ESC European Society of Cardiology
European Heart Journal (2021) **42**, 3114–3121
doi:10.1093/eurheartj/ehab167
CARDIOPULSE

A glimpse into the future of cardiology: how can advanced technologies lead to compassionate care?

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Introduction

The 21st century has seen major changes in the practice of medicine and the delivery of healthcare through a cultural transformation we call digital health.[1] This generation of patients comes with a desire for an equal-level partnership between them and their medical professionals; as well as for a change in the roles of the old status quo.

The role of the passive patient has been transforming into a proactive role being eager to get involved with their health and disease management. Physicians' role of being the key holder to the ivory tower of medicine has been transforming into the role of a guide for their patients in the network of information and technologies (*Figure 1*).

In all this, cardiology has been a prominent example about how the use of advanced technologies, digital health, and automation could shape the future of a medical specialty. Several reasons underscore this notion.

1. The leading cause of death worldwide is ischaemic heart disease, responsible for 16% of deaths, according to the WHO. Since 2000, this disease has seen the largest increase in the number of deaths rising by >2–8.9 million deaths in 2019.
2. Many of the most popular digital health devices on the market measure vital signs and health parameters related to circulation.
3. Most conditions cardiologists deal with require the active engagement of patients on the long term.

The COVID-19 pandemic has emphasized these reasons even more. The pandemic has led to a faster adoption of digital health technologies; made telemedicine the main way of providing care in many areas; and accelerated the process of shifting the point-of-care from hospital buildings and practices to wherever patients are.[2]

This way, by envisioning how these factors shape the future of this medical specialty, cardiology could also pave the way for medical professionals in other fields by helping them better understand what awaits them.

The rise of digital health devices

A swarm of technologies have become available globally in less than a decade (*Figure 2*). Digital blood pressure monitors, hand-held electocardiogram (ECG) devices, heart rate and motion trackers, and smartwatches have become accessible to the masses. Combined, portable diagnostic devices have been developed that can measure multiple vital signs and health parameters at once with built-in algorithms that can also immediately analyse the results.

Millions of patients have started taking direct-to-consumer genetic tests to learn about their risks for major heart conditions; medication sensitivity for a range of drugs used in those conditions and even doing microbiome tests to optimize their diet.

This trend has also reached cardiologists in their daily profession through digital stethoscopes, portable ultrasound devices, algorithms analysing medical images, and in the design of treatment pathways. At least five artificial intelligence (AI)-based technologies have been approved by the Food and Drug Administration (FDA) for use in cardiology.[3] Examples include Arterys for analysing cardiovascular images from magnetic resonance; ECG analysis support and Eko's cardiac monitor. Dozens of other technologies have received CE approval for their use in cardiology.

It seems clear that automation in analysing patients' data and decision support will have a growing role in the job of cardiologists. There is an influx of data coming from patients that add to the vast amount of information they already deal with at the point-of-care. At the same time, the access to information and technologies allows patients dealing with cardiovascular issues to get more involved in their care.

Both trends in themselves would lead to significant changes in how cardiologists do their job, but, together, the transformation of the medical practice in general is inevitable.

A vision about the future of cardiology

In 2032, 44-year-old Linda living in the London suburbs decides that she wants to change her lifestyle by running half an hour a few times a week. As she has no experience in doing regular exercises, she chooses a fitness wearable measuring vital signs and other health data to accompany her on the journey.

After a few sessions, the device starts sending alerts about detecting an abnormal heart rate and irregularities in her ECG. She uses a

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Figure 1 Depictions of the traditional setting of a doctor–patient meeting (left) and the new setting characterized by an equal-level partnership, access to data that come from patients and medical professionals, and the shared use of advanced technologies (right).

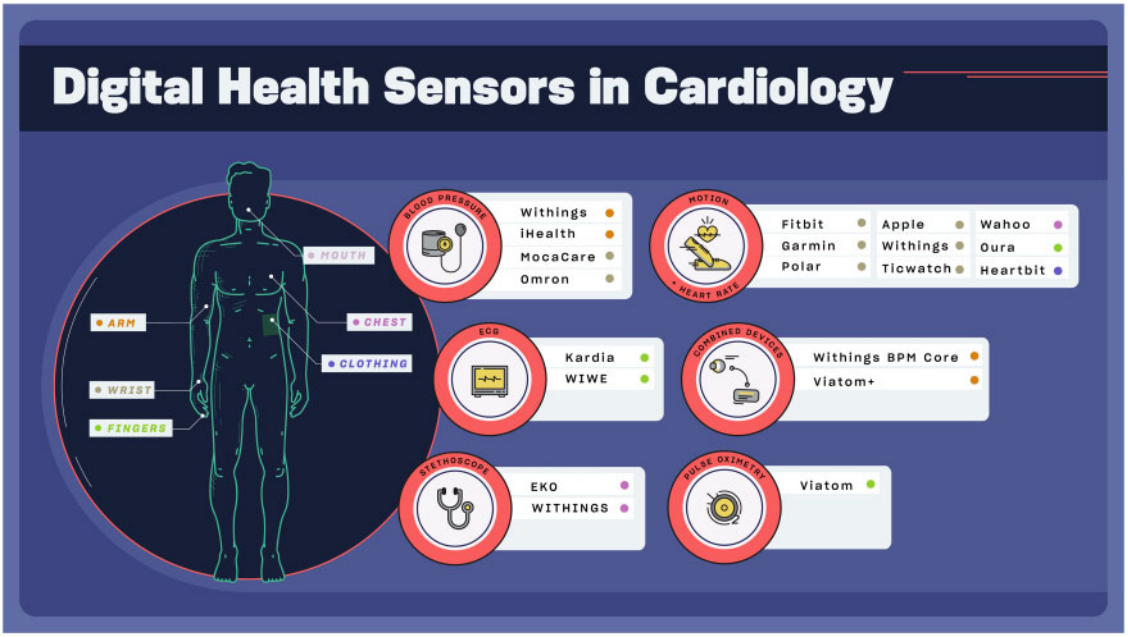

Figure 2 Examples of digital health devices and sensors focusing on vital signs and health parameters related to circulation. The coloured dots next to each device represent on which body part those have to be used.

chatbot on her phone based on AI to advise her what to do with it. The chatbot suggests sharing the data and the notifications with her primary care physicians who advises her to see a cardiologist.

The cardiologist uses an algorithm trained in machine learning to provide a prediction score for how Linda's case might evolve. The algorithm has access to the data of millions of patients and every decision it makes is confirmed by a physician to further improve its efficiency. Linda received a more advanced device that is continuously connected to her cardiologist's dashboard to make sure she is being monitored properly and to help decide on preventive treatment. Since the emerging symptoms were already noticed long before anything major could happen, Linda keeps on running without the fear that she might have a heart condition.

The final decision always belongs to the cardiologist who suddenly has two new members in the medical team: the patient and AI. While this promise could raise fear or doubt for some about how this might work out, hopefully, the rest will only see what matters: a patient avoiding a heart incident, a physician enjoying their profession, and a healthcare system becoming more efficient through a new equal-level partnership.

This is the promise of digital health. With its unique position in the palette of medical specialties, cardiology could be a leading example paving the road for others in how to adopt advanced technologies while focusing on the real-life relationships they can build with patients through compassionate care.

Conflict of interest: none declared.

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doi:10.1093/eurheartj/ehab102

The need for ethical and pragmatic strategies for sample and data collection during public health emergencies—minimizing missed opportunities

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What the COVID-19 pandemic has revealed to clinical researchers

The magnitude of the success in vaccine and countermeasure research to address the pandemic of SARS-CoV-2 in 2020 cannot be overstated.[1] Within a short period of time, the international community teamed up to address one of the greatest challenges in history, leading to unprecedented achievements such as 'Project Lightspeed',[2,3] in which a highly efficient vaccine against SARS-CoV-2 was developed within months. In parallel, other investigators and companies developed with great efficiency successful vaccines and therapies against SARS-CoV-2, trying to meet the high demand for protection of our society and for return to 'normal' life.[4,5]

While these great successes received extensive media coverage, other scientists have faced challenges due to delayed institutional approvals of their COVID-19 research projects.

Certainly, the role of the ethics committee in ensuring the balance between scientific progress and the protection of patients' rights, privacy, and clinical care is of utmost importance. While the review of a research project application by an ethics committee frequently takes several months during 'normal times', this delay may lead to avoidable loss of valuable samples and data during an outbreak of a pandemic. Time is of the essence for the research community during a pandemic as scientists race to elucidate the pathophysiology of the disease and provide guidance to those designing potentially lifesaving public policies. A new pragmatic balance between regulation and productivity in science must be found in such scenarios.

In this article, we suggest a two-step consent algorithm, in which we separate the institutional approval process for sample acquisition from the approval process of sample analysis, allowing sample collection to start immediately during an outbreak of a public health emergency.

Lost samples during the first peak of the COVID-19 pandemic

Our motivation for writing this article arose from anecdotal evidence of missed opportunities during the first peak of the COVID-19 pandemic observed by our international colleagues and by ourselves. In this small-scale collection of data, we found that, on average, 70% of COVID-19 minimal-risk biosamples such as blood or plasma could not be collected during the first wave of the pandemic and were therefore lost due to delays in approvals across many institutions. These delays were caused by an overwhelming number of applications to the ethics committees by investigators aiming to study COVID-19.[6] The lost samples could have potentially provided insights into the pathophysiologic mechanisms of COVID-19 in spring 2020 to better prepare the public and clinical facilities for the second peak in autumn 2020.

The increased volume of applications required institutions to adjust their review and approval practices.[6] While ethical decisions on investigational trials are complex and require a comprehensive and often lengthy review, we suggest a simple and time-efficient approach during a public health crisis for studies that are solely analytical.

Early analytical and observational studies are highly relevant as they seek to generate a better understanding of the pathophysiology of a novel disease such as COVID-19 and to improve diagnosis and risk assessment.[6] In that regard, relevant discoveries had been made in analytical studies concerning the nature of COVID-19, active viral replication of SARS-CoV-2 in the respiratory tract, and how this affects infectivity of patients during the course of the illness.[7] Those findings had a relevant impact on public health procedures.

Given the importance of analytical studies, the low health risk they pose to patients, and the observed delays in their approval process, we suggest a two-step consent process that separates sample collection

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