical

performance level that is acceptable for proceeding with liver transplantation. Assessment of functional status and physical frailty is a standard practice at most transplant centers. A decline in either while awaiting transplantation greatly increases waitlist dropout.[5] Prehabilitation is often touted as a way to prevent physical frailty from deteriorating; however, little standardization exists despite guidance from the American Society of Transplantation. Exercise training can improve many key components of physical frailty, including aerobic capacity and sarcopenia, in patients with chronic liver disease; however, the optimal dose of exercise remains unknown.[6] Furthermore, when exercise is prescribed, many patients with chronic liver disease are unable to access fitness resources and receive insufficient education on how to safely and properly exercise.[7]

The EL-FIT application offers a potential solution to this problem by providing a home-based exercise training program that is specific to patients with chronic liver disease and readily accessible through a smartphone or tablet computer. Importantly, this program is tailored to each individual's baseline fitness level, which is directly assessed by the application following patient input of requested data, and creates progressive difficulty of exercise as fitness level improves. EL-FIT exercise programming includes largely functional, bodyweight exercises but does have an option for several resistance training exercises (eg, overhead press). The application can be paired with wearable fitness technology (eg, FitBit, Apple Watch) to monitor daily steps, heart rate, and sleep time. It also contains a leaderboard function, with the ability to earn badges and compare progress with other individuals of similar physical conditioning and degree of illness. This offers the benefit of social connection, mirroring the design of popular, highly successful commercial fitness applications (eg, Peloton).

Although this study did not examine changes in physical performance or physical frailty, a 12-week controlled clinical trial using the EL-FIT application is underway examining these endpoints (NCT04604860). We anxiously await these results, which are anticipated during the next year, especially in light of the recent pilot study by Lai et al.,[8] which failed to demonstrate significant improvements in physical frailty following 12 weeks of a liver-specific home-based exercise training program using resistance bands and daily step goals. Although the lack of benefit in STRIVE can be partly explained by low rates of exercise adherence (14%), the results are nonetheless discouraging and show that more work is needed to identify and remove barriers to exercise training adherence. Whether EL-FIT or another mobile application specific to patients with chronic liver disease can lead to greater rates of prolonged exercise adherence is unclear; however, having multiple options available for our liver transplantation patients to access different exercise training programs can only be viewed positively and may lead to improved adherence through choice.

One of the potential barriers to the success of mobile applications such as EL-FIT include access to technology. Fortunately, many of our transplant patients do have smartphones and, more important, are technologically savvy to effectively use these devices. Lieber et al.[9] used qualitative interviewing techniques in 20 recent liver transplantation recipients and found almost all (90%) owned and used smartphones to augment their posttransplant care. Beyond this, the authors engaged stakeholders to assess values and preferences to inform the development of a posttransplant-specific mobile application, LiveRight, which is to be piloted prospectively to improve self-monitoring, medication adherence, and health metric reporting with the goal of redefining recovery after transplantation.

It is reasonable to postulate that this type of telehealth can be effective while we await prospective feasibility data for the LiveRight mobile application. Although this platform is novel, a telemedicine-based home management program published recently by Lee et al.[10] using a tablet computer to monitor vital signs, communicate with the health care team, and view educational videos within the first 90 days after transplantation demonstrated lower rates of hospital readmission and improved health-related quality of life. The LiveRight application provides similar information and monitoring but improves on this by providing a social support element in which recipients can one, interact with one another and two, incorporating a medication adherence function.

The COVID-19 pandemic has rapidly accelerated the necessity for patient and provider comfort with telehealth to ensure continued access to high-quality clinical care. We look forward to the results of the multiple ongoing clinical trials using health-related mobile applications to improve delivery of care, improve patient-centered outcomes, and provide evidence to best routinely incorporate telehealth into

standard practices at each and every liver transplantation center.

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REFERENCES

1) Lee JA, Choi M, Lee SA, Jiang N. Effective behavioral intervention strategies using mobile health applications for chronic disease management: a systematic review. BMC Med Inform Decis Mak 2018;18:12.
2) Santo K, Richtering SS, Chalmers J, Thiagalingam A, Chow CK, Redfern J. Mobile phone apps to improve medication adherence: a systematic stepwise process to identify high-quality apps. JMIR mHealth uHealth. 2016;4:e132.
3) Fix OK, Serper M. Telemedicine and telehepatology during the COVID-19 pandemic. Clin Liv Dis 2020;15:187-190.
4) Duarte-Rojo A, Bloomer PM, Rogers RJ, Hassan MA, Dunn MA, Tevar AD, et al. Introducing EL-FIT (Exercise and Liver FITness): a smartphone app to prehabilitate and monitor liver transplant candidates. Liver Transpl 2021;27:502-512.
5) Lai JC, Dodge JL, Kappus MR, Dunn MA, Volk ML, Duarte-Rojo A, et al. Changes in frailty are associated with waitlist mortality in patients with cirrhosis. J Hepatol 2020;73:575-581.
6) Williams FR, Berzigotti A, Lord JM, Lai JC, Armstrong MJ. Review article: impact of exercise on physical frailty in patients with chronic liver disease. Aliment Pharmacol Ther 2019;50:988-1000.
7) Stine JG, Soriano C, Schreibman I, Rivas G, Hummer B, Yoo E, et al. Breaking down barriers to physical activity in patients with nonalcoholic fatty liver disease. Dig Dis Sci 2020. https://doi.org/10.1007/s10620-020-06673-w.
8) Lai JC, Dodge JL, Kappus MR, Wong R, Mohamad Y, Segev DL, et al. A multicenter pilot randomized clinical trial of a home-based exercise program for patients with cirrhosis: the strength training intervention (STRIVE). Am J Gastroenterol 2020. https://doi.org/10.14309/ajg.0000000000001113.
9) Lieber SR, Kim HP, Baldelli L, Evon DM, Teal R, Nash R, et al. What liver transplant recipients want in a smartphone intervention to enhance recovery: prototype for the LiveRight transplant app. Liver Transpl 2021;27:584-589.
10) Lee TC, Kaiser TE, Alloway R, Woodle ES, Edwards MJ, Shah SA. Telemedicine based remote home monitoring after liver transplantation: results of a randomized prospective trial. Ann Surg 2019;270:564-572.