E-health services and devices: Availability, merits, and barriers – with some examples from Finland

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Abstract

Empowering individuals through e-health can be considered as the current trend in developing healthcare services and devices. The aim of this article is to shed light on availability, benefits, and limitations of using these services and devices in people's everyday life. This study is a descriptive review based on a non-exhaustive selection of previous studies that define information exchange, information formats, opportunities, and restrictions of e-health technologies. The main focus of this study is on presenting available e-health services and devices while describing their benefits and limitations. This approach has the potential to provide new insights into the future development and integration of e-health into the healthcare system of a country. The idea behind this review is to provide a better understanding of e-health services for authorities, healthcare professionals, individuals, and related beneficiaries.

Keywords: health information exchange, healthcare facilities, telemedicine, health technology

Introduction

Finland is a country with an aging population as the number of residents aged 65 and older has increased from 23.9% in 1995 to 25.6% by 2015 [1]. Moreover, the health expenditure per capita had an upward trend from 1,800 to 3,727 million euros from the year 2000 to 2017 [1]. Therefore, health expenses constitute the main challenge for the government to provide adequate health services for the residents [2]. Health expenditure had an upward trend from 8.601 to 9.901 percent of the total GDP in all countries from 2000 to 2015 [3]. For this reason, having a higher projection rate of the aging population leads to more health-related expenses. It is essential for countries worldwide to find a sustainable solution for this high demanding expenditure of the budget [4].

One practical solution could be to channel health information to individuals through various means. The main idea of this article is to clarify which e-health services and devices are available on the market, describing merits and demerits of using such services in the healthcare system of a country, by reviewing relevant literature. Following Drucker's [5] definition of information, health information can be described as any information related to healthcare that is organized for a particular reason. Health information can range from medical information to the monitoring of individual health status [6]. According to Rockmann and Gewald [7], the Internet could be an appropriate tool for exchanging health information with individuals. Furthermore, emerging interactive technologies, so-called e-health, can facilitate this development in healthcare services [8].

According to the World Health Organization [9], e-health is described as the use of information and communication technologies for health-related issues, ranging from treating patients to the tracking of diseases and monitoring of public health. These technologies vary from simple Internet websites to more sophisticated mobile devices.

The process of developing the technologies above shows that massive unique modern projects and financial allocations are invested in various countries to support these innovative health information exchange solutions [10]. Furthermore, it has been pointed out that many e-health services and devices are not successful in providing sustainable innovative solutions for healthcare practices [11].

Health information exchange (HIE) is defined as any means of health information transferring between healthcare providers and patients [12]. Therefore, electronic health information exchange is described as a tool to provide reliable health related information exchange between these parties [13,14]. E-health services are developed to gather, save, share and make health-related information usable or reusable by different beneficiaries [2]. They are drawn up based on the information technology platform to perform sharing of health-related data, information, and knowledge [15]. Eysenbach [16] described the main idea of e-health services as channeling or enhancing health information through information technology to the users. Therefore, e-health is considered as a moderator for exchanging health information among various beneficiaries ranging from healthcare providers to patients [17]. Moreover, e-health can facilitate healthcare services for all the regions of a country [18].

On the one hand, the Internet provides a platform for exchanging health information in various formats such as texts, numbers, audio or video clips. This health information in different formats may be easier to understand for both healthcare providers and patients [19]. On the other hand, e-prescribing provides a platform for exchanging health information in text or number format. However, these numbers or texts may not be easy to understand for patients or some of the other

health information users [20]. To the best of our knowledge, there is no previous review about this topic. E-health services and devices vary in different countries, but in this paper the focus is on those available in Finland. Therefore, the main questions for this study are 1) what e-health services and devices are available, 2) what are the benefits of using these services and devices and 3) what are the limitations of using these services and devices?

Methods and material

This article is a descriptive review of literature about e-health services and devices. Although there are many studies related to health information and information seeking behavior, there are only a few that cover advantages and disadvantages of these services and devices. This paper covers and categorizes the most common services on the current e-health market. The study started by reviewing relevant research that was obtained from the Science Direct platform to explore scientific, technical and medical research on this topic, as well as official websites of e-health services and device developers to obtain more relevant information. The focus was on papers on "e-health", "online health information seeking", and "advantage and disadvantage of e-health services". The search process focused mainly on specific services and devices, health information sources, and available e-health services and devices (considering all common spellings and synonyms). Therefore, additional references were found by searching a list of known journals in the research area. The process of gathering information and analyzing it was based on textual criticism and it was mainly focused on the key content of the text related to describing current e-health services and devices. Furthermore, the analysis of this study is based on a non-exhaustive sample of possible relevant literature within an intersection of many research areas ranging from health information behavior to health informatics.

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E-health services and devices

Internet is considered an efficient, speedy and convenient channel for health information sharing [7]. Online health information sources are defined as platforms for easy access and low expense health information sharing [2].

In Finland, like in many other countries, there are many websites, blogs, and forums available for health information sharing. Hyppönen [21] listed the most common health information websites and forums in Finland. It is important to mention that some of the websites which were listed in Hyppönen's [21] study are either no long-er active or are available in a new domain. Therefore, Table 1 shows a summary of various health information websites and forums based on Hyppönen [21] that were available in January 2019.

As you can see in Table 1, different websites with various aims provide health information for people. These websites range from legitimate nationwide health organization to more health specific association. Moreover, it is worth to mention that online newspapers and magazines, homepages run by individuals, and social media sites such as Facebook and Twitter are the other available health information sources which were widely studied [22-26].

Table 1. The most common health information websites and forums based on Hyppönen [21] available in January 2019.

Title	Comment
Terveyskirjasto.fi	Health Library - reliable information about health
Thl.fi (previously Sosiaaliportti.fi)	National Institute of Health and Welfare, THL
Päihdelinkki.fi	A comprehensive website for drugs and addictions
Pienipaatospaivassa.fi	Finnish Heart Association
Parastapalvelua.fi	A website for searching, comparing welfare services from the point of view of customers' benefits. Furthermore, healthcare providers can index in this search engine to promote their services.
Hyvis.fi	A reliable site about the well-being and health inspected by experts. This website has a license from the European Union to provide accurate and trustworthy well-being and health information.
Omakanta.fi	My Kanta is a portal where a patients' electronic prescriptions are stored. It is under supervisory of Ministry of Social Affairs and Health, and Social Insurance Institution of Finland (Kela).
Suomi.fi	A single access point to public services in Finland. It provides various services for Finnish citizens; one of them is related to health and nutrition issues.
Suomi24.fi	A Finnish website that provides a comprehensive category of information about various services for people. One of them is about sharing informal health discussion through a forum.

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The main advantage of Internet-based health information exchanging is the possibility of giving or receiving feedback [27].

Other e-health services and devices range from electronic health records to mobile health devices. They enable sharing of health information in either one or two directions among healthcare providers and patients. Not only do they use the Internet for health information sharing but also as a more usable, accurate and productive system [28;29].

To gain a better understanding of the actual concept of the services above, Table 2 shows a summary of the definition of each of them. The services mentioned in Table 2 have some connections with health information sharing and exchange. For example, a computerized physician order entry, as a system in which healthcare professionals electronically enter a medical instruction for the treatment of their patients, has four steps to process health and medical information sharing, including ordering, transcribing, dispensing, and administration [30]. It means that the process will start with prescribing, checking, entering and administrating medical instructions by a healthcare professional. Therefore, it is directly connected to e-prescribing.

Table 2. Definitions of various e-health services.

E-health/ Formats	Definition
Electronic health record	Electronic tools for collecting patients' health and healthcare data comprehensively from various sources [28].
Computerized physician order entry (CPOE)	Any system in which healthcare professionals electronically enter a medical instruction for the treatment of their patients [30].
Clinical decision support system	Any computer software with the aim of helping healthcare professionals in clinical decision-making activities [31].
Telehealth	Any medical activities involving telecommunication between doctors and patients [32].
Consumer health informatics	Eysenbach [16] described it as a branch of medical informatics that first, analyses users' information needs, then, studies and implements a new method of making health information available for them and, finally, will draw models for developing medical information systems to cope with consumers' preferences.
E-prescribing	E-prescribing provides facilities for physicians and related healthcare professionals to access patients' prescribed medical history [29].
mHealth or m-Health	Mobile health is defined as a medical and public health practice supported by movable devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices [33].

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As an example of an electronic health record in Finland, Kanta, the National Archive of Health Information, has been developed by the national data system services for healthcare services, pharmacies and citizens to contain electronic prescriptions, a pharmaceutical database and patient data records [34].

Kanta as a patient data repository is developed to play the role of a national service to organize and save information about the treatment of patients for providers. Finla Työterveys Oy [35] claims that Finnish citizens will gain benefit from this service if they move to different parts of the country, or when they need health services from another healthcare service provider. Moreover, the system will provide healthcare providers access to medical data and information about patients in case of emergency. Consequently, it is expected that this system provides better treatment-related data without any errors related to treatment or examination overlapping [34].

Colpaert and colleagues [36] mention that Centricity Critical Care Clinisoft, offered by GE Healthcare Europe, is a hospital information system for administrative patient data and laboratory results. Basically, it is a patient center information system for intensive care units in hospitals to provide better health results while it is cost-effective through merging and collaboration [37].

Khan and Arif [38] argued that this service for giving a recommendation, providing or distributing medications is efficient, secure, easily accessible, time-saving and almost free. The healthcare professional must check the prescription of medications for any medical contraindicates such as allergies or overlaps before entering it into the system. Furthermore, it is expected from the system that the medical information must be channeled to the healthcare provider and supplied to the right patient at the right time in the precise medical dosage [30].

Telehealth is about receiving medical advice from experts via telecommunications technology, mainly from a far distance. In this case, e-health services or devices such as mobile health or any wearable devices may be used to collect health information and data from the patient to share with healthcare providers for medical investigations [39].

The system Evidence-Based Medicine Electronic Decision Support (EBMeDS) developed by Duodecim Medical Publications efficiently provides structured patient data via an electronic health record system. The company mentions that the system is fast and flexible for various health information support tasks [12].

Liu et al. [40] pointed out various mobile applications related to monitoring and checking of diseases such as diabetes, asthma, depression, hearing loss, poor vision, anemia and migraines. Ekeland, Bowes, and Flottorp [41] showed that using telemedicine will facilitate better health outcomes and nurse-patient relationships. Furthermore, they added that users of this health service would feel more confident and empowered with ICT used in support, education as well as virtual consultation.

There are numerous mobile software developers and companies which are developing mobile health applications. Holopainen [42] mentioned that a good example of a mobile health application developed in Finland is Healthy Kuopio Health Account. He argues that this mobile application enables residents to collect and manage their health information without the limitation of time or place. M-health applications help users to examine their health information anytime and anyplace. Moreover, the application is available for various mobile operating systems ranging from IOS to Android [42].

One of the first signs of consumer health informatics tools in Finland was a new kind of health kiosk installed in the city of Ylöjärvi. It is a service point located in a convenient place for residents in which they can have access to a variety of health services, health information, health tests (minor medical tests such as blood-related tests), guidance about health issues and several other health-related services [43].

Consumer health IT applications are developed to help patients manage, share and control their health infor-

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mation electronically and to have an active role in managing their health [44].

The health information sharing process shows a resemblance to the technology mentioned above. Health kiosks, community online networks and "cybermedicine" applications are some examples of these systems [16]. A health kiosk is a kiosk in which a patient can self-assess his or her health, make appointment check-ins, reduce waiting time and access several other health-related benefits [45].

Finally, e-prescribing is a prescription center register controlled by the Social Insurance Institution (Kela). This nationwide electronic prescription center is responsible for keeping a record of all the data and information handled by pharmacies [46]. Therefore, according to patients' prescriptions, pharmacies can provide the patients with the right medications. The Kanta e-health data system is taking care of these duties [34].

Advantages and disadvantages of e-health information services and devices

In the same manner as Internet-based health information sharing, the other services have some benefits and downsides, as well. Each of the services have various merits and demerits depending on the point of view. For example, Coughlin [47] mentioned that electronic health records would provide adequate facilities to monitor their patients' health, observe trends and reduce the risk of medical errors via rapid disease diagnoses. However, there are some arguments about them from clinical, organizational, and societal perspectives.

From a clinical point of view, Menachemi and Collum [48] mentioned that results of many clinical studies have indicated that using an electronic health record (EHR) system will improve the quality of care and will reduce medical mistakes based on health information accuracy [36]. However, Menachemi & Collum [48] questioned the productivity of the system which could be affected by rapid technological changes in electronic medical record systems.

From an organizational perspective, results of previous studies showed an increase in revenue, reduction in expenses and several other advantages related to increasing job opportunities as well as increasing satisfaction among physicians for any organization having used this system. However, the rapid changes in technology will increase challenges for organizations to keep their electronic health record devices updated. Therefore, they are faced with high pressure related to financial expenses accruing from upgrading their tools. Moreover, these changes will lead to other challenges, such as teaching medical personnel to use these new technologies appropriately [48].

Finally, Menachemi and Collum [48] mentioned some benefits for using these e-health facilities such as better possibilities to conduct research, improving population health status as well as reducing related expenses. However, they do mention some barriers, such as privacy and security concerns for electronic health records. Tables 3 summarizes the main advantages and drawbacks of the services above.

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Table 3. Advantages and disadvantages of other e-health information services and devices.

E-health	Benefits	Drawbacks
Electronic health record	✓ Provide adequate facilities to monitor patients' health, ✓ Observe trends, ✓ Reduce the risk of medical errors via rapid disease diagnoses [47]	➤ Financial issues related to technology, ➤ Changes in workflow, ➤ Loss of revenue associated with temporary loss of productivity, ➤ Several unintended consequences, ➤ Privacy and security concerns [48].
Consumer health informatics	✓ Improve health communication [55] ✓ Widespread access to health information [47] ✓ Interactivity [55] ✓ Tailoring of information [56] ✓ Facilitate interpersonal interaction & social support, ✓ The potential for anonymity [55].	➤ Access, competencies and related issues, ➤ Limited understanding of the public's health information needs, ➤ Variety of communication contexts and their different backgrounds, ➤ Little training and predictability in information-seeking patterns, ➤ Complexity of communicated information, ➤ Communication barriers, ➤ Complex nature of the information provided by consumers, ➤ Measuring the clinical and cost-effective impact of health communication on providing high-quality health services [57]
E-prescribing	✓ Reduces any medical error related to written prescriptions such as incorrect or unavailable medicine, dosage, ✓ System provides more cost-effective therapies and reduces unnecessary high-cost of medications, ✓ Access to the history of prescription records, Pharmacists gain the advantage of e-prescription regarding streamlining prescription processing and reducing waiting time for patients [54].	➤ Missing or unclear information, ➤ Designing efficient and effective software to avoid this is not easy, ➤ Any expenses related to designing, implementing and using such a system [54]
Telehealth	✓ Easy access to healthcare, ✓ Saves time, travel and other expenses, ✓ Health provider integration, ✓ Comfort-level with the technology, ✓ Reduction of medical errors, ✓ A multifold increase in efficiency, Continuing Medical Education [39].	➤ Policy development, ➤ Connectivity to rural and remote communities /standards/interoperability, ➤ Costs / evaluation / outcomes, ➤ Liability, malpractice, ➤ Confidentiality, security, ➤ Investment opportunities [39].
M-health	✓ User-friendly ✓ Can check health situation ✓ Emergency care ✓ Diagnosing disease ✓ Encouraging healthy behavior, Informative and educational [52,53].	✓ Accuracy rate of health reports, ✓ Lack of official approval or regulation, ✓ Data privacy [52, 53].
Computerized physician order entry	✓ Patient safety, ✓ Improves quality of care, ✓ Development of medical practices [49]	✓ Wrong dose, ✓ Wrong dosage form, ✓ Extra dose [44].
Clinical decision support system	✓ Decreases misdiagnoses, ✓ Reduction in medical error, ✓ Provides reliable health information, ✓ Improves patient medical treatment experience, ✓ All health-related information readily available [50].	✓ Organizational structure, ✓ Resource allocation, ✓ Collaborators and participation in deferent units [51].

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On the one hand, an electronic health record provides a better monitoring system for observing patient health status and trends, and it reduces the risk of medical error [47]. In the same manner, a computerized physician order entry improves patient safety and quality of care [49]. Also, clinical decision-making provides the aforementioned benefits for users while offering reliable health information [50]. Being easily accessible to healthcare services, saving time and being more user-friendly are other merits of implementing telehealth and mobile health services in the healthcare of a country [39,52,53].

On the other hand, missing or unclear information, for example in an e-prescribing system [54], and diversity in communication contexts while users have different health literacy backgrounds, especially in consumer health informatics, are some barriers to using these e-health technologies [57]. It is also important to consider policy development [39] and to have more fixable/flexible organizational structures to improve the enforcement of clinical decision support systems or telehealth in the healthcare system [51].

Finally, financial issues and mistakes in providing the correct doses of mediation are two other issues related to using electronic health records and a computerized physician order entry [44,48].

Discussion and conclusions

This study described different e-health services and devices available on the market, especially in Finland. These e-health services and devices can range from a simple webpage run by an individual to more sophisticated information technological services such as clinical decision support systems, which were discussed in the paper. It is interesting to point out that even though there are quite a lot of e-health services and devices available on the market, many of them may not be practical to use when exchanging health information among different beneficiaries. However, this review described benefits and limitations of the common e-health services and devices available on the market. It is also worth mentioning that conducting a systematic

review of the topic was not possible at this time. Therefore, the chosen approach sets limitations on this study. First of all, this review has not been conducted as a systematic review; instead, the analysis of this study is based on a sample of every possible piece of relevant literature within an intersection of many multidisciplinary research areas related to the scope of this study. Secondly, providing a statistical procedure for combining data from multiple previous studies in order to conduct a comprehensive meta-analysis of the empirical findings of this study was impossible. The review was based on the nature of the empirical method which was implemented on this paper. Consequently, the results of this paper stand on the findings of previous studies.

We also mentioned the benefits of implementing these services and devices in the healthcare system of a country. This study described the merits of each e-health service and device, such as providing facilities to perform self-health monitoring [47], improving quality of care [48], healthcare services being more user friendly [52,53], reducing medical errors [39], improving health communication [55], a potential for anonymity [55], providing access to medical prescription history [54] and other advantages.

Despite many benefits of using the aforementioned services and devices, there are many drawbacks with making use of them, as well. These downsides are mostly considered to be financial issues related to the implementation of such systems [48], policies and organizational structures [51] and evaluating efficiency and the outcome of using these services [39]. Also, barriers for approval or regulation of these technologies [52,53], missing or unclear information [53], training and complexity of health information provided by consumers [57] and other limitations were mentioned.

In order to provide a sustainable, innovative solution to overcome the aforementioned limitations, this study suggests the development of future e-health services and devices by considering influential factors on efficiency of the system such as accessibility [46], costs of development [48], prospective user preferences [56] and developing practical solutions to minimize the complexity of the systems. In this case, the first step

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may be to conduct more studies about the users of these services and devices that focus especially on their health information needs, perceptions about each ser-

vice and on finding practical solutions to improve the efficiency and effectiveness of them.

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