

Editorial

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# Connected health: in the right place at the right time

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## INTRODUCTION

Digital health or electronic health (e-health) involves a broad group of activities that use communication and information technologies to store, retrieve, share, and exchange health-related information for prevention, diagnosis, treatment, monitoring, educational, and administrative purposes<sup>[1]</sup>. Due to the technological progress of recent years, the term, originally indicating activities carried out at the local site, has now been extended to the electronic processes involving the Internet and healthcare delivery over a distance, the so-called telemedicine or telehealth<sup>[2]</sup>. Indeed, telemedicine services are currently the most popular e-health services among healthcare professionals and consumers. A summary of the most typical e-health services available nowadays is reported in [Table 1](#).

## CONNECTED HEALTH

Telemedicine means “healing at a distance”, a composite word of the Greek term “tele”, meaning “distance”, and the Latin term “medicus”, meaning “to heal”. Telemedicine or “connected health” basically refers to the specific use of information communication technology (ICT) to deliver healthcare, clinical and administrative services, and medical education, remotely from one site to another, to offer more prompt and efficient diagnosis and clinical care<sup>[3]</sup>. Telemedicine services based on the Internet and, more recently, after the introduction of smartphones and tablets, mobile health services (so-called “m-health”) are now the most popular and widespread applications in the field of e-health<sup>[4]</sup>. They are commonly used for remote monitoring (telemonitoring) of specific vital and non-vital parameters. According to current models, a web-based shared platform that favors collaborative care and interactions between patients and healthcare operators and among professionals is the most popular and effective telemedicine intervention. The typical



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**Table 1. Main categories of e-health services that are currently available**

Electronic health record	A platform used to store a patient's clinical history (test results, medication, disease history) with the potential for it to be shared online with other providers outside the practice
Administrative and patient information systems	EHR integrated with tools that can be used to support both the administrative and clinical activities to manage administrative data, appointments, billing, planning, budgeting, and personnel
Clinical decision support tools	Tools that use patient-specific data to present evidence-based guidance to clinicians at appropriate times throughout the care planning process, guiding and reinforcing decisions at the point of care and assisting with clinical decision-making tasks
Web-based technologies and services	E-learning for patients (interactive education programs on lifestyle, information related to diseases and treatments) and healthcare professionals (continuing medical education), online discussion groups for patients and healthcare professionals
Virtual healthcare	Digital clinics which enable teleconsultation and videoconferencing, exchange of diagnostic images, and in some cases, computer-assisted surgery through robotics
Medical research support technologies	Based on grid technologies, which allow powerful computing and data management capabilities to handle large amounts of heterogeneous data
Medication management services	Online prescription and drug dispensation, patient's adherence tracking with automatic feedback to the patient, or case management by a healthcare professional
Medical imaging	Storage (for local access) or exchange (for remote access) of diagnostic images or videos (so called "teleimaging") or pathology slide images ("telepathology"). Data exchange may include radiograms, CT or MRI-scans, ultrasound videos, funduscopy images, etc., and may occur in real-time or after the visit
Telemedicine, telecare, m-health	Remote data transmission of various measurements (e.g., BP, heart rate, ECG, body weight, body temperature, oxygen saturation, peak respiratory flow, blood glucose) and patient's health status from a patient's home or a professional healthcare setting to the doctor's practice or the hospital. It also includes televisit and teleconsultation

EHR: Electronic health record; CT: computed tomography; MRI: magnetic resonance imaging; BP: blood pressure; ECG: electrocardiogram.

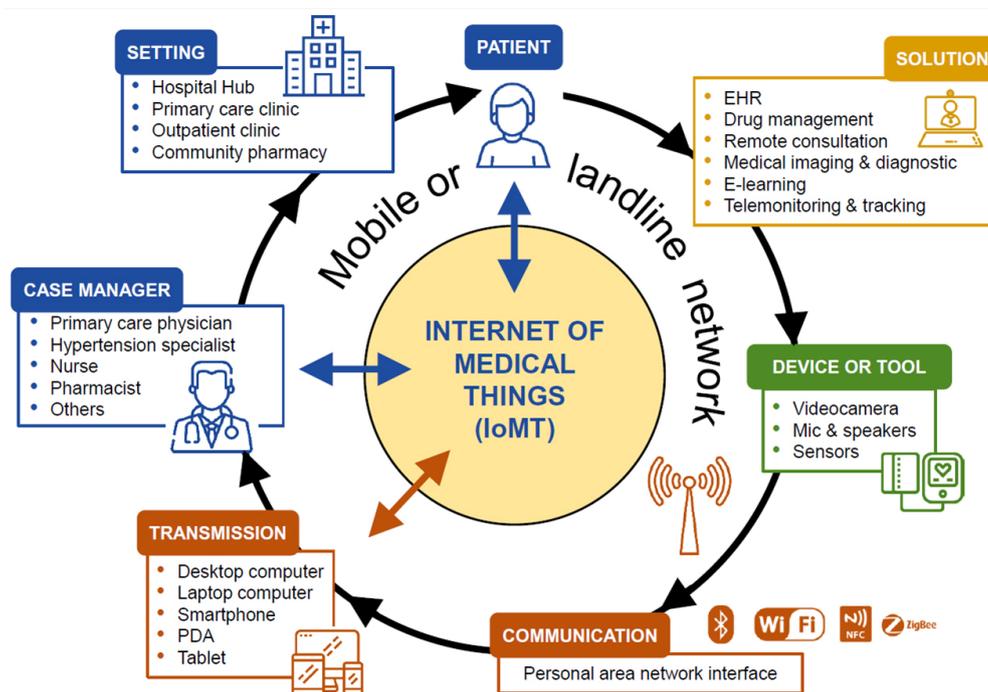
provision model shown in [Figure 1](#) follows a "closed-looped" scheme, also called "Internet-of-Medical-Things" (IoMT), namely a connected infrastructure of health systems and services that are designed to detect issues before they become critical and enable early intervention by caregivers<sup>[2]</sup>.

## TELEMEDICINE DIFFUSION WORLDWIDE

Telemedicine is a promising tool for improving access to care and empowering patients, influencing their attitudes and behaviors, and improving the quality of delivered care and patient's health status. The most popular telemedicine applications are in the field of radiology, cardiology, dermatology, and psychiatry. Patients managed with telemedicine are predominantly diagnosed with cardiovascular diseases such as heart failure or hypertension, and metabolic disease, such as diabetes. Recent estimates indicate that seven million patients are managed annually with telemedicine worldwide. Europe and North America are traditional markets for telemedicine<sup>[5,6]</sup>. In the US, there are currently some 200 telemedicine networks with 3500 service sites. More than 50% of all US Hospitals have adopted some form of connected health for remote patient monitoring. Approximately 80% of European countries have telemedicine services implemented. Diagnosis is the main reason for resorting to telemedicine applications, followed by emergency care (so-called "telecare") and vital sign monitoring. Asia, in particular China, and Oceania are emergent markets for telemedicine, especially following COVID-19<sup>[6]</sup>. Although televisit and teleconsultation are the most popular telemedicine solutions, home-based telemonitoring is the fastest-growing telemedicine application, particularly in the context of a global pandemic.

## A TECHNOLOGICAL CHALLENGE THAT CAN TURN INTO A POTENTIAL GAME CHANGER FOR THE HEALTHCARE SYSTEM

During the recent COVID-19 pandemic caused by SARS-CoV-2, digital health, particularly telemedicine, has thrived and resulted worldwide as an indispensable resource to improve patients' management, not only of those infected by the new coronavirus but mostly of patients with chronic illnesses, isolated at home<sup>[7-9]</sup>. In this sense, a major benefit of e-health is the ability to enable "whole-person" comprehensive care



**Figure 1.** Diagram of most common telemedicine services and their workflow. EHR: Electronic health record; NFC: near field communication; PDA: personal digital assistant; IoMT: Internet of Medical Things. This figure is used with permission from Omboni<sup>[2]</sup>.

according to a personalized patient-centered model of care. According to this model, health information technologies are used to create multidisciplinary networks involving various healthcare professionals (e.g., physician, nurse, and pharmacist) to make the communication among the care team and the patient more efficient, personalizing the care and favorably impacting on patient's health.

Many studies published in the last two decades have shown a high acceptance of digital health technologies and services by both patients and physicians. Approaches based on e-health solutions are particularly suitable for preventing cardiovascular diseases and managing chronic conditions. Other applications include the early diagnosis of dermatological or pneumological diseases. As shown in Table 2, evidence exists of high effectiveness for managing patients with hypertension<sup>[10-13]</sup>, heart failure<sup>[12-15]</sup>, acute myocardial infarction and coronary artery disease<sup>[16,17]</sup>, stroke<sup>[18]</sup>, chronic kidney disease<sup>[19]</sup>, diabetes<sup>[12,13,15,20]</sup>, chronic lung disease<sup>[12,13,15]</sup>, cancer<sup>[15]</sup>, and mental illness<sup>[21]</sup>.

Unfortunately, integrating e-health and telemedicine into the clinical practice is not without challenges due to several technical, infrastructural, economical, regulatory, and cultural barriers, as summarized in Table 3.

### A NEW JOURNAL: CONNECTED HEALTH

Due to their unequivocal benefit for improving medical care, more and more e-health solutions have been developed and tested in feasibility and clinical studies in recent years. A search of the literature (Medline) for the last three decades based on terms such as "digital health", "digital medicine", "digital care", "eHealth", "mhealth", "telemedicine", "telehealth", and "telecare" returned 115,169 publications. A progressive marked increment in the number of publications has been observed over the years [Figure 2].

Current statistics from SJR Scimago Journal & Country Rank indicate 83 ranked journals focusing on digital health or bioinformatics<sup>[22]</sup>. The majority of journals have been established in the last two decades [Figure 2]. Only four of these journals have discontinued publications between 2016 and 2018.

**Table 2. Evidence of clinical benefit of e-health and telehealth interventions in various chronic conditions according to main meta-analyses and systematic reviews of randomized controlled studies**

Condition	Main clinical benefit	Level of benefit
Diabetes <sup>[12,13,15,20]</sup>	Improved glycemic control in type 2, but not type 1 patients	+++
Heart failure <sup>[12-15]</sup>	Reduced mortality and hospital admissions	+++
Chronic lung disease (e.g., asthma and chronic obstructive pulmonary disease) <sup>[12,13,15]</sup>	Improvement in lung function, reduction in the symptoms associated with the illness, and improvement in perceived quality of life	++
Arterial hypertension <sup>[10-13]</sup>	Improvement in blood pressure control	++
Overweight or obesity <sup>[13]</sup>	Reduction in body weight	++
Stroke <sup>[18]</sup>	Significant improvement in recovery from motor deficits, higher cortical dysfunction, and depression	++
Chronic kidney disease <sup>[19]</sup>	Improvement in the management of dietary sodium intake and fluid management	+
Acute myocardial infarction <sup>[16]</sup>	Reduced in-hospital mortality	+/-
Secondary prevention for patients with coronary artery disease <sup>[17]</sup>	Improvement in modifiable cardiovascular risk factors	+/-
Cancer <sup>[15]</sup>	Improvement in quality of life	+/-
Mental illness <sup>[21]</sup>	Improvement in adherence to drug treatment	+

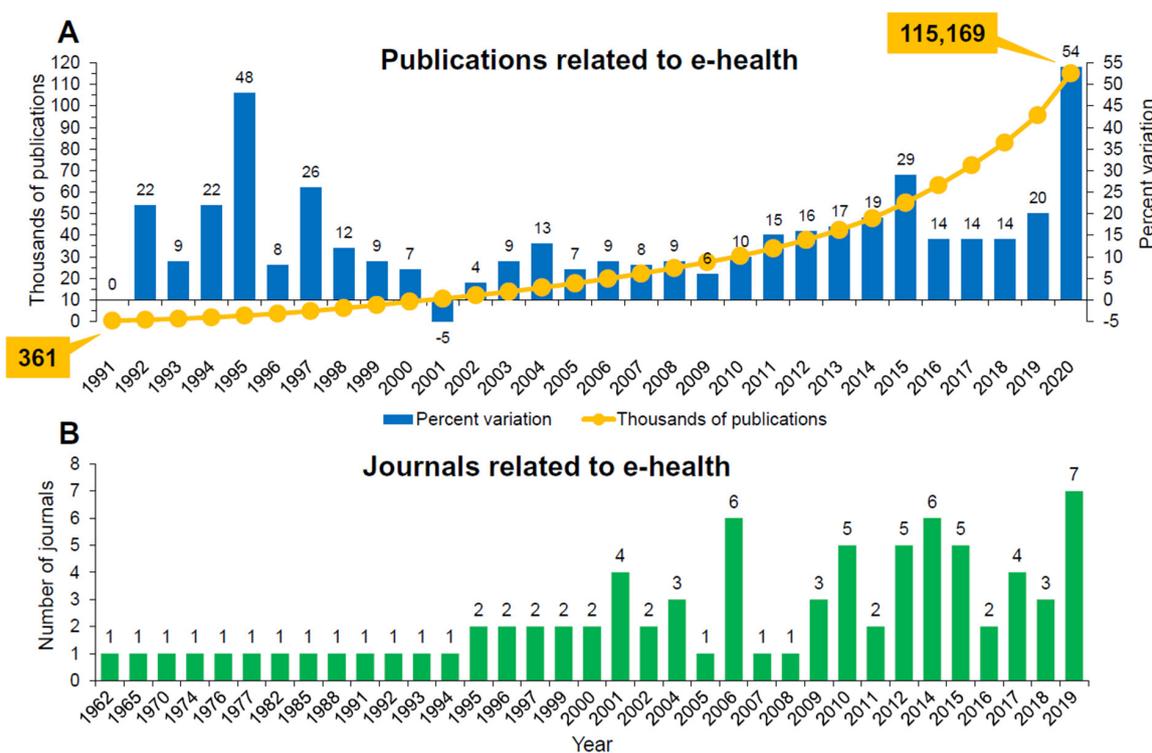
**Table 3. Benefits and barriers to implementation of proper e-health and telehealth interventions**

Benefits	Barriers
Improved health outcomes	Long-term efficacy not proven
Increased access to care	Interoperability
Management of distant patients	Usability
Accelerated delivery of care	Infrastructural barriers
Increased number of patients served	Lack of reimbursement
Time-saving	Regulatory and privacy issues
Cost efficiency	Lack of validation and certification
Interprofessional cooperation	Digital divide
Patient's empowerment	Physicians' inertia

Given this picture, do we need another journal publishing articles related to digital health? Surely, we need a virtual place where computer scientists, bioengineers, physicians, and various healthcare professionals, including pharmacists and nurses, can share and discuss their research results in a pragmatic way, focusing on their discoveries' practical applications. We need a multidisciplinary "agora" where topical experts can exchange ideas and opinions and present innovative digital health solutions that can help boost the integration of e-health services and telemedicine in the armamentarium of healthcare services available to healthcare professionals and patients in the clinical practice.

In this light, the scope of the new journal "Connected Health" is to gather high-quality original research or review papers presenting the available evidence on new digital health technologies, their clinical usefulness, and applications for managing acute and chronic patients. The journal is divided into different sections dedicated to the various aspects of digital health applications for disease management. Notably, the following topics are relevant:

- Innovations in technologies and diagnostics: Technical papers related to m-health, e-health, and telehealth applications, wearable sensors, artificial intelligence, machine learning, blockchain, robotic care (telesurgery), smart home, virtual reality, *etc.*
- Clinical aspects: Feasibility and usability studies, efficacy studies (including the long-term effect on major health status indices, quality of life, performance status, medication adherence, *etc.*).
- Economic studies: Cost-effectiveness of digital solutions.
- Policy: Regulatory issues, health policies, ethics, privacy, and legal issues.
- Personalized and precision medicine: How digital health can provide "whole-person" individualized management of patients, moving disease management to a personalized patient-centered model of care.
- Telepharmacy: Medication dispensation, pharmacovigilance, monitoring of medication adherence and patients' health status, and acting as point-of-care under the supervision of physicians.



**Figure 2.** The number of papers related to e-health published in the last 30 years. The line refers to the cumulative number of publications, while the bars correspond to the percent variation in the number of publications from year to year (A). The number of journals related to e-health according to their year of foundation (B).

## CONCLUSION

Digital health and telemedicine are great challenges for any healthcare system worldwide. The current COVID-19 pandemic has finally made stakeholders and politicians aware that remote managing of infected people and patients with chronic conditions may increase access to care and its effectiveness, and it is time- and cost-saving. It also lowers the amount of strain on healthcare workers, who are striving to manage patients in hospitals and emergency rooms. As claimed in the Editorial title, the new journal *Connected Health* is coming in the right place (the Internet, where digital health is mostly deployed) and at the right time (when the coronavirus outbreak has demanded digital health solutions to improve patients' management and outcomes).

## DECLARATIONS

### Authors' contributions

The author contributed solely to the article.

### Availability of data and materials

Not applicable.

### Financial support and sponsorship

None.

### Conflicts of interest

The author is a scientific consultant of Biotechmed Ltd, a provider of telemedicine services.

### Ethical approval and consent to participate

Not applicable.

## Consent for publication

Not applicable.

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