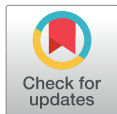**ELSEVIER**

Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Editorial

Digital Health: The Promise and Peril

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Many have said that a potential silver lining of the COVID-19 pandemic is the push, at speed, to adopt digital health[1] as a means to enhance timely access and equitable delivery of services. Adoption of virtual care would not have happened without the underlying monetary incentive for health care providers to scale such services during the pandemic through the provision of temporary virtual care billing codes. Furthermore, we cannot summarily dismiss the accompanying expansion and commercialisation of virtual care vendors in the Canadian marketplace.[2] While such virtual care services may purport to reduce the cost of and need for travel, reducing carbon tax, as well as reducing the need to take time off work to receive health care, they also carry a significant risk of increasing health disparities owing to what is often referred to as the digital divide.[3,4] The digital divide may be attributable to a number of factors, including language barriers, lack of access to technology, and digital health literacy.[5] The past 18 months have highlighted both the promise and the potential peril of digital health, herein encompassing virtual care, mobile health (mHealth), telemedicine, remote patient monitoring, wearables, sensors, point-of-care diagnostics, software as a medical device, and data-driven algorithms that include machine learning and artificial intelligence.

While research publications continue to grow exponentially in the digital health space, implementation and evaluation of digital technologies are lagging. Telemedicine research outputs have increased tremendously over the past decade (compound annual growth rate of 7.4%), outpacing the growth in medicine publications (3.5%) and publication output overall (5.1%), a trend that will likely rise exponentially because of the pandemic (Fig. 1).[6] Moreover, the pandemic has allowed for the proliferation of virtual care services that have not undergone the rigorous validation and evaluation by provincial health technology advisory committees required to be acceptable as a mode of delivery in our publicly funded system.[2]

Despite growing evidence that remote patient monitoring reduces hospital readmissions and improves health outcomes,[7,8] a 2018 report from Canada Health Infoway found that only 31,500 patients participated in tele-homecare programs (both heart failure and lung disease) over the past 8 years.[9] In Ontario, despite 350,000 patients actively living with heart failure, fewer than 1% receive remote patient monitoring. And although many virtual health care applications are available for download and use for self-care, few have been developed in partnership with patients and communities to reflect social, cultural, and local contexts. If done so effectively, virtual care has tremendous potential to improve how we deliver care at scale, helping to build health care system capacity while transforming the experience of people living with or at risk for cardiovascular disease.

To achieve incremental improvement in digital health service delivery, we must consider the Quadruple Aim, an internationally recognised framework with a goal to design and deliver effective health care systems. The 4 key objectives of the Quadruple Aim are to improve the patient and caregiver experience, improve the health of populations, reduce the per-capita cost of health care, and improve the provider experience.[10] A recently developed interdisciplinary collaborative (family practice, mental health, diabetes, cardiovascular disease, digital health, and big data) highlights fundamental elements of the quadruple aim needed to transform the health of those with chronic disease (Fig. 2).[11] In this context, digital health includes patient, provider, and researcher relationships connected by technology, supported through artificial intelligence-based algorithms and wearables, and driven by data and integrated health records available to all providers and patients. For success, this must be driven by health equity, focused on people at the greatest risk for adverse health outcomes, simultaneously improving individual and population health and use of system resources, designed, studied, and implemented across disciplines and parts of the health continuum, including linking primary, community and specialist care around patient-defined outcomes, and fundamentally designed for person-centred care,
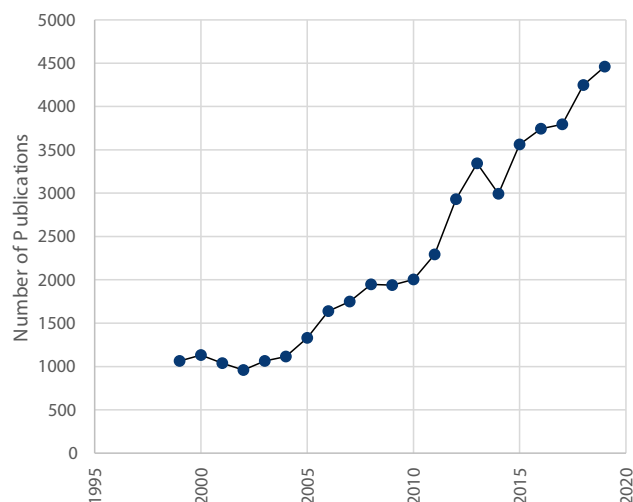
Figure 1. Global scholarly output in telemedicine research from 1999 to 2019. Reproduced from Jayabalasingham[6] with permission from Elsevier.

focused on self-management, patient autonomy, and close relationships with providers.

Respecting Self-Determination and Community Leadership in Digital Health Service Delivery Models

The deployment of digital health services because of the pandemic may be of particular benefit for those accessing specialised cardiac care in remote and isolated communities, who are often required to travel great distances, at prohibitive costs, to receive in-person care. While the pandemic may have
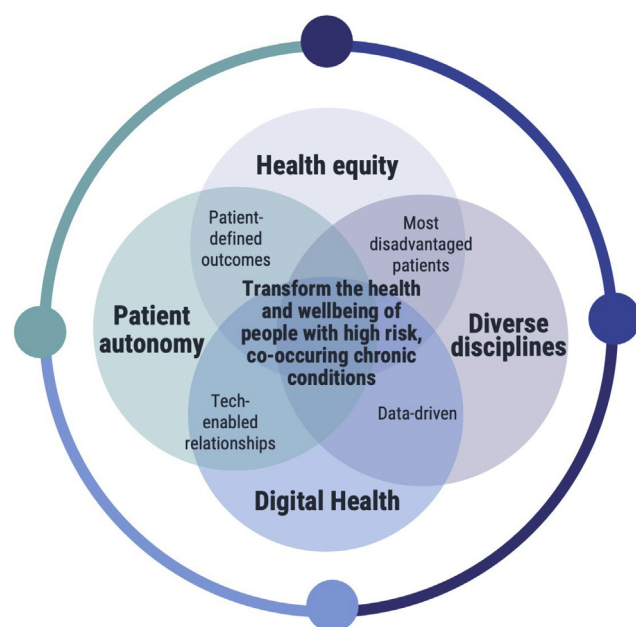
Figure 2. The fundamental elements that enable the success of digital health. Reproduced from Lewis et al.[11] with permission from the University of Toronto.

magnified these inequities,[12] unmasking significant disparities in access to care—particularly in Indigenous communities that have been historically disenfranchised by a colonial healthcare system meant to deny them care—it has also revealed the importance of self-determination, community leadership, and respect for local knowledge in working to address barriers to safe and effective care. As a result of these measures, Indigenous communities in Canada have experienced lower rates of COVID-19 and lower case fatality rates than non-Indigenous peoples.[13] We must recognise the success of these self-determined approaches and embrace them in our service delivery models if we are to properly address the growing burden of cardiovascular disease and other chronic illnesses in the Indigenous population.[14] This recognition will require an examination of our own positionality, privilege, and power as health care providers.

As such, if Indigenous communities determine that digital health is part of a relevant strategy to improve cardiovascular care, then it is incumbent on us that a community-based engagement model, a "Nothing About Us Without Us" approach,[15] be used in respecting the principle of self-determination. We must adhere to the provisions pertaining to health promotion as outlined in the United Nations Declaration on the Rights of Indigenous Peoples,[16] including the right of Indigenous Peoples to be actively involved in developing and determining health and social programs that affect them.

Furthermore, situational awareness, capacity building, and cultural safety are all essential components in the proposition of innovative approaches and technologic advances to improve health care delivery in these settings. For example, access to reliable high-speed internet is essential for access to and delivery of digital health care, with many stating that it is a social determinant of health.[17] Yet only one-fourth of Indigenous communities have access to broadband internet, compared with 97% of urban households in Canada.[18] This divide is even more apparent in Indigenous youth, who report a 13% gap in confidence regarding digital literacy compared with non-Indigenous youth.[19] Therefore, we must look beyond the traditional biomedical definition of health to better appreciate factors affecting the broader social determinants of health. Particularly if we are to have a conversation focusing realistically and sensibly on digital health service delivery models. If not, we will undoubtedly fail in this pursuit and inevitably widen the digital divide—even with the best intentions at hand.

Finally, building trust should also go beyond bilateral negotiations and agreements. Inherent to these partnerships is recognising that these relationships are not political or academic ventures, areas that often fraught with the exploitation of data. Eliminating the digital divide requires developing ownership and accessibility policies related to data collection from which communities can become empowered. Sustainable change will be the result of actively listening to communities to understand their needs and develop infrastructure that local leadership can manage.

Finding the Silver Lining in Digital Health

It is the role of elected officials and health care system leaders to invest in collaborative efforts that promote

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connecting with communities, develop digital health technologies that meet the needs of the community, and support infrastructure to implement the technologies. Furthermore, stipulating how these goals are to be met allows for true collaborative efforts to develop technologies useful to these communities. As is the case with any effort to improve health care outcomes, it will be essential to develop and support the infrastructure necessary to implement and maintain these technologic developments for the future.

While we consider digital health as a potential solution to better health care outcomes in Canada, perhaps we should also pause and consider that Canada spends less on social determinants than any other wealthy country.[20] We know the pandemic has revealed deeply rooted inequities in health access and outcomes in vulnerable populations, such as those with sociodemographic risk factors[21] (ie, economically disadvantaged populations,[22] racial/ethnic minorities,[23] older adults, children), health status (ie, pregnant women, individuals suffering chronic disease and mental disabilities), and/or place-based/geographic factors (ie, who are institutionalised in long-term care homes, homeless, and rural/isolated[24]).

Therefore, if we are to realise the promise of equitable digital health rather than encountering the perils represented by the digital divide, we must also address growing income inequality and increase expenditures on supportive housing, healthy food, and education—all likely more essential than digital health for improving the cardiovascular health of our most vulnerable. For example, access to the internet does not necessarily translate to adoption. In a recent cross-sectional study including 4525 community adults, 38% of seniors > 65 years of age and 72% > 85 were not ready for video visits. Unreadiness was more prevalent among older and single men, non-Caucasians, those with lower education status, and those who resided in nonurban areas. Lack of familiarity with the technology, lack of stable internet connection, difficulty with hearing/seeing, and language were identified as barriers to video visits.[25] We must begin to recognise that health is more than health care if we are to realise the long-term benefits of digital health. Successful digital health programs commit to patient, family, and clinician education. Valuable lessons learned across groups can be shared to optimise comfort with virtual care and other digital health technologies.

This theme issue of the *Canadian Journal of Cardiology* highlights the tremendous promise that digital health may bring. With a commitment to education, a number of key topics are examined, including major advances in virtual care and remote patient health-monitoring technologies, big data utilisation, innovations in artificial intelligence, and data analytics. These innovations have the potential to realise high-quality, cost-efficient, guideline-directed, digital, and exemplary cardiovascular care. These breakthroughs must empower collaborative decision making with patients, recognising local cultural context and relevance, such that patients can actively participate in managing their care and improving their quality of life and survival.[26] Digital health should be central to enabling this transformation, achievement of the Quadruple Aim, while reducing inequities and disparities in care.

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