



E-Health Practices and Technologies: A Systematic Review from 2014 to 2019

Maria Helena da Fonseca ^{1,*}, Fanny Kovaleski ¹, Claudia Tania Picinin ¹, Bruno Pedroso ², and Priscila Rubbo ³

- ¹ Department of Production Engineering, Federal University of Technology—Paraná (UTFPR), Ponta Grossa 84017-220, Brazil; fannyk92@hotmail.com (F.K.); claudiapicinin@utfpr.edu.br (C.T.P.)
- ² Division of Physical Education, State University of Ponta Grossa—Paraná (UEPG), Ponta Grossa 84030-900, Brazil; prof.brunopedroso@gmail.com
- ³ Department of Accounting Sciences, Federal University of Technology—Paraná (UTFPR), Pato Branco 85503-390, Brazil; priscilarubbo@utfpr.edu.br
- * Correspondence: mhelfonseca13@gmail.com; Tel.: +55-42-999388129

Abstract: E-health can be defined as a set of technologies applied with the help of the internet, in which healthcare services are provided to improve quality of life and facilitate healthcare delivery. As there is a lack of similar studies on the topic, this analysis uses a systematic literature review of articles published from 2014 to 2019 to identify the most common e-health practices used worldwide, as well as the main services provided, diseases treated, and the associated technologies that assist in e-health practices. Some of the key results were the identification of the four most common practices used (mhealth or mobile health; telehealth or telemedicine; technology; and others) and the most widely used technologies associated with e-health (IoT, cloud computing, Big Data, security, and systems).

Keywords: e-health; ehealth; practices; technologies

1. Introduction

Digital change has been particularly challenging in healthcare, as there is growing demand for services due to the aging population and the emergence of new diseases. Thus, investment in new treatments is necessary so that everyone has equal access to the healthcare system [1–3]. E-health involves practices such as mhealth and telehealth that employ electronic technologies to provide healthcare resources, services, and information [4].

Mobile health or mhealth consists of the use of mobile devices so that patients can solicit services electronically, use apps to verify information, and manage or monitor treatment or problems or other health-related issues [5]. Telehealth can be defined as the use of telecommunication technologies to promote the care and education of patients and professionals working in the area [6].

E-health has become an integral part of the healthcare system as it addresses a range of difficulties in medicine, including reducing errors and providing more efficient services with more accurate results [7]. Such is the case with the use of electronic medical records, in which all information about a patient is stored, thus preventing inappropriate administration of medication during medical care and ensuring that the patient is treated quickly and comfortably [8]. However, its implementation depends on adequate planning and strategies so that virtual medical care can be performed [3].

The success of e-health in a country is related to several factors, including user acceptance and the types of infrastructure, systems, and management used [6,9]. Meanwhile, there are four stakeholders involved in the outcomes: entrepreneurs, healthcare professionals, patients, and those responsible for health insurance and assistance policies [10]. To effectively implement the use of information technologies in healthcare, e-health strategies must occur in an integrated manner, including the development of norms, laws, or regulations. This situation is valid whether in the fields of telehealth and mhealth, or specific



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Copyright: © 2021 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https:// creativecommons.org/licenses/by/ 4.0/). categories such as electronic medical records or health literacy—eLearning (learning in health) [5,11,12].

The e-health strategy has three main components: (i) knowledge management; (ii) tools and methods; and (iii) policies. These components work to consolidate healthcare systems with support networks and scientific and technological production, manage infrastructure and human resources, reduce barriers to accessing health services, and promote community inclusion [13]. Some barriers to e-health include the difficulties faced when using systems and applications, both by healthcare professionals and patients, as well as ensuring the security and privacy of user data transmitted throughout these systems [12].

Another challenge in e-health is interoperability across systems. That is, new e-health systems must interact with existing ones, and there should be a standard electronic language between hospitals (or clinics) to facilitate communication and data exchange, as well as formal agreements on how the system should work in a standardized way [14,15]. Further, the cost of implementing e-health also presents challenges, which may make the implementation of such systems unfeasible. This is related to the high levels of investment required to purchase equipment to implement more sustainable practices [3,16] than traditional systems that store paper records, alongside the costs of hiring specialized support personnel in information technology (IT) to keep the systems running and software acquisition [8,17].

There are several studies on the topic of e-health, but they generally address a specific practice. One example is [18], in which the authors analyze studies of interventions via e-health using websites and social media in the treatment of patients with mood disorders. Two e-health-related studies with a general approach were found [19,20]. However, such studies do not fully address all e-health practices, which differentiates the present study from previous work on the topic. Although scientific publication databases have a vast range of studies on e-health [21], there are gaps in knowledge related to this topic, which justifies the need for the present review. Herein, we update data related to practices in the field of e-health and provide an overview of the information present in selected articles within a five-year time frame (2014 to 2019), demonstrating what has been published on the topic both in practical studies and literature reviews.

Therefore, the objective of this analysis is to identify, through a systematic literature review, the most commonly used e-health practices worldwide, as well as the key services provided, diseases treated, and the associated technologies that assist in providing e-health practices. This study aims to answer the following questions:

- In which countries and journals are studies published on e-health practices?
- What are the main e-health practices used worldwide?
- What are the main service delivery types and medical fields addressed using e-health?
- What are the main barriers to e-health service delivery?
- What are the most common diseases treated, and in which countries have e-health practices been applied?
- What are the most common technologies used in e-health?

2. Materials and Methods

The identification of the study portfolio was carried out using the Methodi Ordinatio process developed [22] and based on the Cochrane model and ProKnow-C for research studies that use Information and Communication Technologies—ICTs, such as spread-sheets, word processors, and reference managers. The following software programs were employed to conduct the analyses: Mendeley version 1.19.3; JabRef version 3.3; Microsoft Office 365 (Excel and Word); and NVivo trial version 11 for initial article analysis. The Methodi Ordinatio includes nine steps and is used to conduct systematic literature reviews, build bibliographic portfolios, and map the literature on a specific topic. One advantage of the methodology is its multi-criteria decision-making model that considers the impact factor of the journal, the number of citations, and the year of publication. From this, the

InOrdinatio index is calculated, and the researcher obtains a bibliographic portfolio [23]. This methodology has been used by authors such as [24–26].

The Methodi Ordinatio is shown in Figure 1 and is composed of the following steps:

- 1. Step 1—Establish the research objective;
- 2. Step 2—Define the keywords;
- 3. Step 3—Select the databases to be searched;
- 4. Step 4—Search for and register the results obtained;
- 5. Step 5—Define search filters such as publication period and type of study (articles, books, etc.), excluding duplicate articles and those unrelated to the selected research topic;
- 6. Step 6—Identify the impact factor, year of publication, and number of citations of the articles from Google Scholar for the selected portfolio;
- 7. Step 7—Apply the InOrdinatio equation [22] in a spreadsheet to classify the identified articles;

InOrdinatio = $(IF \div 1000) + \alpha \times [10 - (\text{ResearchYear} - \text{PublishYear})] + (\sum Ci)$ (1)

The equation is composed of the following variables: *IF* is the impact factor; α is the value defined by the researchers considering the current relevance of the articles, which may vary from 1 to 10 (for this study, we defined α as 10); ResearchYear is the year the research was conducted; PublishYear is the year the article was published; and $\sum Ci$ is the number of citations of the article according to data from Google Scholar.

8. Step 8—Select the articles for the final portfolio considering the highest InOrdinatio classification; and



9. Step 9—Read and analyze the final portfolio articles.

Figure 1. Research method.

First, the search objective was defined, and the keywords were searched using Boolean operators ("E-Health" OR "EHealth" AND "Practice *"). The keyword "Technology" was not used to search the databases so as not to excessively limit the search. The analysis of e-health-related technologies took place after the portfolio was defined.

The search was carried out using seven electronic databases: Lilacs, MedLine, PubMed, SciELO, Scopus, Science Direct, and Web of Science. These databases were chosen due to the multidisciplinary character of this study and the fact that the information concerning medicine and health is vast. Thus, to conduct a careful analysis, well-known and key sources in the field should be used, such as MedLine, PubMed, Lilacs, SciELO, the Cochrane Library, and the Virtual Health Library (VHL).

MedLine is a database containing supplementary materials and offers a good basis for research as it indexes other databases and aggregates complementary materials. It has been employed in research on e-health, health, and medical technology [6].

Scopus is the largest research database for the fields of technology, medicine, science, social sciences, and the arts and humanities, while Science Direct contains technical publications in the fields of science and health [27]. The Web of Science is an independent global citation database that offers reliable multidisciplinary data for academic research [28].

The time frame for the published research was five years, from 2014 to 2019. According to [29], a five-year period is the half-life for article citations. In addition, the following filtering procedures were applied to the databases to obtain the results: selection of types of articles published (review, research, and journal-published), exclusion of duplicate articles. Thus, 3136 articles were obtained, whose titles, abstracts and keywords were read to exclude studies that dealt with areas unrelated to e-health practices and are beyond the scope of this analysis.

Finally, the Methodi Ordinatio equation was applied to obtain the most currently relevant articles. Articles with an index greater than 100 were considered, and one study was excluded as it was not found, resulting in a final portfolio of 446 articles, as listed in Appendix A—Table A1. Final portfolio.

The database search did not exclude any publication language, aiming to obtain a broad range of results and not limit the present analyses. Table 1 shows how the studies were analyzed to answer the research questions.

Type of Analysis	Research Question
Bibliometric analysis	In which countries and journals are studies on e-health practices published?
Content analysis	What are the main e-health practices used worldwide? What are the main service delivery types and medical fields served with e-health? What are the main barriers to e-health service delivery? What are the most commonly treated diseases, and in which countries has e-health been applied? What are the most common technologies in e-health?

Table 1. Type of analysis used to address the research questions.

The questions referring to countries that are publishing studies on e-health and countries that use these practices were answered, respectively, by identifying the country of the first author and where the studies took place. Thus, the results and discussions of the research were organized in a bibliometric and content analysis carried out on the 446 articles from the final portfolio. For the content analysis of the technologies associated with e-health, 57 articles from the final portfolio (446 articles) were analyzed as they specifically address this topic.

3. Results and Discussion

3.1. Bibliometric Analysis

Figure 2 shows the number of publications per year from 2014 to 2019.



Figure 2. Number of publications per year.

We can see that 2014 had the lowest number of publications on the topic and 2019 the highest. There was fluctuation in the number of publications, particularly between 2018 and 2019, when a marked increase in the number of studies related to the theme of e-health occurred. This increase is related to several factors. The area of mhealth has been growing, as has the number of chronic diseases and other health problems, while the advance of mobile technology has enabled greater access to e-health through devices, enabling an increase in research [30]. An increase in publication on the topic is also due to researcher interest, as it is current and still novel, allowing for greater numbers of studies on topics within the field, as is the case with reports published about e-health indicators, such as those from the Global Health Observatory of the World Health Organization (WHO) and the Nordic e-Health Research Network [31].

Although authors from 58 countries contributed to studies, the geographical distribution was uneven, as shown in Figure 3.



Figure 3. Distribution of articles by country and number of articles published by journal.

The leading countries in developing research related to e-health are United States (109), Australia (41), United Kingdom (32), China (23), Italy (19), Germany (18), Norway (14), and France (10). The countries with the fewest publication include Egypt (1), Mexico (2), and Brazil (3). In the study by [32] on e-health and health informatics skills, the authors found that the countries with the most authors who published on the topic were United States, Canada, United Kingdom, and Australia, and those with the least were Denmark and Norway.

Norway, Australia, Germany, the United Kingdom, United States, France, and Italy are countries with a remarkably high Human Development Index—HDI (which is based on the health, life expectancy, education, and income of a country's population), while Egypt, Brazil, Mexico, and China are countries with high HDI. The wealthier a country is, the better its economic, political, and healthcare infrastructure, enabling more initiatives for e-health development, as has occurred in many European countries [33,34]. Each country has a different level of e-health development, and consequently, countries with more advanced e-health systems have a higher incidence of scientific production on the topic, such as European countries and the United States, as verified by [35]. Moreover, [36] state that although countries on the African continent and Latin America are publishing on the topic, the number of studies is still low as the countries have less developed e-health systems. Such is the case with Brazil and Mexico, which are still at the stage of telehealth improvement and consolidation.

The 446 articles in the portfolio were published across 253 academic journals. However, some journals among those identified stand out for having very few publications on the topic but a high impact factor, such as *The Lancet* (1 publication—60.392 JCR); *British Medical Journal*—BMJ (1 publication—30.223 JCR); *IEEE Communications Surveys & Tutorials* (1 publication—23.700 JCR); *IEEE Internet of Things Journal* (2 publications—9.936 JCR); *Schizophrenia Bulletin* (2 publications—7.958 JCR); *Information Sciences* (2 publications— 5.910 JCR); *AIDS and Behavior* (3 publications—3.147 JCR); *Social Science & Medicine* (3 publications—3.616 JCR); *International Journal of Environmental Research and Public Health* (3 publications—2.849 JCR); *Journal of the American Medical Informatics Association*—JAMIA (4 publications—4.112 JCR); *Frontiers in Psychiatry* (4 publications—2.849 JCR); *PLoS One* (4 publications—2.740 JCR).

In the analysis by [19], who conducted a literature review on e-health, and [32], who did a bibliometric study, the journals that had the most publications were *Journal of Medical Internet Research* and *Telemedicine and e-Health*.

Therefore, for the research question "In which country and journals are studies on e-health practices published worldwide?" we can see that the United States stands out as it has the greatest number of authors who published on this topic, with 109 studies. Moreover, the *Journal of Medical Internet Research* is the most prominent scientific outlet for research on e-health, with 47 publications.

3.2. Content Analysis

3.2.1. Main E-Health Service Delivery Types and Fields

Based on the survey of studies from the final portfolio, Table 2 presents the categories of practices and services provided in e-health as described in the analyzed studies.

E-Health Practices	Specification of Service Delivery Types and Other E-Health-Related Topics Found in the Articles	Medical Fields Identified in the Articles	Authors
Mhealth or Mobile Health	Mhealth; assessment; systems assessment; information; telehealth; monitoring; health literacy.	General medicine; emergency; pediatrics; cardiology; oncology; psychiatry; neurology; dermatology; gynecology; hematology; infectiology/infectious diseases; radiotherapy/radiology; diagnostic imaging; gastroenterology; anesthesiology; nutrition; orthopedics; respiratory system/otorhinolaryngology; general surgery; urology; geriatrics; endocrinology; nephrology; ophthalmology.	[37-42]

Table 2. E-health practices and fields.

E-Health Practices	Specification of Service Delivery Types and Other E-Health-Related Topics Found in the Articles	Medical Fields Identified in the Articles	Authors
Telehealth or Telemedicine	Telehealth; intervention; interaction; mhealth; systems; technology.	Telepsychiatry; teledermatology; teledentistry; telerehabilitation; teleophthalmology; telecardiology.	[43-48]
Technology	Technology; others; mhealth; patient monitoring; support; systems; telehealth; knowledge level; health literacy; systems assessment; program.		[49–54]
Others	Others; diagnosis; telehealth; mhealth; costs; programs; problems; project; quality of services; general e-health; care; project assessment; benefits; development; diagnosis; evaluation system; impact x cost-benefit; use and acceptance/barriers; knowledge level; mhealth; treatments; professionals' views; study groups; intervention assessment; health literacy; technology; telehealth; randomized controlled trial—RCT; standardized service.	Nursing; oncology; gynecology; psychology; neurology; cardiology; psychiatry.	[55–66]

Table 2. Cont.

When answering the research question "What are the most common e-health practices used around the world?" four categories of e-health practices became evident: (i) mhealth or mobile health; (ii) telehealth or telemedicine; (iii) technology; and (iv) others, which include combinations of different practices.

E-health can be defined as healthcare services and health information provided and/or obtained using the internet, mobile devices, computers, and information technology [64]. It involves the application of digital solutions for healthcare, thus facilitating patient care in a more comfortable way [62]. The practice areas are described below.

Mhealth or mobile health enables persons who use mobile devices, such as smartphones, to access systems, data, and apps to monitor and manage their health status [38]. Telehealth or telemedicine includes remote consultations via videoconference/call using desktop computers, smartphones, or tablets with internet access [44,67,68].

The technology applied in e-health helps healthcare professionals, patients, and the lay population to obtain information or access learning, treatment, and resources that are available online [69].

Through e-health, digital health interventions (DHIs), such as assisted therapy, have been shown as effective among children and young people undergoing mental health treatment, as discussed in the systematic review by [64] on randomized clinical trials of DHIs performed with children and young people up to 25 years of age. However, further data are required to offer satisfactory conclusions about the benefits; despite the potential that the intervention can offer, few studies have been carried out on the subject and with small sample sizes, making this assessment difficult.

In an analysis by [62], the authors evaluated the effectiveness of an electronic health project model for people with severe mental illness (SMI), called the Flat Explicit Design Model (FEDM). The study was carried out via a website with 38 people aged 31 to 59 years who have some degree of severe mental illness and involved online tests.

We also identified a study that sought to conduct a theoretical review on the services and applications offered in the practice of mhealth and their use for therapy in the areas of mental health and behavioral disorders, musculoskeletal and connective tissue systems, oncology, and the nervous system [38]. Another study assessed the skills of medical residents, doctors, and clinics working with telepsychiatry, with a focus on e-mental health (e-MH) care [44].

In the "other" category, articles describing a combination of past practices and other areas, such as costs, were included. The study by [56] assessed the current literature to verify whether specialization in telehealth offset the effective cost. The authors found specializations such as teledermatology, teleophthalmology, and telecardiology offset the amount invested in that healthcare service.

Some of the service delivery types and other themes combined with the most representative e-health practices in the literature are discussed below.

Health literacy is knowledge and skills related to health, and it can be obtained through in-person and/or online environments [70]. The latter includes websites, social media, and the use of health data systems [71]. An aspect related to this area in the analyzed studies is low health literacy, as seen in the studies by [72,73]; when searching for health information, internet users must use a critical approach to determine if the information obtained is correct. Often, the information posted online is presented erroneously, which may misguide or misinform the user about the content.

Mhealth or mobile health and monitoring consists of using smartphone applications to help in disease treatment, identification, and support [74]. It also encompasses health exam scheduling and patient monitoring performed via devices with wireless sensors that check essential vital signs, such as blood glucose level and blood pressure [38]. The results of these exams are stored on the device, thus allowing for the transmission of data from exams done at home [75].

In telehealth, when an intervention is combined with interaction with a healthcare professional, it can be defined as telemonitoring of patients with diseases that need follow-up [43]. This enables doctors to see patients without having to go to the hospital or doctor's office [45]. Such a service delivery can be employed with mental health patients who require therapy [44], enabling them to participate in sessions at home at more flexible times [76]. It can also be used to monitor the symptoms of cancer patients undergoing treatment [77].

The systems related to the category "technology" entail the creation of encryptions to protect the data of patients who access their medical records online, as well as data protection in the systems of hospitals, pharmacies, and clinics [52,53] so that data remain confidential and secure [54]. Technology also involves creating support for the systems [78] and developing mobile devices that can be used in the healthcare sector, such as wearable sensors [79]. Further, it includes the use of Internet of Things (IoT) [80], cloud storage [81], and Big Data [82] in the areas of e-health.

Regarding the research question "What are the main service delivery types and medical fields served in e-health?" we found that the main areas of service provision are health literacy, mhealth and monitoring, telehealth, and systems combined with technology. In turn, the main medical fields served that are highlighted in the literature are telepsychiatry, teledermatology, telerehabilitation, teleophthalmology, telecardiology, and teledentistry.

As for the research question "What are the main barriers to e-health service delivery?" we found that costs, laws, and system data security of are the main barriers to be overcome. We identified studies related to e-health practices experiencing barriers in terms of costs related to the use of telemedicine [83], regulation and legislation [38], security in the use of cloud computing [84], limitations in clinical trials of existing digital interventions [64], and limitations in databases [58]. In mHealth, a limiting factor is mobile device battery life [85], as the devices with applications or monitoring equipment must have the battery charged to avoid any problems during use [86]. Further, geographic distance is a primary limiting factor, as each country has different health-related applications available to the population [87] and barriers between patient and physician [38].

3.2.2. Main Diseases Treated

Figure 4 shows the main diseases treated in e-health (total and percentage), addressing the research question "What are the most commonly treated diseases and in which countries have e-health services been used?" The most commonly treated diseases are mental illnesses, multiple diseases (diabetes mellitus 1 and 2, stress, depression, and anxiety), cancer, eating disorders, chronic illness, cardiovascular diseases, and sexually transmitted diseases (STDs). Regarding the countries that currently use e-health, we identified the following countries where studies have been conducted: United States, Canada, Australia, Germany, Sub-Saharan Africa, Africa, Netherlands, Sweden, Switzerland, China, Italy,



Greece, Finland, Iran, Iraq, Bangladesh, Pakistan, Saudi Arabia, United Kingdom, Spain, France, Italy, and Portugal.

Figure 4. Diseases treated with e-health.

Some of the studies evaluate more than one type of issue, for instance, diabetes mellitus (DM), cardiovascular diseases, and chronic lung diseases [39]; mental illnesses such as depression, anxiety, dementia [76]; others, such as the oral health of pregnant women in prenatal care, anti-smoking, organ transplants [88]; cancer, such as breast cancer, skin cancer, and lung cancer [77]; eating disorders, including care regarding infant nutrition, diabetes, and obesity in adults [75]; chronic illness, such as chronic inflammatory rheumatic diseases (CIRDs), asthma, and chronic pain [10]; cardiovascular diseases [89]; cerebrovascular accident (CVA), coronary artery disease, and atrial fibrillation (AF) [90]; sexually transmitted diseases (STDs), such as HIV and/or sexually transmitted infections (STIs) [50]; human papillomavirus (HPV) and child sexual abuse [91].

Mental illnesses and the studies combining more than one type of disease represented 40% of diseases treated with e-health addressed in the literature. The studies deal mainly with randomized clinical trials applied to groups of people. For example, in the study conducted by [92], the authors verified how a telerehabilitation program works to help control type 2 DM. In the study by [93], a randomized clinical trial (RCT) was carried out with 13 primary brain tumor patients. Using the ReMind App, the pilot study obtained favorable results from patients but still required improvement. On the other hand, [94] observed 66 stroke (CVA) patients and their caregivers for eight weeks, using an e-health system as a treatment aid to do physical exercise. They found no significant effect on patient improvement during that period.

Other authors have chosen to review randomized studies, such as the study by [95], who compared the estimated sizes of combined effects through meta-analyses of analysis of covariance (ANCOVA), simple analysis of change score (SACS), and simple analysis of final values (SAFV), using RCTs of digital interventions with glycated hemoglobin HbA1c as the main result or intervention for disease treatment using e-health practices. Finally, in the study by [96], the use of mhealth for intervention as a form of treatment for patients with hallucinations was investigated.

3.2.3. Technologies Associated with E-Health

From the final portfolio (446 articles), 57 publications were selected that address topics related to technology applied in healthcare. When answering the question "What are the most used technologies in e-health?" we identified IoT, cloud computing, Big Data, security, cryptography, algorithms, among others, as shown in Figure 5.



Figure 5. Number of publications in articles combining technology and e-health.

The technology applied to healthcare includes IoT to integrate medical sensors [80], authenticate, encrypt [97], and maintain security and confidentiality during data exchanges [98] and between physicians and patients [99]. It is vital that users are confident that the systems used are protected [100] and authenticated to ensure the privacy of stored data [51,101]. The cloud system facilitates data storage at a low cost while also being secure and private [42,81,84].

The use of Big Data entails the analysis, diagnosis, and treatment of diseases [82,102]. There is also the use of wireless sensors applied to clothing, which can be used to monitor a patient when performing physical exercise [103–105].

The first authors of each of the 57 articles addressing technology in e-health are from 35 different countries, principally China (with 10 articles); India (6 articles); the United States, Australia, and Italy (3 articles each); and Greece, Algeria, Pakistan, and Saudi Arabia (2 articles each). Other countries, such as Spain, South Africa, and Mexico, had only one study. Articles related to technology were published in 38 journals, mainly *Future Generation Computer Systems* (7 articles); *IEEE Access* (4); *International Journal of Information Management* (4); *Journal of Medical Systems* (3); *Computers & Electrical Engineering* (2); *Health and Technology* (2); *Information Sciences* (1); and *Telematics and Informatics* (1). In the literature review by [106] on the application of cloud computing in e-health, 44 studies published between 2010 and 2013 were analyzed. The authors were from countries including the United States (11), Australia (4), China (3), India (2), and Spain (1). As we can see, the results found by [106] are similar to those reported herein.

Through an analysis of the literature, we found that technology can provide benefits across healthcare practices, such as the development of products, processes, and systems, as well as support decision-making. Nonetheless, data security and privacy remain a concern, both for developers and users; regardless of how efficient technologies are becoming, there can always be failures. Thus, there is room for in-depth studies and the development of technologies with more secure systems.

4. Conclusions

To achieve its proposed objective, the present study used a systematic literature review of articles published from 2014 to 2019, resulting in the analysis of 446 articles. Six research questions were defined to analyze the literature on e-health practices. Through the analysis, four categories of the most common practices in the field were identified: "mhealth or mobile health"; "telehealth or telemedicine"; "technology"; and "others." The main services provided with e-health practices are health literacy, mhealth and monitoring, telehealth, and systems combined with technology. Regarding the fields of medical specialties that offer consultations via telehealth, the following were identified: telepsychiatry, teledermatology, telerehabilitation, teleophthalmology, telecardiology, and teledentistry. Other fields were also found that offer services in e-health, such as geriatrics, general medicine, endocrinology, pediatrics, gynecology, and oncology.

Furthermore, 146 of the 446 studies analyzed use one of the common practices for disease diagnosis/treatment/monitoring, with mental illnesses and studies combining the treatment of multiple disease corresponding to 40%. Among the most frequently treated diseases are diabetes mellitus, cardiovascular diseases, chronic lung diseases, and mental illnesses (depression, anxiety, dementia). In terms of the countries that current use e-health, countries in Europe (Austria and Germany), Africa (Sub-Saharan countries), Asia (China), and North America (United States and Canada) stand out.

In relation to the technologies adopted in e-health practices, IoT, cloud computing, Big Data, security, and systems are among the most common.

Systemic reviews such as the one presented herein are important to provide more precise targeting of the practices and technologies that can be adopted in different procedures and processes, considering the context of each country. In general, such analyses can offer information and guide physicians and patients in the use of "new" services.

A study can always be improved, and the present one is no exception. Although the methodology applied followed careful steps and well-defined filters, the choice of only three keywords (considered comprehensive) may have resulted in the exclusion of some relevant studies in the analysis.

The present study was completed at the beginning of the global COVID-19 pandemic, during which physicians and patients began to use considerably more e-health practices and services due to the restrictions imposed by social isolation. Further studies are needed to address the growth in e-health practices, including services, diseases, and new approaches that are in greater demand, and the breakdown of government-imposed restrictions on expanding the use of e-health.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Final portfolio.

Author	Title	Journal	Impact Factor	Year	Citations	InOrdinatio 10
Stoyanov, S.R.; Hides, L.; Kavanagh, D.J.; Zelenko, O.; Tjondronegoro, D.; Mani, M.	Mobile app rating scale: A new tool for assessing the quality of health mobile apps	JMIR mHealth and uHealth	4.301	2015	550	550.00
[38] Silva, B.M.C.; Rodrigues, J.J.P.C.; Torre-Díez, I.D.L.; Lopez-Coronado, M.; Saleem, K.	Mobile-health: A review of current state in 2015	J. Biomed. Inf.	2.950	2015	454	514.00
[83] Flodgren, G.; Rachas, A.; Farmer, A.J.; Inzitari, M.; Shepperd, S.	Interactive telemedicine: Effects on professional practice and health care outcomes	Cochrane Database Syst. Rev.	7.755	2015	245	305.01
[39] Whitehead, L.; Seaton, P.	The effectiveness of self-management mobile phone and tablet apps in long-term condition management: A systematic review	J. Med. Internet. Res.	4.945	2016	206	276.00
Sultan, N.	Making use of cloud computing for healthcare provision: Opportunities and challenges	International Journal of Information Management	5.063	2014	202	252.01
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Giunti, G.; Giunta, D.; Guisado-Fernandez, E.; Bender, J.; Fernandez-Luque, L.	A biopsy of breast cancer mobile applications: State of the practice review	International Journal of Medical Informatics	2.721	2018	23	113.00

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Bujnowska-Fedak, M.M.; Pirogowicz, I.	Support for e-health services among elderly primary care patients	Telemedicine and e-Health	1.996	2014	63	113.00
Meurk, C.; Leung, J.; Hall, W.; Head, B.W.; Whiteford, H.	Establishing and governing e-mental health care in Australia: A systematic review of challenges and a call for policy-focussed research	J. Med. Internet Res.	4.945	2016	42	112.00
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Chouvarda, I.G.; Goulis, D.G.; Lambrinoudaki, I.; Maglaveras, N.	Connected health and integrated care: Toward new models for chronic disease management	Maturitas	3.654	2015	50	110.00
Ferreri, F.; Bourla, A.; Mouchabac, S.; Karila, L.	e-Addictology: An overview of new technologies for assessing and intervening in addictive behaviors	Front. Psychiatry	3.162	2018	20	110.00
Lee, E.W.; Denison, F.C.; Hor, K.; Reynolds, R.M.	Web-based interventions for prevention and treatment of perinatal mood disorders: A systematic review	BMC Pregnancy and Childbirth	2.413	2016	40	110.00
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Pussewalage, H.S.G.; Oleshchuk, V.A.	Privacy preserving mechanisms for enforcing security and privacy requirements in e-health solutions	International Journal of Information Management	5.063	2016	39	109.01
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Machado, G.; Pinheiro, M.; Lee, H.; Ahmed, O.; Hendrick, P., Williams, C.; Kamper, S.	Smartphone apps for the self-management of low back pain: A systematic review	Best Practice & Research Clinical Rheumatology	3.016	2016	39	109.00
Slev, V.N.; Mistiaen, P.; Pasman, H.R.W.; Verdonck-de Leeuw, I.M.; van Uden-Kraan, C.F.; Francke, A.L.	Effects of eHealth for patients and informal caregivers confronted with cancer: A meta-review	International Journal of Medical Informatics	2.721	2016	39	109.00
Hossain, N.; Yokota, F.; Sultana, N.; Ahmed, A.	Factors influencing rural end-users' acceptance of e-health in developing countries: A study on portable health clinic in Bangladesh	Telemedicine and e-Health	1.996	2019	9	109.00
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Li, F.; Li, Z.; Han, W.; Wu, T.; Chen, L.; Guo, Y.; Chen, J.	Cyberspace-oriented access control: A cyberspace characteristics-based model and its policies	IEEE Internet Things J.	9.516	2019	8	108.01
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Hamza, R.; Yan, Z.; Muhammad, K.; Bellavista, P.; Titouna, F.	A privacy-preserving cryptosystem for IoT E-healthcare	Information Sciences	5.524	2019	7	107.01
Greenwood, D.; Blozis, S.; Young, H.; Nesbitt, T.; Quinn, C.	Overcoming clinical inertia: A randomized clinical trial of a telehealth remote monitoring intervention using paired glucose testing in adults with type 2 diabetes	J. Med. Internet Res.	4.945	2015	47	107.00
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Børøsund, E.; Cvancarova, M.; Moore, S.; Ekstedt, M.; Ruland, C.	Comparing effects in regular practice of e-communication and web-based self-management support among breast cancer patients: Preliminary results from a randomized controlled trial	J. Med. Internet Res.	4.945	2014	56	106.00
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Bucci, S.; Schwannauer, M.; Berry, N.	The digital revolution and its impact on mental health care	Psychol Psychother	2.244	2019	5	105.00
Oueida, S.; Aloqaily, M.; Ionescu, S.	A smart healthcare reward model for resource allocation in smart city	Multimedia Tools and Applications	2.101	2019	5	105.00
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Hammersley, M.; Okely, A.; Batterham, M.; Jones, R.	An internet-based childhood obesity prevention program (TIMc2bhealthy) for parents of preschool-aged children: randomized controlled trial	J. Med. Internet Res.	4.945	2019	4	104.00
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Alwashmi, M.F.; Hawboldt, J.; Davis, E.; Fetters, M.D.	The iterative convergent design for mobile health usability testing: Mixed-methods approach	JMIR mHealth and uHealth	4.301	2019	4	104.00
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Kitsios, F.; Stefanakakis, S.; Kamariotou, M.; Dermentzoglou, L.	E-service evaluation: User satisfaction measurement and implications in health sector	Computer Standards & Interfaces	2.441	2019	4	104.00
Lindner, P.; Miloff, A.; Zetterlund, E.; Reuterskiold, L.; Andersson, G.; Carlbring, P.	Attitudes toward and familiarity with virtual reality therapy among practicing cognitive behavior therapists: A cross-sectional survey study in the era of consumer VR platforms	Frontiers in Psychology	2.129	2019	4	104.00
Cho, Y.M.; Lee, S.; Islam, S.; Kim, S.Y.	Theories applied to m-health interventions for behavior change in low- and middle-income countries: A systematic review	Telemedicine and e-Health	1.996	2018	14	104.00
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Celesti, A.; Fazio, M.; Márquez, F.; Glikson, A.; Mauwa, H.; Bagula, A., Celesti, F.; Villari, M.	How to develop IoT cloud e-health systems based on fiware: A lesson learnt	Journal of Sensor and Actuator Networks	0	2019	3	103.00
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Chen, Y.; Crespi, N.; Ortiz, A.M.; Shu, L.	Reality mining: A prediction algorithm for disease dynamics based on mobile Big Data	Information Sciences	5.524	2017	22	102.01
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AlBar, A.M.; Hoque, M.R.	Patient acceptance of e-health services in Saudi Arabia: An integrative perspective	Telemedicine and e-Health	1.996	2019	2	102.00
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Kooistra, L.; Ruwaard, J.; Wiersma, J.; Van Oppen, P.; Van Der Vaart, R.; Van Gemert-Pijnen, J.; Riper, H.	Development and initial evaluation of blended cognitive behavioural treatment for major depression in routine specialized mental health care	Internet Interv.	0	2016	32	102.00
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Miramontes, R.; Aquino, R.; Flores, A.; Rodríguez, G.; Anguiano, R., Ríos, A.; Edwards, A.	PlaIMoS: A remote mobile healthcare platform to monitor cardiovascular and respiratory variables	Sensors	3.031	2017	21	101.00
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Prasad, M.; Manjunath, C.; Murthy, A.K.; Sampath, A.; Jaiswal, S.; Mohapatra, A.	Integration of oral health into primary health care: A systematic review	J. Family Med. Prim. Care	0	2019	0	100.00
Bhatia, R.; Taneja, U.	Factors affecting indian consumers' intention to use eHealth services	Journal of Health Management	0	2019	0	100.00
Farzana, S.; Islam, S.	Symmetric key-based patient controlled secured electronic health record management protocol	Journal of High Speed Networks	0	2019	0	100.00
Øvrelid, E; Halvorsen, M.	Supporting process innovation with lightweight IT at an emergency unit	Journal of Integrated Design and Process Science	0	2019	0	100.00
Eke, E.; Kisi, M.; Ugurluoglu, D.	A research on awareness of e-health practices	Journal of Mehmet Akif Ersoy University Economics and Administrative Sciences Faculty	0	2019	0	100.00

Author	Title	Journal	Impact Factor	Year	Citations	InOrdinatio 10
Anya, O.; Tawfik, H.; Alani, M.; Hu, J.	Cybersecurity design considerations for cross-boundary clinical decision support	J Reliab. Intell. Environ.	0	2019	0	100.00
Kruczek, A.	e-health—modern technologies in mental health care	Postepy. Psychiatrii. I. Neurologii.	0	2019	0	100.00
Costa, W.L.G.; Pereira, E.; Kontonatsios, G.	Use of smartphones for hypoglycaemia prediction—A feasibility study	Procedia Comput Sci	0	2019	0	100.00
Senges, E.; Guiot, D.; Chandon, JL.	Desired ageing well: Predictive validity for consumers aged 50-80	Recherche Et Applications En Marketing-English Edition	0	2019	0	100.00
Webers, C.; Beckers, E.; Boonen, A.; Van Eijk-Hustings, Y.; Vonkeman, H.; Van De Laar, M.; Van Tubergen, A.	Development, usability and acceptability of an integrated eHealth system for spondyloarthritis in the Netherlands (SpA-Net)	RMD Open	0	2019	0	100.00
Vesnic-Alujevic, L.; Pereira, A.G.; Breitegger, M.	Wearable sensors exploring EU policy narratives by engaging the extended peer community	Tecnoscienza	0	2019	0	100.00
Metz, M.J.; Veerbeek, M.A.; Elfeddali, I.; De Beurs, E.; Van Der Feltz-Cornelis, C.M.; Beekman, A.T.F.	Shared decision making in mental health care; evaluation of the added value for patients and clinicians	Tijdschr. Psychiatr.	0	2019	0	100.00
Allner, R.; Wilfling, D.; Kidholm, K.; Steinhäuser, J.	Telemedizinprojekte im ländlichen Raum Deutschlands. Eine systematische Bewertung mit dem "Modell zur Evaluation von telemedizinischen Anwendungen". TT—[Telemedicine projects in rural areas of Germany. A systematic evaluation with the "M"	Z. Evid. Fortbild. Qual. Gesundhwes	0	2019	0	100.00
Scherer, M.; Szecsenyi, J.; Gerlach, F.	Digitalisation in medicine—Who proceeds and who looks behind a plea for a DEGAM digital strategy [Digitalisierung in der medizin—Wer schreitet voran, wer schaut hinterher? Ein plädoyer für eine DEGAM-digitalstrategie]	Z. Allgemeinmed.	0	2019	0	100.00
Gebre-Mariam, M.; Bygstad, B.	What can enterprise architecture do for healthcare? A framework of antecedents and benefits	Electronic Government	0	2019	0	100.00
Ivanova, O.; Wambua, S.; Mwaisaka, J.; Bossier, T.; Thiongo, M.; Michielsen, K.; Gichangi, P.	Evaluation of the ELIMIKA Pilot Project: Improving ART adherence among HIV positive youth using an eHealth intervention in Mombasa, Kenya	African Journal of Reproductive Health	0.547	2019	0	100.00

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