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CARDIOVASCULAR RESEARCH Onlife

Mobile cardiology during the COVID-19 outbreak

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Commentary on 'Rapid implementation of mobile technology for real-time epidemiology of COVID-19', by D. Drew *et al.*, Science 2020; doi: 10.1126/science.abc0473.

The digital revolution is everywhere, influencing almost every part of our lives and it is here to stay, redesign, and disrupt. Healthcare is quickly becoming digital, as society is leveraging mobile applications (apps) for consultation, first diagnosis, physical fitness, improving adherence to therapies, obtaining medications, amongst many others.[1] In the wake of the coronavirus disease-2019 (COVID-19) pandemic, digitalization waves coupled with the potential of the mobile app improvement technology have protected the world from falling apart. The ability of COVID-19 to quickly spread across every country globally has made the collection of population-scale data, to help tackle the pandemic, extremely challenging.[2] Thus, in an effort to aid real-time epidemiology monitoring, Drew *et al.*[3] have unveiled a free mobile app called the COVID Symptom Study, which collects daily symptoms reports from millions of users in the UK. This app provides a guided interface to report a range of individual demographic data and risk factors and, with continuous use, participants can submit daily updates on symptoms, information on healthcare visits, SARS-CoV-2 testing results, and if they are seeking healthcare support, the level of intervention and associated outcomes.[3] This unique prospective population-based study is helping to monitor the community dynamics of COVID-19 and to categorize populations with high symptom outbreaks. Indeed, a recent analysis of this data has shown that there are six distinct 'types' of COVID-19, each distinguished by a particular cluster of symptoms with differing clinical needs, creating a potential predictive tool for the need for respiratory support in severe COVID-19.[4]

The application of these digital tools for disease surveillance and control allows data collection not only for long-term studies but also for immediate public health use. In line with this, special care should be directed to the cardiovascular system due to the complex interaction with COVID-19.[5] Indeed, pre-existing cardiovascular diseases (CVD) have been associated with a worse prognosis and a more severe progression of COVID-19, whereas COVID-19 itself can also induce arrhythmia, cardiac injury, fulminant myocarditis, heart failure, pulmonary embolism, and disseminated intravascular coagulation. Due to the unknown long-term consequences, regular cardiovascular risk assessment should be considered also in all patients who survive COVID-19.[6] As isolation and quarantine remain the most effective tools to control the outbreak,[5] the use of mobile health (mHealth) technology, a subset of digital health that uses mobile apps and wireless devices (wearables), may help to address the barriers to cardiovascular education, disease prevention, cardiac rehabilitation, and therapy guidance (*Figure 1*).[7]

Emerging evidences support using mHealth in the management of modifiable risk factors to prevent CVD, having a significant impact on physical activity levels, reductions in systolic and diastolic blood pressure, improved smoking cessation rates, weight reduction, and diabetes control.[7] There is also growing use of mHealth technologies in remote patient monitoring and surveillance for disease decompensation, monitoring key metrics and symptoms in patients with chronic heart disease such as heart failure (HF) and myocardial infarction. Such programmes often use mHealth tools as part of a monitoring system that allows direct transmission of key variables (e.g. blood pressure) to healthcare teams in an effort to reduce hospitalizations and improve diagnosis and survival.[7,8] Also, mobile apps and text messaging interventions to deliver cardiac rehabilitation are being settled and tested for those who have existing heart disease but cannot attend in-person rehabilitation programmes, along with the ability to personalize healthcare per patient. These devices generate an enormous amount of data, requiring big data and artificial intelligence expertise and technology for maximal extraction of its potential.[1] In the context of a global pandemic and in the absence of analytic outcomes data to guide evidence-based decision-making, the advantages for mHealth tools implementation are: (i) to guarantee suitable, sensitive, and timely therapy of CVD patients; (ii) to reduce the risk of COVID-19 exposure to patients and healthcare workers; and (iii) to limit resource use under settings of constraint.[9] Additionally, the psychological impact of the pandemic on patients is significant. Recent data suggest that the admission rate for acute cardiac conditions during the COVID-19 pandemic is much lower than expected,[10] pointing to the reduced access to emergency medical services due the contagion fear in hospitals and, consequently, the mHealth importance in this context. However, epidemiological studies documenting mortality at home and in hospital during the COVID-19 epidemic compared with previous years during the same period will probably clarify this.[10]

mHealth is a promising tool to ensure rapid and appropriate delivery of cardiac care that may help in filling the gap of fractured healthcare systems, especially in low- and middle-income countries (LMICs). Though, despite the substantial excitement surrounding these digital tools, access to mHealth, unless supplemented financially, may limit its usefulness in the most vulnerable populations.[7] Moreover, there is already an overwhelming number of cardiovascular mHealth options available to

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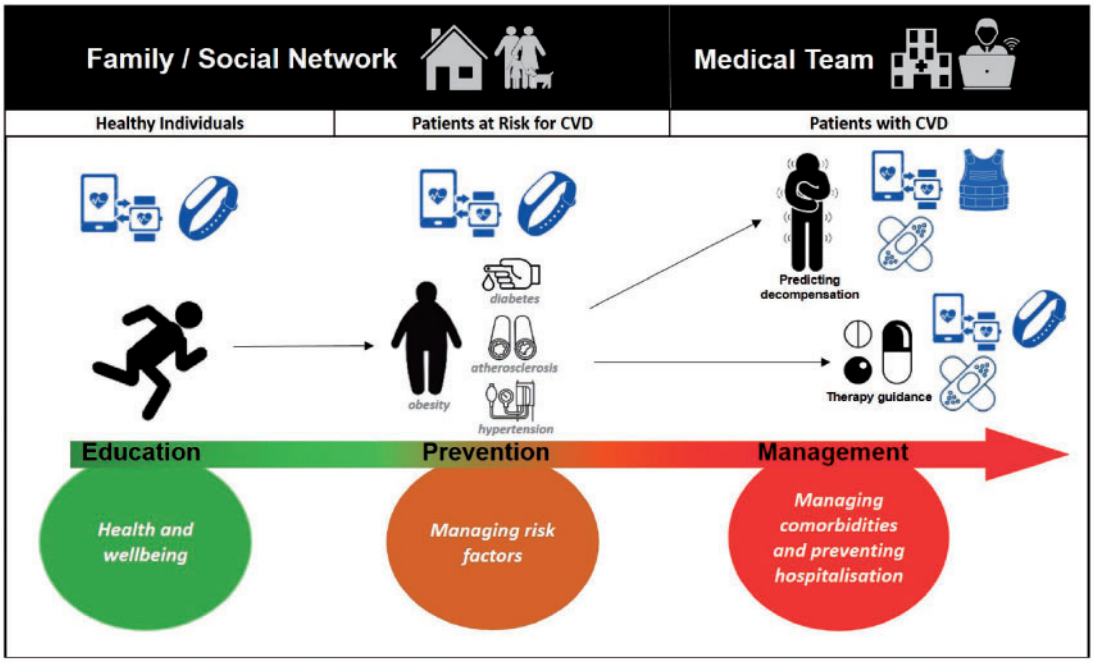

Figure 1 Examples of wearable devices that may be applied at diverse stages in the cardiovascular diseases (CVD) 'expedition' from education and prevention through to detection of decompensation and therapy. The medical team and family and social network are presented in 2-way communication with the patient and mobile health data. : Smartwatch connected to mobile phone or tablet—Heart rate, ECG and/or blood pressure monitoring; : Activity band—accelerometer and/or heart rate monitoring; : Vest—Multi-lead ECG and/or pulmonary fluid monitoring; : Patch—ECG and/or pulmonary fluid monitoring.

consumers, but without significant regulation from the Food and Drug Administration. Significant concerns for those using mHealth technologies also exist around online security and leaking of private information. These tools must be guaranteed to be scientifically and ethically sound to guarantee widespread public trust and acceptance.[7,8] Therefore, future studies are necessary to better evaluate mHealth interventions regarding long-term outcomes, optimizing programs, safety, and cost-effectiveness. Importantly, scientific societies will play a crucial role in the development of guidance on the production and on the usage of mHealth options in clinical practice, suggesting when, to which type of patient and under which terms of use it is advisable to prescribe an mHealth technology for CVD self-care. The European Society of Cardiology is actively engaging with this agenda, setting up recently a Digital Health Committee.[1]

With the high availability of mobile technologies and the pioneering ways in which they are being used, mHealth will continue to renovate the delivery of cardiac care. The digital revolution is here, let's take advantage of it!

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Biography: Rui Adão is a Biologist with a PhD degree in Cardiovascular Sciences obtained in 2019 at the Faculty of Medicine of the University of Porto (Portugal), where he currently works as a postdoctoral research scientist at the Cardiovascular Research and Development Center-UnIC. Rui has a strong expertise in animal models of pulmonary arterial hypertension (e.g. monocrotaline, hypoxia-Sugen5416) and in *in vivo* and *in vitro* evaluation of cardiac function. Rui has also maintained relevant collaborations with institutions of excellence in cardiovascular research and therapeutic innovation, including INSERM (France), Medical University of Graz (Austria), Christchurch School of Medicine (New Zealand), and Antwerp University (Belgium). As an early career researcher, he has won numerous prestigious scholarships and awards such as a Janssen Innovation Award (2018) and European Respiratory Society Short-Term Fellowship Grant (2017). His current research focuses on elucidating the role and therapeutic potential of novel small molecules (e.g. small peptides and microRNAs) in the setting of pulmonary arterial hypertension and associated heart failure. He is also a core member of the Scientists of Tomorrow Nucleus of the European Society of Cardiology.