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The Future Impact of Healthcare Services Digitalization on Health Workforce: The Increasing Role of Medical Informatics

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Abstract. The digital revolution is gradually transforming our society. What about the effects of digitalization and Internet of Things in healthcare? Among researchers two ideas are dominating, opposing each other. These arguments will be explored and analyzed. A mix-method approach combining literature review with the results from a focus group on eHealth impact on employment is used. Several experts from the WHO and from Health Professional Associations contributed for this analysis. Depending on the type of service it will entail reductions or more need of healthcare workers, yet whatever the scenario medical informatics will play an increasing role.

Keywords. eHealth, Health services digitization, human resources for health, Internet of Things, Medical informatics

1. Introduction

The digital revolution is gradually transforming our society. Technology is becoming very cheap, making it pervasive to people and enterprises, and enabling it to reach more markets at a lower cost of production. However, it also seems leading to a disproportion between the appealing launch of innovative services and measures of its economic impact [1]. It also appears to be threatening employment, alike previous technology revo-lutions (e.g. industrial and electrical) [2]. There are many examples, from Call centers that are competitively substituting the sales force, eBanking that is removing banks from the high street; Airbnb and Tripadviser changed the travel agencies business for good. Likewise, Internet of Things (IoT) is a new paradigm, which is bridging the gap between the physical world and its representation within the digital world [3]. In healthcare, IoT is about integration of the "things" that form the life of people into software applications, leveraging benefits from the information continuity. IoT technology is a recent component of Information and Communication Technologies (ICT), looking into the potential of combining wireless sensor networks, beacons, radio-frequency identification (RFID), data processing, security, etc in healthcare services. What will be the expected effects of digitalization in healthcare? Among researchers two ideas are dominating, opposing each other. From one side, extrapolating from recent data, the skeptical picture about the payoff of new healthcare technologies, and the need to deal with healthcare reorganization due to low level of

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economic growth and increasing demand for services [4]. A recent paper has shown the potential impact on unemployment from change in healthcare services, with both positive and negative outcomes [5]. On the other, skeptical about this data, are ones more convinced of the promise of innovation in healthcare, believing that the economic gains from the eHealth revolution are still to come [6]. The Internet and related digital technologies have produced a significant growth of information in healthcare. Emerging evidence provides support for some beneficial effects of interactive eHealth systems, although many challenges still remain with respect to understand approaches to methodology, implementation, and evaluation [7-8]. Chronic diseases are the main cause of mortality throughout Europe, with prevalence and impact on the cost of care that is threatening the sustainability of health systems and pushing to significant reorganization efforts [9-10]. Healthcare reorganization is being address by dif-ferent approaches: from reorganizing processes and skill-mix, staff education and training; appropriate pay and reward systems; to designing new eHealth services and IoT [11]. eHealth services are expected, as in the banking business, to be an effective way to allow a change in the organization of services [12]. However, there is a large gap between the promises and evidence with demonstrated benefits [13]. This means that there are still a lot to learn and study on how to overcome the barriers that limit this process. Once eHealth services are fully developed and Ambient Assisted Living/IoT solutions are spread around what would be the actual impact on the healthcare workforce? This study aims at addressing the potential effects of digitalization of healthcare services on the reorganization of healthcare and on healthcare workforce.

2. Methods

A mix-method approach combining literature review with the results from a focus group on eHealth impact on employment is used. Several experts from the WHO Collaborating Center for Health Workforce Policy and Planning, from the Ministry of Health and from Health Professional Associations contributed for this analysis.

We combined the usual understanding of eHealth services [13-14] with Brynjolfsson and McAfee [2] perspective was took as reference framework, as they argument about the future draws from an analogy to the industrial revolution suggesting that the digital revolution will be comparable in its effects on the long-run, and eventually creating significant unemployment in the short-mean time.

3. Results

Firstly, the main eHealth services topics were reviewed and the outcomes from Brynjolfsson and McAfee were analyzed [2]. This review supported and guided the focus group discussion. Clearly, among all the participants, the digitalization revolution was related with the advent of steam power and electrification as the three are example of general-purpose technologies, i.e., technologies with broad application across an economy. Adding to this perception, there is belief that the Moore's law will keep somehow driving innovation, whereas the doubling of computing power roughly every eighteen months enables the significant decline in the cost of computational power. This allows for sustainable improvements and reductions in costs of eHealth technologies. As a result, healthcare organizations are likely to find even wider use than previously expected for sensors and medical devices, open up the services to new

categories of workers, moreover related with medical informatics. A different prospect emerged from the potential of IoT, allowing devices to interact with each other and respond to new conditions without direct human intervention. Considering the scenario where there is the digitization of all processes in healthcare it would produce a stream of data making possible a ubiquitous IoT and eventually providing the necessary information for continuing improvement in the healthcare processes. It is accepted that business investment in ICT is correlated with productivity gains [1]. Therefore, it implies that healthcare organizations should have a strategic median-term perspective, moreover regarding human resources (HR). The focus group participants were aware that basic routine changes in health organizations are not easy, they take time. It was mentioned that the multi-professional setting are often significant barriers for health services changes. It was identified several valuable approaches to address these barriers, from introducing skill-mix improvements to designing a new eHealth service, considering new business models [11, 15]. Most participants were not sure about short-term implications regarding HR in healthcare.

3.1. Digitization Impact on Health Workforce

In a second stage of the focus group, a list of eHealth services [12-13] was identified and validated. It was accepted a characterization of eHealth services divided into three main categories: "store-and-forward" (knowledge-based services not requiring real-time interaction), "remote monitoring" (monitoring vital and physiologic signs at a distant) and real-time "interactive services" (real-time knowledge-based services). The participants discussed each of the services and evaluated them in three aspects (Table 1): the professionals that should be involved in each service; the special skills required to practice in the context of eHealth; and the impact for the workforce, in terms of the significant reduction (-) or growth (+) of health professionals' number.

Table 1. List of eHealth services and impact on health workforce.

eHealth Service	Health Professionals participating	Special skills Required	Healthcare Workforce
Store-and-forward			Impact (+++,---)
Tele-radiology	2 Physicians* radiologists, 1 administrative	No	-
Tele-diagnosis (ECG, EEG, MAPA, etc.)	Technician, Nurse, Physician	No	- -
Healthcare eLearning	Technician, Nurse, Physician	Yes (Pedagogy)	-
Expert (& 2nd opinion) offline consulting	2 physicians, 2 nurses or 2 technicians	Yes (communication)	+
Remote monitoring			
AAL - Ambient Assisted Living (e.g. sensors)	Technician or nurse	Yes (Several)	+ +
Telenursing (monitoring)	Nurse	Yes (communication)	+
Telepharmacy (monitoring drug intake and interactions)	Pharmacist	Pharmacist (Communication & pharmaceutical care)	+
IoT	Administratives, Nurses, Physicians	No	+
Interactive eHealth			
TeleTriage	Nurse and physician	Yes (communication)	-
Real-time Consultation between health professionals	2 physicians, 2 nurses or 2 technicians	No	-
Specialist Consultations (Tele-cardiology, Tele-dermatology, Tele-ophthalmology)	1 or 2 physicians	Yes (communication)	-

Tele-Trauma	1 or 2 physicians	Yes (equipment)	-
Remote therapy	Technician	Yes (equipment)	+
Robotic Surgery	2 physicians	Yes (equipment)	+
Emergency telemedicine	Nurse, physician	Yes (Emergency)	+
Tele-hemodialysis	Physician	No	- -

4. Discussion

All participants agreed that proper eHealth services implementation would require adjustments in the organization and on the workforce. Depending on the type of service it will imply reductions or additional need of professionals. More importantly, as it was mentioned by three participants, most organizations are not aware and are not prepared to tackle this challenge. In fact most situations regarding eHealth are research-based [14].

It was clear for all that a "store-and-forward" service involves typically the acquisition of clinical data (i.e. biosignals, medical images, etc.) and the transmission of this data to a health professional at a convenient time for proper assessment (offline). A broader use of this type of services (teleradiology, telediagnosis, eLearning, expert con-sulting, etc.) could significantly optimize the access and use of diagnostic technologies to an extent that it could eventually reduce (e.g. with automatic systems) significantly the number of professional working on those services (comparing to todays' numbers).

However, the "remote monitoring" that enables health professionals to monitor a pa-tient remotely using various technological devices (i.e., from AAL, telenursing, telephar-macy, etc.) is basically opening a new channel of services. These services were inexistent several years ago, but with the ageing of the population and the increasing in chronic patients this sort of services will grow and it will require more professionals to respond to the demand. Moreover, new sort of professionals, from specific medical informatics, health data analysts, AAL maintenance technicians to nurse specialists will emerge.

"Interactive eHealth" services provide real-time interactions between patient and provider (e.g. healthcare professional or a call center). These services could include (mobile) phone or skype conversations, online communication and even home visits, according to specific clinical protocols. There are sure differences between teletriage, specialist consultations, teletrauma, remote therapy, robotic surgery. For instance, participants considered that teletriage, emergency telemedicine, tele-hemodialysis and teleconsultations would help optimizing the today's use of human resources, therefore reducing the need for more professionals (in specific contexts). But remote therapy and robotic surgery are enlarging a market and the opportunity to reach more distant patients (and health units), and therefore will create a new demand for more health professionals.

Overall, it is still not clear what would be the impact on heath workforce. There are areas that the eHealth services will enable to optimize HR whereas other areas that will demand more professionals, probably even promoting the emergence of new professions. Technological change allegedly eliminates routine labor, whether physical or cognitive, and it increases demand for non-routine work typically requiring more education [6]. Nevertheless, the impacts of digitization are much more profound and raise many questions that are open to further research: what other new professions are needed (e.g. the "Nursing data manager" more focused on information management) and what changes on the general health professions will digitization will force? What

new organizations and business models are necessary to address the healthcare demand? Will physicians will be using more sophisticated decision support systems and would this use reduce, or increase, the number of health professionals required to respond to the demand? All this questions imply more resources to specific evidence-based answers in order to properly respond to global health workforce challenges ahead [15]. Still, it seems health services will be using more clinical informatics, data analysts and IT managers [16].

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