

# Digital Health and the Future of Cardiovascular Care

An overview of the ways digital health is impacting and will impact the treatment of cardiovascular conditions.

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**H**ow does digital health pertain to you? Perhaps you are a physician who is overworked, feeling burnout, and dreading yet more patient information to manage.<sup>1</sup> Perhaps you are an administrator trying to figure out how to incorporate digital offerings to your patient population or a patient who wants more input and control over your health care by engaging in remote physiologic monitoring to stay in touch with your doctor between office visits and to avoid the emergency department. In any case, today you cannot escape the headlines about the digital transformation in health care.<sup>2</sup>

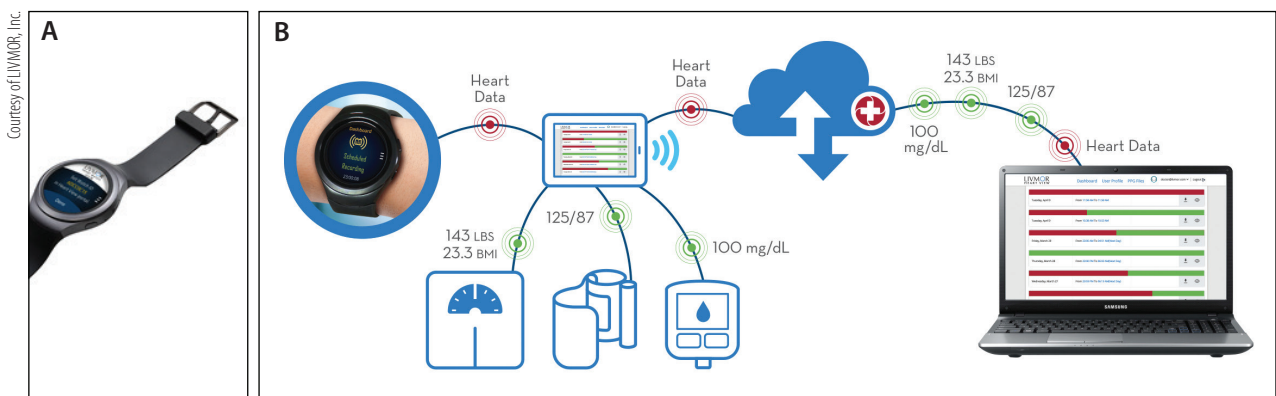
## WHAT IS DIGITAL HEALTH?

*Digital health* is the convergence of digital technologies with health care delivery using information and communication solutions to address health conditions.

The technology may be software or hardware solutions or services such as telemedicine, text messages, wearable devices, or remote monitors and sensors with web-based analysis. It may more broadly include genomics, artificial intelligence (AI), machine learning analytics, and mobile applications. Digital health aims to connect physiologic parameters identified outside of the traditional hospital or clinic settings to enhance the precision and personalization of health care delivery for patients, particularly those with chronic conditions.

## WHY SHOULD WE PAY ATTENTION?

When there is a sea change in an industry, there are several tell-tale signs.<sup>3</sup> There is a decrease in customer (ie, patient) loyalty, which has been seen in health care, with patients increasingly using mobile health visit solutions,



**Figure 1.** The Halo watch (A). Heart rhythm, blood pressure, and weight signals are uploaded to the cloud platform for evaluation and feedback from medical personnel to the patient (B). BMI, body mass index.

such as Teladoc (Teladoc Health), rather than scheduling personal doctor office visits.

In addition, digital startups have seen major spikes in investments from venture capitalists, which have topped \$11 billion over the past year alone<sup>4</sup>; major players such as Google, Apple, and Microsoft have placed big bets on digital health care startups in areas like clinical research, genetics, drug delivery, and more. Portfolio companies, such as 23andMe, Flatiron Health, and Freenome, collect massive amounts of patient data and use advanced AI and machine learning to drive insights into patient health and trends.

Even the FDA has released a digital health innovation action plan and has launched pilot programs to facilitate digital health product approvals. Policy changes such as these, as well as the addition of remote physiologic monitoring codes for 2019 by the Centers for Medicare & Medicaid Services (CMS) and updates to these codes slated for January 2020, suggest the government is facilitating the untethering of health delivery from the standard brick-and-mortar facilities we are used to. New business models such as Livongo's monthly subscription service designed to support enrolled prediabetic patients and prevent progression to diabetes led to a valuation of more than \$1 billion. Remote monitoring is especially of interest to multiple stakeholders, including: (1) self-insured companies, which save on insurance costs if they can avoid expenses from chronic conditions; (2) providers that participate in shared savings plans and show improved outcomes with remote monitoring; and (3) health care systems looking to incorporate sensor technology to digitally enhance their patient care offerings.

## WHAT CAN DIGITAL DEVICES DO FOR US RIGHT NOW?

CT scans read by AI and machine learning were more accurate in predicting 5-year all-cause mortality than CT scans read by humans in a study looking at 10,000 scans.<sup>5</sup> At the 2018 Consumer Electronics Show, there were > 500 digital health and > 620 wearable device exhibitors present, which was a dramatic increase from 5 years prior. Wearable technologies can measure arrhythmias, respiratory rate, weight, blood pressure, temperature, stress levels, sleep apnea, and more. Wearable monitors measuring cardiac parameters such as atrial fibrillation (AF) (eg, Apple Watch, Halo watch [LIVMOR, Inc.; Figure 1]) can improve the identification of patients with asymptomatic AF who could be at risk for cryptogenic or undiagnosed stroke. Goldkorn et al showed that wearable devices that measure heart rate variability were more sensitive than traditional nuclear stress testing (73% vs 26%) in diagnosing patients with clinically important coronary disease referred for cor-



**Figure 2.** The Lumeo sensor device measuring oxygen saturation (A). Platform display of the readings from a Lumeo sensor for clinical review (B).

onary angiography.<sup>6</sup> Some devices are under investigation in the vascular field. The Lumeo oxygen platform (Profusa, Inc.) uses a tiny hydrogel biosensor injected under the skin to measure tissue oxygen levels to help identify patients who may be at risk for ischemia (Figure 2).

## CONCLUSION

Digital health for cardiovascular conditions is in its infancy, but with the global impact of these diseases and the contribution of chronic conditions to the health care budget, it seems likely that remote monitoring and digital transformation will be a part of our everyday practice of medicine very soon. The interest from venture capital funding, governmental policy support including the FDA and CMS, and multiple stakeholders impacted by the adoption suggest digital health is here to stay. ■

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