Digital Transformation in Healthcare: Challenges, Opportunities in a Socio-Technical Perspectives

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Abstract. *Nowadays healthcare is fully-fledged transformed from a basic service into an information industry, but as such it is still complex and inefficient. ICTs have been proposed to address healthcare challenges with initiatives collectively referred as "e-health". However, the new models of care e-health enables require organizations to make a major shift from traditional practice, which is often fraught with difficulties. We propose a meta-review over the organizational impacts of e-health and argued for sociotechnical approach (STA) to discuss the e-health dimensions, namely the technical and social subsystems and their interaction. The aim is to focus over the "organizational changing" e-health allows, in an attempt to standardize some elements of the e-health research. We also recorded the medical settings mainly involved. We contributed to the literature giving a basis for further research and supporting STA as a theoretical framework for future interventions. Furthermore, we identified Dentistry as a potential area for further research.*

Keywords: ICTs, healthcare, e-health, sociotechnical systems, sociotechnical approach, literature review, organizational impacts, chronic diseases, triple aim.

1 Introduction

For centuries, healthcare (henceforth HC) has been a basic service provided by many governments to their citizens. Over the last few decades, however, HC has switched from a basic service to an information industry, to the extent that HC is currently the biggest service industry on the globe [Wickramasinghe, 2005].

Several factors has concurred to this result. First, the constantly increasing HC expenses, due to population growth and aging in Europe and worldwide [Sola, 2015], combined with decrease in young population in developed countries [Gokalp, 2018]. It is not accident, in fact, that up to the 80% of these expenses can be attributed to the care of patients suffering from chronic diseases (henceforth CDs) [European Commission, 2014], like diabetes and cardiac failures. Second, the growing expectations from both the public and the private sector, which have increased pressure over the HC managers, researchers, clinicians and other field practitioners [Aceto, 2018]. Lastly, the concurrent wave of advance in science-based medical knowledge [El-Miedany, 2017].

As an information industry, however, HC is still complex and inefficient [Evans, 2000]; accordingly, a need for new solutions that require less human resource has emerged. Successful improvements of the HC system (HCS), in fact, require simultaneous pursuit of three key outcomes, known as "Triple Aim" [Berwick, 2008]: improving the patient experience of care, including quality and satisfaction; improving the health of populations; and reducing the *per capita* costs of HC [Shaw, 2018].

The information and communication technologies (ICTs) and the Internet had been promising to face current HC's challenges. Even though literature refers to these initiatives in different ways, the *buzz-term* "*e-health*" ("electronic health") has become an accepted neologism that directly correlates to health and computing. "E-health" is widely used by many individuals, academic institutions, professional bodies and funding organizations [Oh, 2005].

So far, it is accepted that e-health is fully-fledged a "*paradigm shift*", a cultural transformation of traditional HC rather than a technology-based full digitalization of human activities. Moreover, HC industry is traditionally slow in embracing new business techniques and technologies [Wickramasinghe, 2005] but still little attention has been paid on e-health socio-organizational challenges. Consequently, as the use of ICTs in HC becomes more widespread, the "*technological determinism*" [Venkatraman, 1994] vs "*organizational changing*" perspective becomes more critical [Dunne, 1992]. The importance of the interaction "people + technology" during the new technology adoption is given by the fact that e-health has yet to realize its full potential, despite the health-related technological advances. The trend is further demonstrated by the many critical voices in the literature about the design, adoption and use of e-health, while the majority of early literature related to e-health with positive words only.

In line with this, in our opinion the socio-technical approach (henceforth STA) is a suitable framework to study the impacts of e-health technologies, as the sociotechnical premise is that all technologies are socially situated.

Accordingly, the research question (henceforth RQ) that motivated this paper is: *How do new, or recently introduced, e-health innovations impact on users?*

The remainder of the paper is structured as follows. Paragraphs 1.1 and 1.2 illustrate the evolution of e-health and the applicability of STA, respectively. Section 2 introduces the research methodology. Section 3 summarizes the results. Section 4 discusses the findings through the STA. Section 5 ends the paper with the conclusions of the paper, suggestions for future developments, limitations and implications.

1.1 Major stages in e-health evolution

The history of e-health parallels the evolution of Medical Informatics (MI), which is the intersection of Information Science, Computer Science and Healthcare. MI deals with the resources, devices and methods required to optimize the acquisition, storage, retrieval and use of information in HC and biomedicine. MI pioneered in 1950s as the interest of few, visionary, academics; it took more than two decades later to made HC institutions and industry realizing its concrete potential. Since ~1975, the first specialized MI conferences took place and MI topics started to be included in the research programs of European Union (EU) [Mihalas, 2014]. However, concepts as "*hospital information systems*", "*medical data protection*", "*artificial intelligence*", "*advanced decision support systems*", "*telemedicine", "telehealth"* and "*electronic health record*" (henceforth EHR) still remained mainly confined to the academia and researchers.

The breakthrough happened in the 1990s because of the rapid progress of the ICTs into HC, which let MI research going definitely beyond the academic environment and impacting on politicians [Mihalas, 2014]. MI established itself as independent discipline, with own objects and methods; moreover, the huge trust in MI let it strengthening its role as a worldwide business, which rapidly skyrocketed. EU started financing several projects for MI research and implementation and new information systems (Hospital Information Systems - HIS) and technology (Health Information Technology - HIT, such as EHRs, decision support systems - DSS and e-prescriptions) for daily use in hospital purposes were developed [Mihalas, 2014]. EHRs also increased in complexity and importance. Barely used before 1999 [Eysenbach, 2001], the term "e-health" came into use in the year 2000 and has since become widely prevalent.

The 2000s started thus with a general enthusiastic atmosphere, but it was destined to last short. Even successful e-health projects, in fact, showed a huge discrepancy between expectations and reality and impacted lower than expected [Mihalas, 2014]. On one hand, those results rose several considerations in an unprecedented way; on the other, they helped in getting a clearer understanding of e-health and its potential for the global HC challenges. The importance of quality assessment became evident. In 2010, EU argued that "*implementing e-health strategies has almost everywhere proven to be much more complex and time-consuming than initially anticipated*" [Watson, 2010].

In the last decade, HC model has been constantly moving towards systems distributed around patients, for progressively building the "digital patient" (*e-patient*). From a technological point of view, this has been possible thanks to many HIT paradigms enabled by the Internet enhancement, such as "m-health" (mobile phone use) and "p-health" (use of personal portable devices for health data acquisition). The ICT pillars underpinning these paradigms include wearable, personal and smart devices; wired networks, WSN (wireless sensor networks) and WBAN (wireless body area networks); personal devices and sensing technologies; 3D printing, virtualization techniques, robotics, artificial intelligence; and social media [Aceto, 2018; Mihalas 2014]. Furthermore, these technologies generate an overwhelming amount of unstructured and semi-structured data, which are handled by Cloud Computing and Big Data Analytics. This raises new security and privacy challenges [Ahmed, 2018].

As a trend, each implementation in e-health is made with the best intentions and in response to the perceived changes needed to function in today's HC environment [Lorenzi, 1997]. However, it also appears that in spite of the identification of many "*barriers*" and "*promoters*" [Mair, 2012] and the growing attention on the hidden gaps (cases of e-health failures, systematic analysis of barriers, visible difficulties in HIS implementation) [Mihalas, 2014], the implementers rarely consider an organizational change model with these new paradigms [Lorenzi, 1997]. Consequently, rational recommendations for e-health projects must weigh social behavior a critical enabler; the design and implementation of new e-health systems, in fact, need to follow a specific philosophy dictated by the level of digital maturity of a country and its citizens.

1.1 Theoretical framework

Socio-technical systems' (henceforth STS) theory dates back in the '50s and was developed by the researchers [Trist, 1951] at the Tavistock Institute in London. Its initial mission was to weave together social and psychological sciences in order to rehabilitate World War II soldiers [Ghaffarian, 2011]. The researchers at Tavistock suspected that the same techniques used for the soldiers would be applicable to the work of lower rank employees, who spent most of their time on routine and simple tasks without any clear prospect for job satisfaction or personal development [Ghaffarian, 2011]. The case study was English coal miners; Trist started by the paradoxical observation that despite miners obtained technologies facilitating their tasks, better pay and amenities, the productivity was falling and absenteeism was increasing. The cause was hypothesized to be the adoption of the new technology, which had brought with it a retrograde step in organizational design terms [Ghaffarian, 2011] and had made their hierarchical and rational organization, flat hierarchical and irrational.

The term "socio-technical" was thus coined to underscore this association. Essentially, the STA [Bostrom, 1977] conceptualizes the organization as a system composed by two interrelated and mutually interacting subsystems - the "social" subsystem (SS) and the "technical" subsystem (TS) - in a given environmental context [Whetton, 2010]. SS includes people (e.g. employees, clients, doctors, nurses, patients) and their knowledge bases, skills, and roles (structure), while TS comprises clients, technology (also digital ones, like hardware, software and databases), techniques and workflow (tasks). According to STA, when a *change* occurs –e.g. during new technological adoption- the system is open and needs continuous adaptation in order to maintain equilibrium between the two subsystems and the environment. Moreover, so as to make the technology adoption effective and to achieve improvements for the whole organization, neither TS nor SS should be privileged over the other. The two subsystems should have a good "fit" - mainly conceptualized as "harmony" or "joint optimization" [Bostrom, 2009] - that should result in not only increased "instrumental" objectives (i.e. productivity, performance) but also better "humanistic" ones (better worker enjoyment, quality of work life) [Sarker, 2011].

Figures 1 and 2 schematize the structure of STS and its traditional conception.

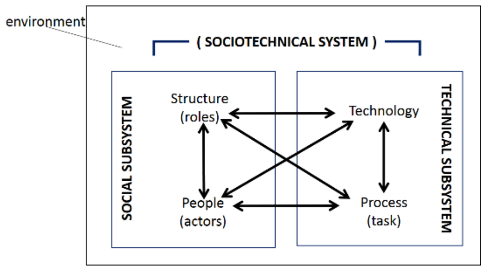

Fig. 1. STS in a given environment, SS and TS, their components and interactions.

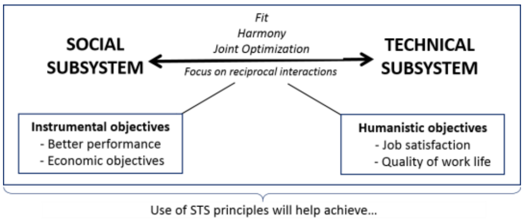

Fig. 2. Traditional conception of the STS model.

STA provides a powerful framework for information systems (hereafter IS) research, given that IS, by definition, is sociotechnical [Briggs, 2010].

2 Methodology

First, in answering the RQ, we performed a meta-review. A meta-review critically appraises and synthesizes findings from reviews, systematic reviews and meta-analyses. A conventional systematic review, instead, resumes findings from individual studies and may or may not incorporate meta-analysis. For clinical practice guidelines, meta-analysis accorded to be the highest level of evidence. However, in areas that have attracted a large amount of research, like the digitalization of health services, it is now common for there to be numerous systematic reviews and meta-analyses. Therefore, there is a need for critical appraisal and synthesis of systematic reviews and meta-analyses, in order to ensure that decision-making is informed by the best-accumulated evidence available. The meta-review -which is an overview of reviews - can be used for this purpose [Higgings, 2013]. We outline that we applied the research protocol by Webster & Watson [Webster, 2002] for systematic literature reviews, as meta-reviews and systematic reviews utilize similar methods [Conway et al, 2013].

Our literature search covered the period 2004-April 1st 2019. We choose 2004 based on that the first international call for definitions of e-health posted in 2001 by Eysenbach ([Eysenbach, 2001], first article of the "*What is e-health?*" series) was really updated in June 2004. The pointed problem, which arose in 2004 from the lack of a definition of e-health, was: how is it possible to communicate about a phenomenon when that phenomenon is not clearly defined? Since then, there has been much discussion, in the light of archiving and retrieving e-health studies; moreover, the ability and flexibility of ICTs to improve usefulness and effectiveness have been recognized by governments worldwide [Mitchell, 2013].

We choose to query over Scopus and Web of Science (WOS), as they are the two major interdisciplinary databases for peer-reviewed literature in social and economic sciences. The keyword strategy aimed at looking for the main words currently used for meaning "*digital transformation of healthcare*". In the exploratory phase, we tried several keywords and their combinations (digital health, healthcare, e-health, telehealth, telemedicine). However, in accordance with the literature [Fatehi, 2012], we found that "e-health" outnumbered the others. It must be appointed that "e-health" is subjected to orthographic fluctuations, e.g. it can be written with or without a hyphen or space between the prefix and the stem (“e-health”, “e health”, “ehealth”). We opted for “e-health” in accordance to the other “*e-terms*” (e.g. e-mail, e-banking, e-commerce, e-book) and to Dinevski [Dinevski, 2010], who reports that although the official European bodies use both “ehealth” and “e-Health”, the wording “e-health” is the generally accepted notation in the professional literature. Fatehi [Fatehi, 2012] also argues that the documents referring to “e-health” will be predominant in the literature by 2022.

Based on these observations, we thus decided that the “e-health” keyword *per se* was enough to track the different sources. Our keyword was searched in the fields “article title, abstract, keyword”. We selected only reviews published in English on journals. We did not impose any country of origin, authors’ names, access type, source title, keywords, affiliation or funding sponsor restrictions.

In addition, we favored a multi-disciplinary research approach that drew from both technical and social disciplines, as each of them potentially contains knowledge and skills that contribute to the RQ. Table 1 summarizes the selected areas.

Lastly, other inclusion criteria for the meta-review include the followings:

- *Population/participants*: users, e.g. administrators, patients and consumers, health professionals and family caregivers, regardless of diagnoses or conditions;
- *Interventions*: we included all the studies describing specific e-health interventions on humans, ICTs for communication in healthcare, Internet/mobile/ubiquitous-based interventions for diagnosis and treatments, and social care. Any medical settings was accepted.
- *Outcomes*: social, organizational & managerial impacts, which include: what people understand about technology and what they do in their daily practices with technology; people’s perceptions of technology as instances of both projections (what is new and becomes possible) and remembrance (what is old and hard to forget); how the interaction with technology influence the organizational structure, culture, policy and workflow process.

Table 1. Selected subject areas/categories for the literature research query for each database.

Scopus	WOS	
Business, management and accounting	Artificial intelligence	Medical informatics
Computer science	Business	Multidisciplinary
Decision sciences	Computer science	Operations research
Dentistry	Computer science information science	Psychology
Economics, econometrics and finance	Computer science interdisciplinary applications	Psychology social
Health professions	Economics	Public administration
Medicine	Health policy services	Public environmental occupational health
Multidisciplinary	Healthcare sciences services	Social issues
Psychology	Information science library interdisciplinary	Social sciences
Social sciences	Management	Social sciences biomedical systems

3 Results

This section summarizes the findings.

Review characteristics. The relevant literature was selected through a rigorous staged search protocol, which is summarized in Table 2.

Table 2. Description of the literature search protocol [Webster, 2002].

Stage	Description	Hits
1	Records identified through databases (WOS/Scopus)	501
2	Duplicate articles	82
3	Records after duplicates removed	419
4	Abstracts selected, based on the inclusion criteria	224
5	Full-text selection	124
6	Backward and forward search	125

The initial search found 501 records over Web of Science and Scopus. After removing the duplicates (N=82), 419 titles remained. Based on the criteria for inclusion, the titles/abstracts were first screened thus to select the potential records. We selected 224 abstracts for potential eligibility, while 195 papers were excluded based on the following: no abstract available (N=18), not a review, meta-analysis, systematic review or no article type specified (N=17), e-health-related but not specific to social, managerial or organizational impacts (N=160). A hard copy of each primary reference was obtained. After careful reading of the full-texts and the backward and forward search, 125 articles were selected and 99 articles were excluded. Reasons for exclusion were not in English (N=3), not a review, meta-analysis or systematic review (N=25), insufficient relevance to research question (N=42), unclear methodology (N=4), no full-text available (N=25). Moreover, as Webster's protocol suggests, we filled a data extraction table to include details of the author, year, country of origin, review type, e-health type, specific intervention, topic/medical setting, outcomes and population. Please note that that as for page limitations, we will not insert the table here but describe the results in words; for the same reason, the full list of included papers will not be inserted in the References but will be available under request.

Selected studies range from 2005 to 2019; papers included were classified as systematic reviews (N=61), narrative reviews (N=35), narrative and systematic reviews (N=2), reviews (N=6), meta-analysis (N=5), systematic reviews and meta-analysis (N=6), meta-reviews (N=3), scoping reviews (N=3), one realist ("conceptual") review, one Cochrane review, one short review, one meta-synthesis. Most of the studies comes from Australia (N=18), Netherlands (N=14), United Kingdom (N=21), U.S.A. (N=33), Italy (N=6), Canada (N=5), France (N=5), India (N=3) and Korea (N=2).

It is interesting to notice that e-health was a term coined out of the realization that "telemedicine" (technologies that delivered medicine at a distance) was too isolated a concept and that any use of technology had to be better integrated with other information technologies and into health systems. However, we found "telemedicine" to be most recurrent reported e-health type in the full-texts (N=34), while "e-health" often was used as a keyword/tag. Other cited e-health interventions include m-health (N=21), Internet/Web-based (N=17) and computer-based interventions (N=2), mixed interventions (N=22), telecare (N=1), telehealth (N=1). Eleven studies did not specify the e-health intervention type they used and three just cited "digital interventions", in particular for e-mental settings. Lastly, specific intervention include apps – both for self-management, the professional apps for education and training and tutoring -, remote consultation (N=), online medical prescription, remote monitoring (N=12) and reporting (N=), virtual reality (N=4), virtual teams (N=1), robotics (N=2), online support (coaching, mailing lists, online communities, online social networks/portals for patients) (N=5), services for patients (EMR/EHR, reminders for patients, appointment booking, automatic feedback), and the wearables (N=5).

Population. Patients are the most cited stakeholders among our findings (N=95), others include HC providers (professionals, physicians, practitioners, decision-makers), researchers, and services (Governments, hospitals).

Outcomes. In general, e-health appears to be positively correlated with better clinical outcomes and efficacy/effectiveness of the medical treatment. This is very true especially for some medical settings that well adapts to digital solutions, like teledermatology [Van Der Heijden, 2010]. This positive clinical outcome, however, seems to be linked to the characteristics of users, like demographics, beliefs and attitudes, skills and knowledge, health and status of current/potential e-health services users. Also, the role (patients vs HC providers) seems to affect the perception of e-health technologies and thus the behavior and the rate acceptance.

We found patients generally to be more enthusiastic about technology than health workers, because it allows them to have greater autonomy in selecting HC options [Morrison, 2012]. However, user's age appears to affect the uptake of, and satisfaction with, e-health services. Older adults, in fact, often lack sufficient e-health literacy to maximize their benefit from these resources [Perazzo, 2017; Wright, 2012]. Similarly, digital approaches are welcome by young doctors and find much more resistance in the "old-style" ones, resulting in a generational gap between emerging technology solutions and their potential customers.

Again, ethnicity [Hughes, 2014], gender, literacy level and culture appear to affect access to, and uptake of, e-health services. Latinos [Lopez, 2016], African American [James, 2017], Native American, rural children [Hage, 2013], and even women are reported as special-needs populations [Alverson, 2008] to whom e-interventions appears to be particularly efficient in improving patient activation and participation to behavior change programs. On the contrary, others report that lower socio-economic groups are less likely to have a computer or opportunities for high-speed, private, home-based Internet access. This socio-demographic digital divide prevents certain individuals from engaging in sufficient e-health interventions and can lead to amplify racial disparities [Hughes, 2014]. Another indicator of uptake of e-health resources are level of motivation and degree of engagement. Lack of motivation is reported to be one of the most common barriers to behavioural therapy [Piotrowicz, 2017] and self-monitoring in CDs [Jalil, 2015]. Jalil also reports that persuasion can help accomplishing motivation and awareness to build better habits for exercise and medication, while Hardiker [Hardiker, 2011] reports EHR is no sufficiently distinct strategy for keeping patients engaged in self-management.

In the framework of e-health and telemedicine applications, HC providers have to meet the needs of the patients with the HCS requirements. Accordingly, some authors [Vegesna, 2017] reviewed the utility of technology, reporting that many doctors see ICTs as a matter of technology; others have investigated technology as a support for depression and anxiety in HC providers who deal with people with long-term [Sin, 2018], degenerative [Bossen, 2015], or cancer patients [Slev, 2016]. Again, Wyatt [Wyatt, 2018] have investigated doctors' active role into the evaluation and improving of apps for patients' use, and Yusif [Yusif, 2017]. Others [Liddy, 2018; McGeady, 2008] reported that online tools can improve the communication with the healthcare providers. Moreover, Vitacca [Vitacca, 2009] although physicians do use technology for personal needs, they are often hesitant in adopting this technological approach as part of practice workflow (e- mail, phone) and perhaps also for possible lack of patients' protection of confidentiality and privacy.

Other main organizational barriers to broadly, daily e-health use for clinicians and healthcare providers include the following: satisfaction rate [Lu, 2012], complexity of implementation [De Grood, 2016], workload increasing [Verbeck, 2011], insufficient technological skills [Pike, 2018], lack of insights and vision, diversity of requirements amongst specialties and coordination problems; diagnostic accuracy [Choi, 2018], perceived reductions in manpower [Nouhi, 2012], poor working conditions, physician–patient discordance in automated diagnosis systems [Ghazi, 2015], need for better administrative support, policy support, standards and interoperability [Mair, 2012] in addition to a reform agenda and supportive strategies [Jalghoum, 2016].

Unexpected findings. Despite our pre-defined RQ, we were also interested in capturing unexpected findings, which literature research enables. First, we found that just one study concentrated over e-technologies in the acute-phase/trauma, in form of home health monitoring intervention [Lewis, 2012]; all the other papers included are about CDs. This is an interesting observation as acute diseases have represented the foundation for the worldwide HCS. The most investigated medical specialties in e-health literature mirror their diffusion and common relevance in the industrialized countries. We found, among the others, Cardiology (11 hits), Psychiatry (23 papers), Immunology (2 hits), Gastroenterology (2 hits), Pneumology (11 hits), Geriatrics (7 hits), Dermatology (2 hits), Gynecology, Obstetrics and Neonatology (6 hits), Oncology (6 hits) and Endocrinology (7 hits). We found Dentistry is under debated (1 hit). In epidemiological terms, this is a surprising finding as dental diseases are reported as the most prevalent CDs worldwide ("silent epidemic", [Benjamin, 2010]). Nevertheless, dental caries and periodontal disease are the two biggest threats to oral health and a costly burden to HC services, which e-health interventions in Dentistry are been demonstrating to be cost-efficient and cost-reducing to connect specialists with rural or underserved populations [Di Cerbo, 2015]. Accordingly, further research in e-Dentistry should be encouraged.

4 Discussion and Future Research

This section discusses the findings through STA lens and explores new directions for future research.

The first set of themes emerged is about the unstandardization of published literature. The reason is most probably twofold: first, the recent ICTs application in healthcare; second, that organizational design studies vary throughout the organizations themselves and are dependent on the workflow and function of the users in that area. Consequently, the ways in which STA can leverage e-health technologies to help achieving the goals of Triple Aim depend on the specific contexts in which digital tools are being adopted into HC services.

A second set of themes we found is about the social dimension. Even though a wide variety of stakeholders are engaged in e-health literature - including patients and their family members, healthcare providers, the industry, universities and even the government -, social dimension is not prominent in the literature. The delivery of HC is mediated by organizational and individual behavior, so using models grounded in sound psychological theories of behavior is helpful in understanding how existing interventions produce their effects and in designing future interventions, including better harnessing of informatics [de Lusignan, 2015].

A quick glance reveals tensions between all of these stakeholders, which have been augmented by the digitalization. However, most of the studies concentrated over the e-health effects on the patients, while studies aimed at healthcare workers or other stakeholders were a minority. This says a lot about the current conception of HC as a service. In fact, while customer experience is key to success in all services, in HC the service being delivered is also intended to achieve the potentially more important goal of improving, sustaining, and sometimes saving human life. We suggest IS researchers to concentrate on this dimension.

A third set regards the relationship with the technology adoption. Digitalization has enabling a gradual change from the historical operating model, which was based on the premise that patients go to doctor's offices, clinics and hospitals to receive health care, and is emphasizing patient's role in their own care. This shift toward a "patient-centered" HC and the "empowerment" of patients in self-care appears to be a winning strategy for e-health implementation and rate acceptance. Digital technologies are increasingly seeing as vital to the understanding, prevention, diagnosis and management of CDs such as diabetes, depression and dementia. E-health also enables the provision of tools for connecting homecare with HC providers and venues.

At present, the most accessible technology worldwide, even to the poor and disenfranchised, is the mobile phone; accordingly, if we want a vehicle for reaching the underserved with health interventions from health, the mobile phone is the technology of choice. Smartphone apps are the most common, cost-effective and cost-efficient method to gather data on a person's health condition within their community and promote self-care. This explains the growing prevalence of m-health interventions compared to other e-health technologies, like wearable monitors and smart-home systems [Chan, 2009], which include few studies and are limited to selected contexts.

Furthermore, our review revealed that no e-health intervention or implementation is possible if the beneficiaries of e-health services do not/are able to/are willing to use those digital health services. In this sense, we outline that most of the literature based the digital technology adoption into one of two scenarios, the "*technology-push*" and the "*technology-pull*".

We found the first as the more recurrent. Technology-push occurs when a manager or other decision-maker pushes a technology in a particular HC environment, often within a pilot project or larger digital programs. We found this perspective is common for studies about rural areas [Hage, 2013], emerging [Scott, 2015] and low-income countries [Tierney, 2010], as for the need for overcoming geographical [Han, 2010] and infrastructural obstacles, as for test new e-health strategies. This is the case, for example, of e-health applications in Australia [Hansen, 2011; Iacono, 2016], Korea [Lee, 2009], South Africa [Ruxwana, 2010], Mali [Bagayoko, 2016], sub-Sahara Africa [Obasola, 2015], Uganda [Kiberu, 2017], Saudi Arabia [Alsulame, 2016], Greenland [Nielsen, 2017], Latin America [Prieto-Egido, 2014], Botswana [Mauco, 2018] and India [Davey, 2013]. We found technology-push scenario makes technology adoption challenging, as the people who will use the service have not yet bought into its value before the decision to procure it is made [Shaw, 2018]. In organizational contexts, well-known consequence of such a scenario is increased digital divide [Rezai-Rad, 2012], decreased hierarchy and chain of command, horizontal setting and the introduction of non-strictly medical staff.

Indeed, our review found that in those studies the social system – composed by the full of patients, doctors, and their values – are not mentioned during the adoption process. Again, many barriers - as distance, cost of equipment, inadequate Internet access, time and limited human resources - and patient-related factors – such as the worry of losing the direct contact with their own doctor, fears, issues about security and protection of their integrity and privacy, practical digital skills, and cognitive limitations due to CD - contribute to the poor quality of e-health interventions. Moreover, most of these are on pilot initiatives, which need to be implemented with sustainable interventions involving all stakeholders on a sub-regional scale [Luna, 2009].

The "technology-pull" scenario occurs instead when a team of people scope out a clear problem they are facing in their service and identify a particular kind of technology that could help to solve their problem. Within this approach, people have generally agreed upon the perceived value of a particular tool for solving a problem they face and are ready to engage in service changes in order to put the technology to use [Shaw, 2018]. In this case, HCS has the major role and responsibility for the correct implementation of technology into clinical practice. We found this represents a barrier for e-health to become standard and systematically penetrating the market, as hospitals are set up on complex practical and administrative organizational levels and politicians may have a lack of understanding of what works and does not work in this area.

In conclusion, the adoption of new technologies in HC by patients and medical professionals depends on individual opinions of factors relating to them. The crossing of barriers will take time; hence, e-health interventions should be understood as both cause and consequences of longer-term processes of change. In other words, digital technology is advancing so quickly and with such broad reach, that the dynamics of organization's evolution and the phenomena digitalization promotes are what should be studied [Bock- shecker, 2018]. Theoretically speaking, this transition may imply to rethink STS as based not over SS-TS "equilibrium" but over "living" and "agile" processes. This can be expressed through the modern interpretation of STS (New Gen STS) [Pasmore, 2019], which are referred as "digital sociotechnical changing" [Petrakaki, 2010]. Accordingly, STA needs to be an ongoing iterative learning process, for continuously re-designing systems within systems in the face of continuous change [Winby, 2018].

5 Conclusions, Limitations and Implications

This publication is the first stage of a larger study. Its main contribution is to shed a light on the complex relationship between e-health technologies and their social part in the new digital HC environment, and their possible misalignment. We proposed a meta-review over the organizational impacts of e-health and the main HCS goals e-health enables (safety, effectiveness, patient-centeredness and timeliness) as a function of level of user (patients, physicians, caregivers, micro- and macro-system of care). We also argued for reading these aspects within the sociotechnical lens, both in order to focus over the "organizational changing" and in an attempt to standardize some elements of the e-health research. We punctuated the reasons for this lack of standardization and stressed the differences between the main stakeholders. We also set a background for the e-health applications in CDs management and suggested expanding e-health research to the case study of Dentistry, as dental diseases are the most prevalent CDs worldwide but are still underrated in managerial literature.

Of course, there are some limitations. First, we had not attempted to discuss all the aspects of e-health in-depths, as the subject is extensive and deals with a variety of topics, both technically and in policy terms. This implies that it would be no correct to state that our research is exhaustive. It is plausible that the single keyword strategy and the two selected databases have limited the literature search and thus our findings. Accordingly, we resolve to extend future research to further databases (such as EBSCO, JSTOR, IEEE Xplore) and more complex search queries. Another limitation regards the heterogeneity in the overall analysis and the absence of broad, multicenter and standardized studies in the selected literature. Current literature appears, in fact, to be fragmented and heterogeneous, thus to make comparisons difficult.

Lastly, our paper also proposes interesting implications for both researchers and practitioners. As regards the former, the study analysis highlighted the potential role of STA in benefiting e-health research for better evaluations. Regarding the latter, as this study highlights the impacts of e-health over the patients and the doctors, it is useful at addressing the major organizational challenges of digital implementation of HC and encouraging new e-health initiatives.

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