Novos Paradigmas na Saúde Digital e a Medicina Interna do Futuro

New Paradigms in Digital Health and the Internal Medicine of the Future

Juliana Sá[1,2], **Henrique Martins**[2,3]

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Introduction

Digital evolution is a process in continuous development that provides several benefits and can address a number of challenges currently faced by health systems in general. It is common to project, invariably into the future, the trends and factual evidence that are already present today. This exercise allows us to anticipate attitudes and motivations in the face of a future "reality", which can trigger awareness and a proposal for preparatory action. It is in this spirit that this article should be read.

In the field of digitalization in health, we can certainly say that the future is now. The scope of digital evolution goes beyond the tangible perspective of technological innovation; it is a social evolution, with a change in expectations and work processes in healthcare, both on the part of professionals and the general population. New challenges will come, and have already come, to health professionals, to a greater or lesser extent, depending on the influence of digitalization on their work.

The World Health Organization defines digital health as "the field of knowledge and practice associated with the development and use of digital technologies to improve health".[1] In its digital health strategy 2020-2025, it advocates that digital health should be an integral part of health priorities and benefit people in an ethical, safe, reliable, equitable and sustainable way. Digital health interventions refer to the use of digital technology and connected devices to improve health outcomes and healthcare delivery. This includes telehealth, electronic health records, implantable devices, mobile applications and other forms of digital health technology.

[1]Serviço de Medicina Interna, Centro Hospitalar Universitário de Santo António, Porto, Portugal
[2]Faculdade de Ciências da Saúde, Universidade da Beira Interior, Covilhã, Portugal
[3]Iscte-Sintra, Iscte-IUL, Lisboa, Portugal

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Digital-based Health Systems

A digitally-based health system is a system focused on prevention, paperless, which promotes personalized medicine and where problems can be identified in order to improve and correct them. This system must strengthen the ability of individuals to manage their own health through the support of digital systems, leaving the physical provision of care in the background. This requires a transformation of processes, professionals and users: to invest in redesigning physical interaction, recognizing that telehealth is the "new health". These transformations demand the creation of a basis of trust with society founded on data security, privacy and the interoperability of systems.[2] The healthcare professionals of the future will have a robotic, hybrid approach - a fact that is already happening today in certain surgical practices that are partially dependent on the use of robots.[3] The healthcare system should be mostly preventive, paperless, empowering, personalized and responsible. The strengths of digital healthcare lie not in the technology itself, but in the fact that digital technology is present in processes, in professionals and in people, so that everyone can be a creator of healthcare. In this context, the digital health system can be an expert in prevention, providing care based on the latest scientific evidence. It should have the capacity to switch to any form of necessary physical care, drug therapy, surgery, hospitalization or last-resort vital function support, while maintaining regular monitoring of digital therapy.

Digital Therapeutics

The concept of Digital Therapeutics[4] is a sub-domain of digital health that includes a new category of therapies - a name that is preferable to the term "therapeutics", which has an overly pharmaceutical connotation, while the term therapy is broader and can encompass cognitive therapy, psycho-therapy, among others. Digital Therapeutics (DT) are evidence-based interventions, designed and delivered using software, which are shown to be capable of preventing, managing or even treating a disease. Some DTs can even replace or complement the use of chemical drugs, which until now have been the "gold standard" (Table 1). It is a booming area with plenty of scope for definition.[5] Digital Therapeutics is a new subdomain of digital health and a new category of therapy that will play an important role in medical practice. It offers interventions that normally only trained professionals know how to do, or helps patients to adhere to

Table 1: Classes of Digital Therapeutics (DT) and relationship with diseases and medication use.

Class of DT	Description	Examples
Treat a disease	This class includes situations where DT is used to treat a disease and can even replace the use of medication	In randomized clinical trials, users of Daybreak and Vorvida[6,7] cut alcohol use by half and, in a single-arm study, half of Clickotine users showed 7 days of abstinence from smoking tobacco.[8]
Prevent and control a disease	This includes situations where DT serves to prevent the onset of a disease or supports its effective control to the point of avoiding the use of medication.	Neurotrack's virtual cognitive health program[9,10] showed improvements in cognitive function, depression and anxiety in elderly patients with subjective cognitive impairment. Participation in Omada Health's program[11] suggests a reduction in the incidence of diabetes by 30% to 33% and stroke by 11% to 16% over 5 years, and an ROI break-even point of 3 years.
Optimize medication	This class includes situations where DT is used in association with traditional medication for a specific disease, but allows the medication to be reduced in terms of dose or frequency of use.	A randomized study found that Kaia, a software program that digitizes and provides multimodal rehabilitation-based back health tools, was more effective in treating low back pain than traditional physiotherapy and education.[12] Better Therapeutics, a 12-week prescription cognitive-behavioural therapy program, caused participants with an average HbA1c of more than 6.5 percent to reduce it by 0.8%.[13]
Add value/ complement medication	This includes situations where the use of a DT solution improves the results of the same medication, i.e., maximizes the therapeutic effects of traditional medication.	The addition of reSET-O to the usual treatment resulted in increased treatment retention rates (82% vs 68%) and a more than twofold increase in the abstinence rate (40% vs 18%).[14] Users who completed the KAIA-COPD program[15] reduced their scores on COPD assessment tests (average of 2.5 units). In a meta-analysis[16] of twelve randomized clinical trials specific to Deprexis, the efficacy of Deprexis, an integrative and personalized digital CBT intervention, was confirmed for reducing depression post-intervention.[17]

the prescribed treatment, whether pharmacological or not. If there are limitations to existing conventional methods of pharmacotherapy, or when rehabilitation is required, or if there is an unmet need for medical treatment, Digital Therapeutics can be an efficient tool for the pharmaceutical industry and professionals.

Human-Digital Relationship

People with a particular health condition are often the main drivers behind the use of technology. In some cases, they themselves set up their own companies and technological applications to manage their problems.[18] There is now a wide range of pathologies for which technological solutions have been developed for monitoring and follow-up, such as devices and werables.[19] Positive experiences on managing people with chronical diseases such as chronic obstructive pulmonary disease,[20] heart failure[21] and diabetes mellitus[22] have been described.

The integration of the digital world is not limited to health, but includes all aspects of people's daily lives, from access to digital portals to the integration of equipment into their own bodies.[9] Technology has been getting closer and closer to humans (and to healthcare) as connectivity with the digital increases and so does the intrusiveness on the human being. Digital technologies such as portals, or APPs (e.g. PEM mobile) are not very intrusive when compared to "implantables" - implantable medical devices - where it goes so far as to be integrated into the physical body. Digital technology will continue on its intrusive path to virtual reality, which is now often associated with the theme of the metaverse. The concept of the metaverse, originally introduced by Neal Stephenson in his science-fiction book "Snow Crash" in 1992, is a networked 3D parallel reality that can be accessed through digital technologies such as glasses or audiovisual equipment. The metaverse can be classified into four types: augmented reality, lifelogging, mirror world and virtual reality. The metaverse allows for an immersive experience with the combination of different approaches and a continuum of physical-digital interaction.[23] MRT, "metaverse related technologies", include already established digital technologies, and some with evidence of usefulness in medicine, such as virtual reality (VR) and augmented reality (AR).[24]

The combination of these technologies offers the opportunity to visualize images and map objectives in image-guided procedures. The concept of the metaverse is increasingly being used in the personalization of "avatars" that represent the physical, mental and emotional characteristics of patients in the virtual world and that allow healthcare to be transformed into personalized care, improving the understanding of pathologies and their treatment.[25] In addition, these technologies have been widely used for teaching healthcare professionals in various fields,[26] studying and modelling the human body (for example, through 3D reconstruction for the simulation of therapeutic approaches). The use of these technologies has been reported experimentally in the treatment of diseases such as chronic pain using a combination of pharmacological and non-pharmacological

treatment, with positive effects demonstrated by functional magnetic resonance imaging.[27] Other studies have shown positive effects in the surgical treatment of cancer and in physical and cognitive rehabilitation.[28] There are also studies reporting the use of these technologies in the diagnosis and cognitive training of people with dementia.[29]

Particularly in Internal Medicine training, the use of VR and AR can be used in the practical training of procedures, guaranteeing training opportunities in safe conditions and with the advantage that technological developments allow for the creation of progressively more realistic conditions. This training can be part of an initial training plan or a periodic training process for procedures that are carried out less frequently. The emergence of the concept of the metaverse in health (meta-medicine) is built on four steps: holographic construction, holographic simulation, the fusion of virtual and real reality and the link between real and virtual reality.

Three characteristics distinguish meta-medicine: the interaction of all things - doctors and patients have access to real data incorporated into a digital environment in real time; virtual and real integration; and decentralization - through blockchain technology guaranteeing certification, authentication of digital medical information. Through this technology, doctor and patient have their own digital identities, what is known as digital twins.

Artificial Intelligence

The expansion of artificial intelligence, as we can see from the growth of ChatGPT or BARD, makes us rethink what thinking is, and in health, what clinical reasoning is. Artificial intelligence began with the aim of studying natural intelligence and as a branch of engineering. In 1950, Alain Turing discussed three strategies that could lead to the creation of a thinking machine.[30] Artificial intelligence systems are capable of acquiring, storing and manipulating knowledge in a given context. This technology is changing the context of medicine, firstly the issue of personalized medicine, also called "black box medicine" because there is no complete understanding of how systems make decisions.[31]

Thinking back over the last few centuries, and the amount of health data available, it's possible to imagine a trajectory from medicine as mysticism and a healer's approach, then through an era of scientific medicine based on identifying one or more diagnoses, followed almost automatically by action governed by science published in scientific articles and clinical guidelines. This is followed by the advent of personalized medicine based on genomics, proteomics, metabolomics and various other sciences, but where it is still possible to break down all the variables that lead to an indication of precision.[32]

In the field of Internal Medicine, digitalization offers many opportunities for reducing errors, improving health outcomes, tracking health data, etc. Technologies such as AI play an essential role in various areas related to improving clinical systems, providing health information to the population and treating various diseases. Recent evidence from the literature suggests that AI will play a role in establishing diagnoses; however, its challenges and limitations must be carefully considered.[33] Algorithms combining neuroimaging techniques have been reported to predict the diagnosis of Alzheimer's disease.[34]

An example of this application is the use of algorithms that integrate biological data, lifestyle habits and environmental data to predict the onset of chronic diseases in a given population, such as diabetes mellitus35 or coronary heart disease.[36]

The Digital Doctor and the Role of Internal Medicine

Nowadays, doctors are imminently digital, as they already need technological support to carry out their work. However, the implementation of digital health is not without its challenges and a fan of social and technical concerns. Difficulties related to the acceptance of technology associated with the absence or insufficiency of regulation, the development of digital solutions for the collection, storage and analysis of data, posing questions related to privacy, data protection and consent, the speed of technological development raising uncertainties related to the security of systems; the (ethical) dilemmas posed by the use of artificial intelligence; genomic information and its potential for use for good or ill. The question of the reliability of digital clinical systems is a crucial issue for the uptake and use of these systems. Despite the growth in the supply of digital solutions, there is a need to ensure the development of a fair, redistributive and balanced health data economy. On the other hand, digital sovereignty structures, which relate to the ability to ensure that data is collected and stored in a proportionate, logical and secure manner, are a not very mature topic, but one that deserves and will require further reflection and maturation. Finally, the sustainability of systems architecture, ensuring that there are concepts and rules that define the structure and semantic behaviour of systems and how they articulate and communicate.

Technological developments will not solve all the problems. Although digital technology can be an aid to clinical reasoning, it does not replace it, it does not replace the human factor, the therapeutic and emotional effect of the doctor-patient relationship, but it is transforming care and even the professional identity of doctors. Recognizing this transformative role is essential if clinicians are to be part of digital innovation as co-creators, if they are to contribute to innovation and let it contribute to improving healthcare. Medicine will continue to be the most human of all sciences, but digital evolution can be essential in building the space and time for this to happen. In this context, Internal Medicine, as the integrationist specialty par excellence, and those who practice it, in the clinic

and beyond, have the role of knowing how to wisely integrate digital, medicine and digital health. How? Starting by learning more, getting involved and creating structures (for example, a Digital Health working group at the SPMI) that are conducive to civic and scientific participation, both individually and in groups with organizational and national dynamics, with the authorities and bodies responsible for this process. ■

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JS – Conceção e revisão do artigo
HM – Conceção do artigo e revisão final
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Correspondence / Correspondência:

Juliana Sá - julianampsa@gmail.com
Serviço de Medicina Interna, Centro Hospitalar e Universitário de Santo António, Porto, Portugal
Largo Prof. Abel Salazar, 4099-001 Porto

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