Digital Health and Physical Therapy

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Abstract
In recent years, digital health has become more incorporated in daily live in general, and in clinical practice in medicine.
Mobile health (mHealth) technologies are modernizing medicine by affording greater patient engagement, monitoring, outreach, and health-care delivery.
The cardiopulmonary fields have led the integration of mHealth into clinical practice and research. mHealth technologies in these areas include smartphone applications, wearable devices, and handheld devices, among others, and provide real-time monitoring of numerous important physiological measurements and other key parameters. Cardiac rehabilitation and secondary prevention are modalities that could greatly benefit from digital health integration, as current compliance and cardiac rehabilitation participation rates are low and optimisation is urgently required. This viewpoint offers a perspective on current use of digital health technologies in cardiac rehabilitation, heart failure and secondary prevention.
Telehealth refers to health care interactions that leverage telecommunication devices to provide medical care outside the traditional face-to-face, in-person medical encounter. Technology advances and research have expanded use of telehealth in health care delivery
Physical medicine and rehabilitation providers may use telehealth to deliver care to populations with neurologic and musculoskeletal conditions, commonly treated in both acute care and outpatient settings.
Telehealth physical therapy has the potential to transform many critical areas of care in musculoskeletal practice.

Keywords: *digital health; mobile health; telehealth; physical therapy; rehabilitation.*

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1. Introduction

Rapidly accelerating technological development in recent years has brought many new opportunities in the field of healthcare services.

The global challenge caused by the COVID-19 pandemic drives the world to innovative solutions. Just as in other industries, a demand appeared for digital, free from personal contact consultation in healthcare, alongside the classic doctor-patient relationship. This trend is expected to determine the future of healthcare in the long term (Vitéz-Durgula, 2022).

2. Digital health

Digital health is transforming medicine at a breathtaking pace: wearable biosensors, mobile health applications, and electronic health records have revolutionized data collection and processing, allowing low-cost, quick delivery of data from patients directly to healthcare providers, administrators, and analysts. Modern technologies have the potential to dramatically transform health care for the better. It may be tempting to rush in and invest or develop new products in the medtech space, but you can't just walk into digital health technology and expect it to work on the front lines of clinical care. The mistake many entrepreneurs make is thinking that their tools and experience will apply to healthcare as well, which is rarely the case (Spiegel, 2017).

Digital health refers to the use of information and communications technologies in medicine and other health professions to manage illnesses and health risks and to promote wellness. Digital health has a broad scope and includes the use of wearable devices, mobile health, telehealth, health information technology, and telemedicine (Ronquillo, 2022).

According to Australian Institute of Health and Welfare (2022) digital health has a broad scope, and includes:

- ✓ mobile health and applications (such as SMS reminders via mobile messaging, wellness apps, Medicare Online and COVID check-in apps);

- ✓ electronic prescribing;
- ✓ electronic health records (including My Health Record);
- ✓ telehealth and telemedicine;
- ✓ wearable devices (such as fitness trackers and monitors);
- ✓ robotics and artificial intelligence.

In recent years, digital health has become more incorporated in daily live in general, and in clinical practice in medicine. According to Falter et al. (2020) while electronic health records, smartphone health applications and smartwatches are already becoming part of routine practice, evolutions in the field of telemedicine, robotics and artificial intelligence indicate that our current methods are just the tip of the iceberg.

Digital health is becoming more integrated in daily medical practice. In cardiology, patient care is already moving from the hospital to the patients' homes, with large trials showing positive results in the field of telemonitoring via cardiac implantable electronic devices (CIEDs), monitoring of pulmonary artery pressure via implantable devices, telemonitoring via home-based non-invasive sensors, and screening for atrial fibrillation via smartphone and smartwatch technology. Cardiac rehabilitation and secondary prevention are modalities that could greatly benefit from digital health integration, as current compliance and cardiac rehabilitation participation rates are low and optimisation is urgently required. This viewpoint offers a perspective on current use of digital health technologies in cardiac rehabilitation, heart failure and secondary prevention (Falter, 2020).

3. Mobile Health

Mobile Health (mHealth) is defined by the World Health Organization as "medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants, and other wireless devices" (Kay, 2011). This definition has more recently expanded to include mobile applications ("apps"), social media, and location tracking technology to obtain data relevant to surveillance, diagnosis, and management of chronic diseases (Bostrom, 2020).

Use of mHealth-compatible devices has increased in recent years, and age and socioeconomic gaps of ownership are narrowing (MacKinnon, 2020).

Wearable mHealth technologies include smartwatches, handheld devices, and skin patches, among others. Approximately 25% of US adults use wearables at least once a month, driven by smartwatch popularity with young adults. About 45% of smartwatch owners use their smartwatch as an activity tracker, second only to messaging notifications (Liu, 2017). According to Steinhubl (2015) cited by MacKinnon (2020) reported physiological parameters measurable by wrist-worn watches include pulse, BP, heart rhythm, cardiac output, body temperature, respiratory rate, oxygen saturation, blood glucose, physical activity, sleep patterns, and stress level.

There are estimated to be more than 250 000 mHealth applications currently available to consumers, and many applications have been designed for surveillance and management of cardiovascular disease (CVD) (Bostrom, 2020).

Mobile health (mHealth) technologies are modernizing medicine by affording greater patient engagement, monitoring, outreach, and health-care delivery. The cardiopulmonary fields have led the integration of mHealth into clinical practice and research. mHealth technologies in these areas include smartphone applications, wearable devices, and handheld devices, among others, and provide real-time monitoring of numerous important physiological measurements and other key parameters(MacKinnon, 2020).

mHealth technologies have demonstrated superior accuracy of measuring physical activity compared with self-reporting, the latter of which routinely results in overestimation of activity. Beyond their monitoring capacities, mobile apps and wearables with personalized feedback have shown success in increasing daily steps and weekly minutes of moderate to vigorous physical activity. The mActive trial demonstrated an increase in daily steps with an activity tracking and personalized text messaging intervention, whereas no change in daily steps was observed in activity tracking alone(MacKinnon, 2020).

CVD, perhaps more than other disease domains, lends itself to synchronization with mHealth technologies, as many metrics relevant to

disease management (heart rate, blood pressure, weight, rhythm analysis) are dynamic and quantifiable. To date, mHealth has been used to facilitate recovery after acute myocardial infarction (AMI), monitor arrhythmias, and to track ambulatory blood pressures. Applications have also been created to encourage medication adherence, facilitate social support, and augment the positive effects of cardiac rehabilitation (CR) (Bostrom, 2020).

Some apps include social networks with peer comparison and connections to social media. Apps with social feedback were beneficial in mothers and older adults whereas no effect was observed in young adult men. Mothers also reported significant reductions in depression scores, presumed to be the result of increased physical activity. mHealth interventions potentially may improve multiple cardiovascular risk factors (CVRFs), as illustrated by the mActive-Smoke study finding an inverse relationship between smoking urge scoring and steps taken 30 to 120 min prior to the urge reporting (MacKinnon, 2020).

mHealth has enabled numerous avenues for remote management of CVD. Older adults, with the highest burden of disease, may stand to benefit the most. mHealth-CR represents a particularly attractive area given traditional barriers to facility-based CR. Small studies have demonstrated potential benefits to mHealth-CR, but older adults have been under-represented, and further research will help to elucidate engagement and outcomes among older adults who are prescribed this intervention. Despite potential barriers to mHealth adoption in older populations, there is also evidence that older patients may be willing to adopt these technologies (Bostrom, 2019).

A significant utility of mHealth is the delivery of accessible cardiac and pulmonary rehabilitation and secondary prevention programs (CR/SPPs) to people otherwise not reached by traditional CR/SPPs. The inability to drive is one of the strongest predictors of nonparticipation in CR/SPPs, suggesting a potential role for remote interventions. When compared with traditional CR/SPPs, home-centered mHealth CR/SPPs demonstrated increased participation and completion rates. Improved health outcomes of functional capacity, weight loss, and mental health were also observed. Cardiac and pulmonary rehabilitation and secondary prevention programs (CR/SPPs)

can modify cardiovascular risk factors and improve exercise capacity. Furthermore, participation in CR/SPPs reduces all-cause mortality after percutaneous coronary interventions by 45% to 47% (MacKinnon, 2020).

According to MacKinnon et al. (2020) mHealth interventions have shown utility in the prevention, monitoring, and management of atrial fibrillation, heart failure, and myocardial infarction. With the growing prevalence of cardiopulmonary disease, mHealth technologies may become a more essential element of care within and outside of traditional health-care settings.

According to Bostrom et al (2020) some studies have shown that mHealth interventions may be cost effective in the setting of heart failure (HF) and cardiovascular rehabilitation(CR).

mHealth may prove to be a means of increasing patient engagement, and its community outreach facilitates more equitable and sustainable care. However, access to mHealth, unless supplemented financially, may limit its overall utility in the most vulnerable populations (MacKinnon, 2020).

According to McCool et al (2022) we are undoubtedly in the wake of one of the most vociferous shifts in health care but one where the benefits are likely to reach primarily the middle and higher socioeconomic groups unless we deliberately focus our efforts on low- and middle-income countries (LMICs).

4. Telehealth

Increasingly we are seeing media reports and company announcements about the use of digital platforms and technologies to provide physical therapy. The advancement of care delivery models that embrace technology has great potential to increase consumer access to care, promote consistent evidence-based treatment, and reduce unnecessary, costly, or riskier treatment (Roger, 2022).

Telehealth refers to health care interactions that leverage telecommunication devices to provide medical care outside the traditional face-to-face, in-person medical encounter. Technology advances and research have expanded use of telehealth in health care delivery (Tenforde, 2017).

The World Health Organization defines telehealth as the delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment, and prevention of disease and injuries; for research and evaluation; and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities. The American Physical Therapy Association (APTA) defines telehealth as the use of secure electronic communications to provide and deliver a host of health-related information and health care services, including but not limited to physical therapy–related information and services for patients and clients(Lee, 2018).

Internationally, physical therapists utilize telerehabilitation as the common term for telehealth applications. For example, the Australian Physiotherapy Association's position statement2 describes the provision of rehabilitation across the spectrum of acute, subacute, and community settings at a distance, using telecommunication technology to deliver real-time audio and video conferencing between providers and patients as synchronous telehealth. Other telehealth applications include secure electronic transmission of clinical information and medical data, described as asynchronous or store-and-forward telehealth. Telehealth physical therapy has the potential to transform many critical areas of care in musculoskeletal practice (Lee, 2018).

Physical medicine and rehabilitation providers may use telehealth to deliver care to populations with neurologic and musculoskeletal conditions, commonly treated in both acute care and outpatient settings. Patients with impaired mobility and those living in locations with reduced access to care may particularly benefit. Video-teleconferencing has been shown to be effective for management of burn patients during acute rehabilitation, including reduced health care use expenses and less disruptions to care. Telehealth can facilitate developing interprofessional care plans. Patients with neurologic conditions including stroke, spinal cord injury, traumatic brain injury, and amyotrophic lateral sclerosis may use telehealth to monitor symptoms and response to treatment. Telehealth also may facilitate occupational and physical therapy programs as well as improve weight

management and skin care in patients with chronic conditions. Other applications include imaging review in sports medicine, symptom management and counseling in concussion, traumatic brain injury, and pain management programs. Limitations of telehealth include barriers in establishing relationship between medical provider and patient, ability to perform limited physical examination, and differences in payment models and liability coverage (Tenforde, 2017).

Russell and colleagues (2011) reported high patient satisfaction with a 6-week telerehabilitation intervention compared to usual care in outpatients after total knee arthroplasty in Australia.

Many telehealth applications currently available to physical therapist, for example: Goniometer Pro, Physitrack, et al.

Digital therapeutic company DarioHealth is launching a digital physical therapy and musculoskeletal (MSK) care platform dubbed Dario Move. Dario Move includes a biofeedback sensor, real-time feedback and support from physical therapists and coaches, and personalized exercise programs designed by therapists. The new product comes after Dario acquired MSK health company Upright Technologies. The deal was originally announced in January 2021 (Olsen, 2021).

According to Konstantin Mehl: “Kaia Health is providing a proven MSK and COPD solution combining computer vision and human care to achieve better outcomes,” said Kaia Health CEO, President, and Founder. Its virtual physical therapy provides chronic disease management technology to enable real-time exercise feedback that has been third-party validated for its accuracy (Mageit, 2021).

Omada's latest MSK tech empowers physical therapists to conduct remote appointments. Chronic care management company Omada Health is rolling out a new tool that uses computer vision technology to help physical therapists virtually measure a patient's movement and range of motion. The new technology will be integrated into Omada's musculoskeletal (MSK) services and will be able to provide therapists and patients with a set of longitudinal data (Lovett, 2021).

SWORD Health provides employer-based virtual physical therapy with a focus on musculoskeletal disorders.The platform matches patients

with a licensed physical therapist who creates personalized programs for each member. During sessions, patients wear motion sensors that wirelessly send information to the physical therapist, who can provide real-time feedback on the patient's performance. After each session, the sensors share patient data with the physical therapist so they can analyze the metrics and make adjustments as needed (Hackett, 2021).

The effectiveness and feasibility of telerehabilitation was also seen in patients with various neurological disorders, with results showing significant improvements in patients affected by amyotrophic lateral sclerosis, multiple sclerosis, Rett syndrome, acquired brain injury and other neurological disabilities. Remote rehabilitation indeed made it possible to reach patients unable to travel and to overcome the need for recurrent outpatiens visits. Lastly, telerehabilitation also appeared to be a feasible, effective and generally wellaccepted intervention in patients with a variety of other conditions, including orthopedic complaints, vestibular dysfunction, fibromyalgia, spinal disorders, stroke, oedema, as well as pulmonary, oncological, overweight and obese patients. Where appropriate, the implementation of telerehabilitation in clinical practice could therefore be considered an alternative or complementary option to traditional in-person care (Brigo, 2022).

5. Conclusion

Aided by digital technology, a future could be realised in which we are able to offer high-quality, affordable, personalised healthcare in a patient-centred way (Falter, 2020).

Telerehabilitation is now a mainstay in health care delivery, with recent trends pointed to continued expansion in the future. Physical therapy (PT) being provided via telehealth, also known as virtual PT, has been demonstrated to provide functional improvements and satisfaction for the consumer and provider, and is applicable in various physical therapy treatment diagnostic areas. Research and technology enhancements will continue to offer new and innovative means to provide physical therapy (Havran, 2021).

References

Australian Institute of Health and Welfare, Australian Government. (2022). Digital health. Available from: https://www.aihw.gov.au/reports/australias-health/digital-health. Accessed: July 22, 2022.

Brigo, E., Rintala, A., Kossi, O., Verwaest, F., Vanhoof, O., Feys, P., & Bonnechère, B.(2022). Using Telehealth to Guarantee the Continuity of Rehabilitation during the COVID-19 Pandemic: A Systematic Review. *Int J Environ Res Public Health*. 19(16):10325

Bostrom,J., Sweeney, G., Whiteson, J., & Dodson, J.A. (2020). Mobile health and cardiac rehabilitation in older adults. *Clin Cardiol*. 43(2):118-126.

Falter, M., Scherrenberg, M., & Dendale, P. (2020). Digital Health in Cardiac Rehabilitation and Secondary Prevention: A Search for the Ideal Tool. *Sensors (Basel).* 21(1):12.

Hackett, M. (2021). SWORD Health closes $25 million Series B round to accelerate company growth. Available from: https://www.mobihealthnews.com/news/sword-health-closes-25-million-series-b-round-accelerate-company-growth. Accessed: August 18, 2022.

Havran, M.A., & Bidelspach, D.E.(2021). Virtual Physical Therapy and Telerehabilitation. *Phys Med Rehabil Clin N Am*. 32(2):419-428.

Herr, R. (2022). Digital Health Technology and Physical Therapy. Available from: https://www.apta.org/article/2022/04/15/digital-health-technology-and-physical-therapy. Accessed: 19 September, 2022.

Kay, M., Santos, J., & Takane, M. (2011) New Horizons for Health Through Mobile Technologies. World Health Organization; Geneva, Switzerland.

Lee, A.C., Davenport, T.E, & Randall, K. (2018). Telehealth Physical Therapy in Musculoskeletal Practice. J Orthop Sports Phys Ther. 2018 Oct;48(10):736-739. doi: 10.2519/jospt.2018.0613. https://www.jospt.org/doi/10.2519/jospt.2018.0613?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%20%200pubmed

Liu, S. (2018). Owners' daily use of smartwatch functions in the United States in 2017. statista website. https://www.statista.com/statistics/741692/us-owners-daily-use-of-smartwatch-functions/

Lovett, L. (2021). Omada's latest MSK tech empowers physical therapists to conduct remote appointments.

MacKinnon, G.E, Brittain, E.L. (2020). Mobile Health Technologies in Cardiopulmonary Disease. *Chest.* (3):654-664.

Mageit, S. (2021). Kaia Health raises €62M Series C funding for MSK and COPD care. The digital therapeutics company plans to expand its services in the US and Europe. Available from: https://www.mobihealthnews.com/news/emea/kaia-health-raises-62m-series-c-funding-msk-and-copd-care. Accessed: 19 September, 2022.

McCool, J., Dobson, R., Whittaker, R., & Paton, C. (2022). Mobile Health (mHealth) in Low- and Middle-Income Countries. *Annual Review of Public Health*. 43:525-539.

Olsen, E. (2021). DarioHealth launches MSK platform Dario Move. Available from: https://www.mobihealthnews.com/news/dariohealth-launches-msk-platform-dario-move. Accessed: 19 September, 2022.

Olsen, E. (2022). Digital physical therapy. Available from: https://www.mobihealth news.com/tag/digital-physical-therapy. Accessed: 19 September, 2022.

Ronquillo, Y., Meyers. A., Korvek, S.J. (2022). Digital Health. 2022 May 8. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; Available from: https://www.ncbi.nlm.nih.gov/books/NBK470260/. Accessed: 23 September, 2022.

Russell, T.G., Buttrum. P., Wootton, R., & Jull, G.A. (2011). Internet-based outpatient telerehabilitation for patients following total knee arthroplasty: a randomized controlled trial. *J Bone Joint Surg Am*. 93: 113– 120.

Steinhubl, S.R., Muse, E.D., & Topol, E.J. (2015).The emerging field of mobile health. *Sci Transl Med*. 7(283):283rv3.

Tenforde, A.S., Hefner, J.E., Kodish-Wachs, J.E., Iaccarino, M.A., & Paganoni, S. (2017). Telehealth in Physical Medicine and Rehabilitation: A Narrative Review. PM R. 9(5S):S51-S58.

Vitéz-Durgula, J. (2022). Egészségügyi innovációk Magyarországon – startup aspektus. Healthcare Innovations in Hungary –from the Point of View of Startups. In: *Pandémia – Fenntartható Gazdálkodás – Környezettudatosság/Pandemic – Sustainable Management – Environmental Awareness*. Conference proceedings. Edited by Obádovics Cs, Resperger R, Széles Zs. University of Sopron Press. ISBN 978-963-334-411-8(pdf).