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Taylor Arient	2667729
Kirsten Boerhorst	2185008
Dalia Fathi	2600770
Romée Coert	2577464
Renske Braken	2682686



List of abbreviations

Abbreviation	Definition
App	Application
DOI	Diffusion of Innovation
eHealth	Electronic Health
HCP	Healthcare professional
ICT	Information Communication Technology
mHealth	Mobile Health
TAM	Technology Acceptance Model
TPB	Theory of Planned Behaviour

Executive summary

Within healthcare, there is an increasing interest in eHealth and mHealth. These are digital technologies and interventions that support healthcare needs such as maintaining or collecting data. The development, adoption and implementation of these technologies involve several actors such as healthcare professionals, patients and healthcare insurance companies. However, there seems to be no consensus on how systems adopt eHealth and mHealth innovations. Therefore, the aim of this review is to contribute to the general understanding of factors that influence the adoption and implementation of eHealth- and mHealth apps by providing a comprehensive overview of actors' perspectives, barriers and facilitators for app adoption. The corresponding central research question is:

From a healthcare perspective, what is the current role of various actors in the adoption or implementation of e-health interventions in Europe?

With the following sub-questions:

- *What types of apps are there and for which medical indications are they used?*
- *What are barriers and benefits/facilitators of implementation?*
- *What are the perspectives (usability, adherence, etc.) of different actors?*

This review retrieved 387 articles with two search engines. Ultimately, 12 articles published between 2016-2020 were included for analysis and synthesis. These publications showed an increased interest in eHealth across many healthcare specialisations. The main barriers and facilitators per overarching theme were:

- Human resources:
 - Barriers: a lack of time, knowledge and a strategic plan.
 - Facilitators: training professionals and using leaders who endorse eHealth.
- Technology:
 - Barriers: a decrease in face-to-face communication, accessibility issues and a lack of technical support, ICT knowledge and interest in technology.
 - Facilitators: interactiveness and customisation options in apps, and opportunities to connect with doctors and other patients.
- Monetary means:
 - Barriers: a lack of budget and funds.
 - Facilitators: economic incentives for HCPs and a tax-based financing system for healthcare incentives.
- Data security:

- Barriers: worries about data security, privacy, confidentiality and third-party access to personal data.
- Facilitators: to have more clarity with privacy policies addressing data security, privacy, confidentiality and third-party access.
- Acceptance:
 - Barriers: A lack of acceptance among HCPs and patient advocates.
 - Facilitators: Have more experts and HCPs who believe in eHealth to endorse these apps.

Positive attitudes were related to confidence patients gained from apps, better medicine adherence, disease awareness and disease prevention. Negative attitudes were related to usability hurdles, reduced acceptance by HCPs and scepticism about the added value of eHealth apps.

This review provided insight into factors that influence eHealth app adoption and implementation. The results showed that there is an overall willingness to try eHealth apps. However, this was in a hypothetical setting, which gave overly positive results. Additionally, there was a shortage of proven added value. Data security was a main concern for all actors. The EU has security and privacy legislation in eHealth to protect its citizens.

A strength of this review is the use of two scientific databases to increase article diversity. Additionally, the research team consisted of five researchers, which allowed multiple perspectives and ensured thoroughness and consistency. Limitations were the lack of information on revenue- and business models and the absence of the perspectives of healthcare insurance companies.

Recommendations and suggestions for the MPA program were to:

- Offer a free trial period to end users to give them the opportunity to experience the added value of eHealth apps and potentially increase the number of users.
- Have a clear privacy and data policy in eHealth apps and include a consent form for end users.
- To be cautious with results of pre-market studies. Hypothetical approaches could give overly positive results.
- Convince patients of benefits of eHealth apps next to healthcare professionals.
- Explore what app functions are favourable to app users to make it more appealing for a bigger audience.

Future directions are that studies should include more types of actors, since app adoption and implementation does not only rely on patients and healthcare professionals. Additionally, to gain insight into the feasibility of app implementation, earning models should be researched.

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1 | Introduction

Currently, there is a growing interest in the use of electronic Health (eHealth) and mobile Health (mHealth) technologies within the context of healthcare. These mobile technologies have the potential to improve health research, prevent diseases, enhance diagnostics, advance treatments, increase the access to healthcare and can possibly reduce healthcare costs (Nilsen, 2012). EHealth and/or mHealth are broad concepts that are used to describe various forms of digital technologies and interventions used by all sorts of stakeholders (Shaw, 2017). Because these concepts are really broad, it is difficult to find a well-defined definition (Shaw, 2017; Eysenbach, 2001). In this literature review, the following definition is used: *“e-health is an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies. In a broader sense, the term characterizes not only a technical development, but also a state-of-mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve healthcare locally, regionally, and worldwide by using information and communication technology”* (Eysenbach, 2001, p.1). However, this review does not include all types of eHealth, but will focus on the use of mobile health applications (apps). Here, an eHealth app is defined as a form of software that can be downloaded on a mobile device, such as a smartphone or tablet computer, and used to manage, transmit, or store health information. The app provides its users with similar functions as to the ones on PCs. Generally, apps are small, individual software units with a limited function (Techopedia, 2020).

Several actors are involved in the use and development of eHealth and/or mHealth innovations. For example, patients, care providers/healthcare professionals (HCPs), healthcare insurance companies and eHealth companies. EHealth companies aim to sell IT products which satisfy the needs of healthcare workers in terms of developing eHealth products that facilitate providing the right care to the right patient in any time and place. HCPs are interested in adopting mHealth into healthcare to improve quality, safety efficiency of healthcare (Catwell & Sheikh, 2009). However there are several issues that arise with this interest. For example, it is of importance that health workers' information needs are integrated in healthcare technology and besides, it needs to be suitable for usability requirements and the workflow (Yu, Wu, Yu & Xiao, 2006). Furthermore, health insurance companies are interested in the adoption of eHealth and mHealth because the integration of eHealth and mHealth can help them obtain patients' health information (Zubaydi, Saleh, Aloul & Sagahyroon, 2015). Finally, mHealth can also be used for patients as a platform to educate and engage them and provide continuous care at distance (Martin, 2012).

There is limited scientific evidence available which proves the effectiveness of mHealth innovations. However, governments and organisations of various countries collectively believe that mHealth is the

backbone of an informed and thus, empowered patient (Gagnon, Ngangue, Payne-Gagnon & Desmartis, 2015). Additionally, eHealth is relatively new in healthcare research and therefore, knowledge on the adoption of eHealth in healthcare is still limited (Faber, van Geenhuizen & de Reuver, 2017).

This review was commissioned by the Athena institute in order to investigate how systems adopt (eHealth) innovations, with the role of earning models as a major factor. This study focuses on eHealth and mHealth adoption Europe; in this research this is the European continent instead of the European Union. This is due to Brexit and the fact that countries such as Norway and Switzerland are not part of the EU, while it is interesting to study them because of their similar healthcare systems. By investigating the added value of eHealth and mHealth apps, this review seeks to contribute to the general understanding of factors that influence the adoption and implementation of eHealth- and mHealth apps by providing a comprehensive overview of actors' perspectives, barriers and facilitators for app adoption. From this research objective, the following research question was formulated: *From a healthcare perspective, what is the current role of various actors in the adoption or implementation of e-health interventions in Europe?*

In order to answer this research question, the topic is split in three sub-questions:

- *What types of apps are there and for which medical indications are they used?*
- *What are barriers and benefits/facilitators of implementation?*
- *What are the perspectives (usability, adherence, etc.) of different actors?*

2 | Theoretical background

In this chapter, the theoretical background of the current approach will be explained. Firstly, an important concept, namely *innovation* needs to be defined. In this review, *innovation* is contextualized as any eHealth or mHealth application that is used in the monitoring of patient health data or records. In the next paragraphs, three possible theories or frameworks regarding implementation and the adoption of health technologies or innovations will be enlightened. Each framework will be briefly explained and consequently, the best fitted one will be selected.

To structure the coding process and to analyse the barriers and facilitators in eHealth (innovation) adoption and implementation, several theories were considered. One of such frameworks is the Technology Acceptance Model (TAM). This model is a rational choice theory commonly used to study technology adoption that assumes all people seek profit and benefit maximization when evaluating technology. However, due to the inclusion of seven countries a consistent value system cannot be assumed, deeming this theory as unfitting (Hillmer, 2009).

A second theory that could be useful and is frequently used in technology adoption research is the Theory of Planned Behaviour (TPB) (Ajzen, 1991). This theory states that a person's behavioural change depends on both motivation (intention) and ability (behavioural control). A distinction between three types of beliefs can be made: behavioural, normative, and control. Due to the analysis of factors influencing individual adoption rather than organisational, this theory was also deemed as inappropriate for this review.

The last potential theory is the Diffusion of Innovation (DOI) theory (Rogers, 1983). This theory explains how the perceived attributes of an innovation affect its rate of adoption. As described by DOI theory, the five attributes of innovations are relative advantage, compatibility, complexity, trialability, and observability. *Relative advantage* is defined as the degree to which the user views the innovation as being better than an innovation that replaces. Depending on the user and the innovation, relative advantage can be viewed in terms of economic or social impact. The perceived relative advantage of an innovation is positively related to its rate of adoption. Due to this positive relationship, incentives may be paid to adopters in the form of money or other commodities that encourage a change of behaviour, in this case the adoption of an innovation. Rogers draws the following conclusions in regards to incentives: 1) incentives increase the rate of adoption, 2) incentives lead to adoption of an innovation by individuals who differ from those who would normally adopt, and 3) individuals who adopt an innovation to receive the incentive have less motivation to continue using the innovation in the long-term. The second attribute that contributes to the adoption of an innovation is *compatibility*, defined as

the degree to which an innovation is perceived as consistent with its users' existing values, past experiences, and needs. The third attribute that negatively influences the rate of adoption is the *complexity* of an innovation. Complexity is defined by the DOI theory as the degree to which the user perceives the innovation as difficult to understand or use. Complexity is most commonly operationalised as the length of time it takes to learn how to use an innovation. The fourth attribute that positively influences the rate of adoption of an innovation is the *trialability*. Trialability is the degree to which an innovation can be experimented with. Due to a higher uncertainty, early adopters of an innovation view trialability as more important than later adopters. The last attribute positively influencing the rate of adoption is *observability*. Observability is the degree to which the results or the effects of an innovation can be observed.

Ultimately, the DOI was chosen as the best fitted theory. The reason for using DOI theory can be justified by its ability to investigate innovation adoption from a broad perspective, which is in line with the objective of the research question. The inclusion of five factors that influence adoption increases the structure of this review since the adoption factors are previously defined. The adoption factors defined in the DOI theory can be associated with barriers and facilitators to adoption, another objective that our research question aims to achieve.

3 | Methods

The articles used for this review were retrieved with two search engines and critically assessed by five independent researchers. §3.1 describes the search strategy, §3.2 and §3.3 present the inclusion and exclusion criteria. Then, §3.4 describes the relevance assessment of the articles. Finally, §3.5 describes the critical review of the data.

3.1 Search strategy

Based on the theoretical framework, four search strings were combined and used in both databases. During the search, Boolean operators were used to retrieve relevant literature. The complete syntax is listed in Table 1.

Two search engines were used to collect data for this review: Web of Science and Scopus. Web of Science is a database that covers a multitude of academic disciplines, such as science, social science and humanities. This well-established search engine provided a broad scope for the literature search. Scopus also covers a multitude of disciplines, such as health science and life science. Due to the nature of the central research question, these databases gave a broad overview on publications within our scope. Additionally, the use of two search engines gave a more complete set of publications.

Table 1: Syntax for Web of Science ‘topic’ search and Scopus ‘article title, abstract keywords’ search.

	E-health apps AND	Earning models AND	Actors AND	Implementation
OR	lifestyle	“Business model”	"healthy patient*"	implementation
	“chronic diseases”	“Earning model”	patient*	adoption
	“mental health”	“added value”	"healthcare professional*"	usage
	“monitor* medical data”	“Revenue model”	"healthcare insurance compan*"	utilisation
	“monitor* health”	benefits	"health care insurance compan*"	utilization
	“mobile health management”			acceptance
	m-health		"medical specialis*"	endorsement

	e-health		psychologist*	use
	ehealth		psychiatrist*	
	mhealth		caregiver*	
	ICT		"care giver*"	
	"health information technology")		doctor*	
	AND (Application* OR app*)		nurse*	
			dieticia*	
			general practitioner*	
			GP	

3.2 Inclusion criteria

Peer-reviewed articles were included if they met the following inclusion criteria: 1) Describe the added value of the use of eHealth or mHealth applications. 2) Studies focussed on the barriers and drivers for health app adoption and use. 3) Articles focused on perspectives of the actors involved in mobile application use. 4) The success of application adoption and reimbursement of eHealth was explained. 5) Studies that were conducted in the European continent due to differences in global healthcare systems. 6) Only articles published between 2016 -2020 were included, due to vast advancement of the eHealth field. Older publications would be outdated by now. 7) Qualitative, quantitative, or mixed methods study designs.

3.3 Exclusion criteria

Due to the scope and the timeframe of this research, several exclusion criteria were used: 1) articles not written in English or without open access, 2) reviews were excluded due to complexity and comparability of studies, 3) studies conducted outside of the European continent 4) studies focussed on COVID apps, telemedicine in general, development of apps, 5) studies lacking stakeholder perspectives, or with a small sample size (<20) and 6) Grey literature was excluded and only published peer-reviewed articles included, since these publications provide validated knowledge.

3.4 Assessment of articles for relevance

The database searches initially produced 448 hits, of which 387 papers remained when duplicates were removed. From these 387 articles, titles and abstracts were reviewed by five researchers: every article was checked by two independent researchers. In an Excel file, the researchers indicated if they wanted to include or exclude the article. When both researchers marked the article as potential, it was chosen for full text read. If two researchers did not agree or indicated that they were not sure about inclusion, a third researcher assessed this article. This strategy resulted in 72 selected articles for full text read. Next, the same procedure was conducted for the full article read (two independent researchers per article). As a result, 12 articles were selected for this review and the final list of articles was discussed by all authors. Figure 1 provides a flowchart of the selected articles in this literature review. Appendix A2 provides an overview of the 14 articles that remained for thorough analysis

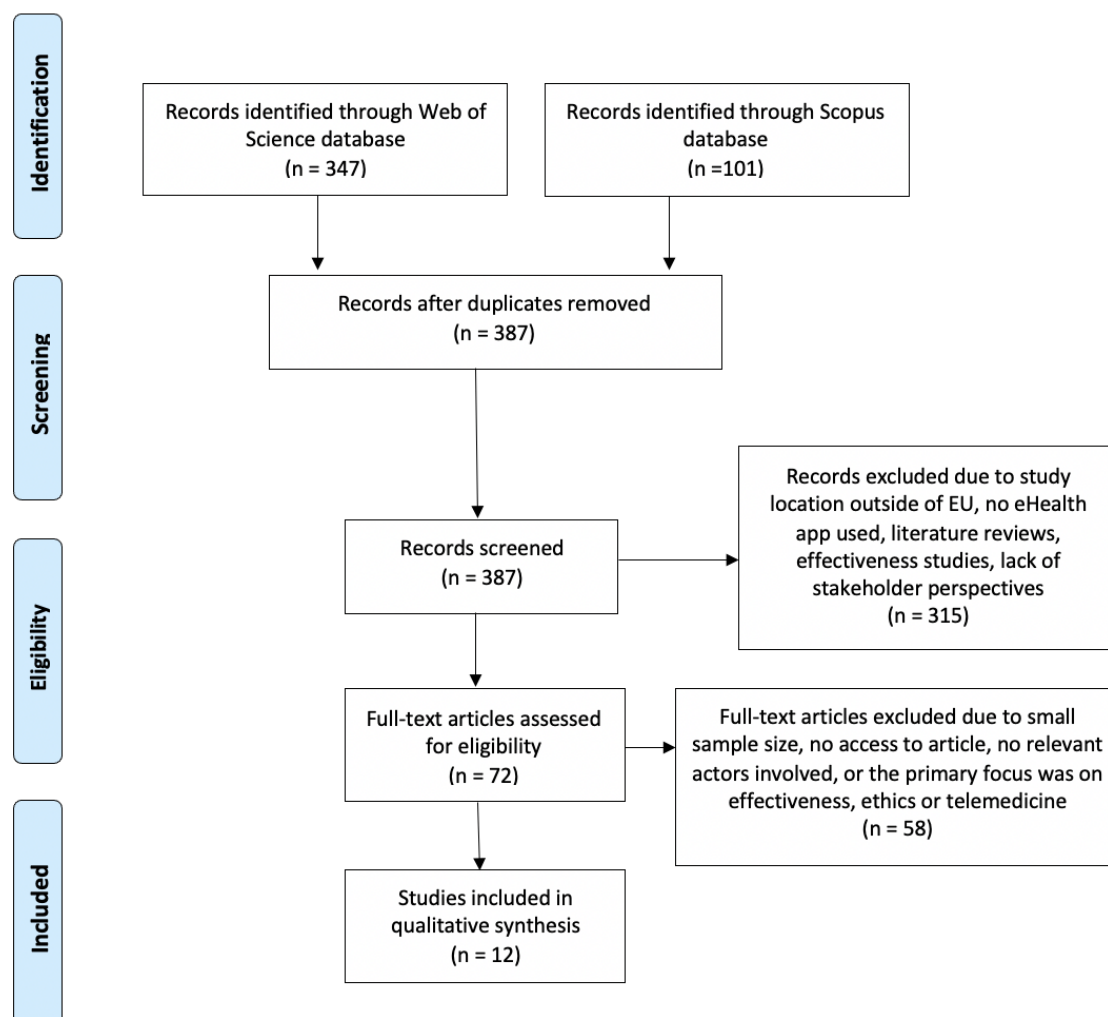


Figure 1: Process of article selection (PRISMA flow diagram)

3.5 Critical review of the literature

The critical appraisal of the literature was done in two phases. First, the researchers read all the articles to familiarise with the data. Then, the data was extracted of all the articles by means of a data extraction form in Excel. This gave an overview of the study regions, context and participants, study design and methods, findings and implications of each article.

Second, all articles were coded by means of a coding sheet. A coding guide was made based on *a priori* concepts defined by the theoretical framework. This coding guide was adapted during the coding process when new subcodes or themes were uncovered by the data. Each article was coded by two independent researchers in Atlas.ti. During analysis and synthesis, overarching themes were identified.

4 | Results

This chapter presents the results from the literature review. First, general findings are presented in §4.1. §4.2 elaborates on the types of apps and their corresponding medical indications that were found in the literature. §4.3 describes the definitions of e- and mHealth used, §4.4 outlines barriers and facilitators of eHealth app implementation, §4.5 describes actors' perspectives and lastly, §4.6 gives a brief summary of the most important results of this review.

4.1 General findings

Twelve articles were found that discussed actors' opinions on eHealth applications or interventions. An overview of the 12 studies can be found in Table 2. The selected articles were published between the years of 2016 and 2020 to gather the most recent perspectives as described in the inclusion criteria.

Table 2: Overview of final 12 articles

Title	Author	Year
Prevailing Opinions on Connected Health in Austria: Results from an Online Survey	Haluz, D.; Naszay, M.; Stockinger, A.; Jungwirth, D.	2016
Information and communication technology and the future of healthcare: Results of a multi-scenario Delphi survey	Jungwirth, D., & Haluz, D.	2017
Perceptions of Patient Engagement Applications During Pregnancy: A Qualitative Assessment of the Patient's Perspective	Goetz, M., Müller, M., Matthies, L. M., Hansen, J., Doster, A., Szabo, A., Wallwiener, S.	2017
Need for general practitioner involvement and eHealth in colon cancer survivorship care: patients' perspectives	Nugteren, IC; Duineveld, LAM; Wieldraaijer, T; van Weert, HCPM; Verdonck-de Leeuw, IM; van Uden-Kraan, CF; Wind, J.	2017
Effects of a long-term smartphone-based self-monitoring intervention in patients with lipid metabolism disorders	Steinert, A., Eicher, C., Haesner, M., & Steinhagen-Thiessen, E.	2018
Exploring the Specific Needs of Persons with Multiple Sclerosis for mHealth Solutions for Physical Activity: Mixed-Methods	Giunti, G., Kool, J., Rivera Romero, O., & Dorronzoro Zubiete, E.	2018
Mobile Health Adoption in Mental Health: User Experience of a Mobile Health App for Patients With an Eating Disorder	Anastasiadou, D., Folkvord, F., Serrano-Troncoso, E., & Lupiáñez-Villanueva, F.	2019
Patients' Needs and Requirements for eHealth Pain Management Interventions: Qualitative Study	Ledel Solem, I., Varsi, C., Eide, H., Kristjansdottir, O., Mirkovic, J., & Børøsund, E.	2019
Adoption and Attitudes of eHealth Among People Living With HIV and Their Physicians: Online Multicenter Questionnaire Study	Jacomet, C., Ologeanu-Taddei, R., Prouteau, J., Lambert, C., Linard, F., Bastiani, P., & Dellamonica, P.	2020
Influence of the Business Revenue, Recommendation, and Provider Models on Mobile Health App Adoption: Three-Country Experimental Vignette Study	Lupiáñez-Villanueva, F., Folkvord, F., & Abeele, M. V.	2020
Integrated Care Programs for People with Multimorbidity in European Countries: eHealth Adoption in Health Systems	Melchiorre, M., Papa, R., Quattrini, S., Lamura, G., & Barbabella, F.	2020
Mobile Health Usage, Preferences, Barriers, and eHealth Literacy in Rheumatology: Patient Survey Study	Knitz, J., Simon, D., Lambrecht, A., Raab, C., Tascilar, K., Hagen, M., Hueber, A. J.	2020

4.2 Types of apps and corresponding medical indications

Several types of eHealth innovations and corresponding targeted health conditions were discussed by the articles included in this review. The types of eHealth innovations and their corresponding health indications are shown in Table 2. Studies were included with a wide variety of health indications to achieve a scoping view of published literature on eHealth interventions. This wide variety shows the increasing population in the use of eHealth across all specialisations.

Table 3: Overview of article topics and countries

Country	Year	Sample	Type of Innovation	Targeted Health Indication
The Netherlands	2017	20 patients with stage I-III colon cancer	Self-management for cancer survivorship via interactive website	Colon cancer
Spain, Germany & The Netherlands	2020	2,016 consumers	Hypothetical lifestyle tracker apps	Health behaviour tracking
Germany	2020	193 adult patients	Mobile app for disease monitoring	Rheumatic diseases
Austria	2016	562 adult patients	General e-health and telemedicine	Health behaviour tracking
Switzerland	2018	12 patients & 12 health professionals	Mobile health application for patients with MS	Multiple sclerosis
Germany	2017	30 pregnant women	Mobile and web based patient engagement pregnancy apps	Pregnancy
Austria	2019	73 Austrian healthcare experts	Hypothetical telehealth software and monitoring solutions	No specific disease
France	2020	279 HIV patients & 219 physicians	eHealth application for people living with HIV	HIV
Europe (24 countries)	2020	Mapping of 85 eHealth tools	Evaluation of eHealth applications for	Multimorbidity (Multiple chronic diseases)
Germany	2020	100 patients	Smartphone application for lipid metabolism disease management	Lipid metabolism disorders
Norway	2019	20 patients with chronic pain & 5 spouses	eHealth pain management intervention	Pain management
Spain	2019	11 experts on mHealth, 10 healthcare professions, 8 eating disorder specialists, & 9 patients with an eating disorder	mHealth tool (TCAApp) for self-management of eating disorders	Eating disorder

4.3 Mobile/Electronic health defined

An initial finding of this review was that the various articles defined mobile health and electronic health in different ways. Some articles used previously accepted definitions from organizations such as the World Health Organization which states that *electronic health is the application of communication and information technologies to all activities connected to health* (Jacomet, et al., 2020). One article makes a clear distinction between eHealth and telemedicine stating that eHealth is any internet-based health

service while telemedicine is used to refer to “tele”-labeled services that uses information communication technology (ICT) to exchange medical information, such as telemonitoring (Jungwirth & Haluza, 2017). Overall, it was found that electronic and mobile health are broad terms encompassing many types of technological advances in healthcare and it is necessary to pre-define the terms prior to investigating adoption factors.

4.4 Facilitators and barriers

The articles reviewed in this literature review revealed several barriers and facilitators of the implementation of eHealth application(s). Table 4 provides an overview of the identified themes and the corresponding barriers and facilitators. Below Table 4 the themes will be discussed.

Table 4: Overview of the themes and the corresponding barriers and facilitators.

Theme	Barriers	Facilitators
Human resources The amount of manpower and personnel needed for app implementation	Lack of strategic plan Lack of time (HCP and patients) Lack of knowledge (HCP and patients)	Training professionals Having leaders who believe in eHealth Organisations are supposed to assimilate innovations better if they are (among other factors) managed through <i>decentralised decision making</i>
Technology The digital necessities in order to be able to implement and use an eHealth app	Access to mHealth is not always easy for end users No interest in technology / not enough ICT knowledge Lack of technical support Decrease in face to face communication	Customisation options of apps Interactiveness Opportunities to connect with other patients or doctors
Monetary means All types of financial means that support the implementation of eHealth apps for app providers and app users	Lack of budget	Tax-based financing system for healthcare incentives Economic incentives for HCP
Data security The safety app users need in order to trust the app and to feel free to share personal data in the app	Participants worry about privacy & security of data Professionals also worry about security and confidentiality	Addressing aspects of privacy, confidentiality and data security necessary for good implementation of eHealth

	Worries about unauthorized third-party access	
Acceptance The beliefs held by several actors in eHealth apps.	Lack of acceptance by patient advocates Lack of acceptance by HCPs	Having leaders who believe in eHealth

4.4.1 Human resources

One identified theme was ‘human resources’, which included several barriers and facilitators. An interesting barrier was the lack of a strategic plan from leaders. According to Anastasiadou (2019) and colleagues this hampers the adoption of eHealth applications in healthcare. By introducing key opinion leaders that believe in eHealth, the innovation can be pushed forward (Anastasiadou, 2019). In addition, the study of Melchiorre et al. (2020) suggested that organisations should be managed through decentralised decision making in order to assimilate innovations. Furthermore, a lack of knowledge for both HCPs and patients was found. HCPs are not always trained in the use of eHealth applications (Anastasiadou, 2019). Therefore, HCPs are uncertain to implement eHealth applications. This barrier could be solved by training HCPs in how to use eHealth applications and clearly show the benefits (Anastasiadou, 2019). The benefits should also be made clear to patients. Giunti (2018) and Goetz (2017) found that patients often do not understand the advantages of an eHealth application. They want to know why an eHealth application is useful (Giunti, 2018; Goetz, 2017). Thus, a knowledge base of the application should be developed. Besides the lack of clear benefits, patients do not fully understand the technology itself, resulting in a fear of the unknown and the potential to not adopt the innovation (Anastasiadou, 2019; Giunti, 2018; Goetz, 2017; Melchiorre, 2020; Steinert, 2020; Jungwirth, 2019). The last human resource barrier was the lack of time and an increased workload for both HCPs and patients. Because the eHealth application could be time consuming, HCPs and patients were more likely not to adopt it (Anastasiadou, 2019; Giunti, 2018).

4.4.2 Technology

The next theme was ‘technology’, including barriers and facilitators related to the use of eHealth applications. Two articles stated that the access to eHealth applications is sometimes difficult for patients (Anastasiadou, 2019; Giunti, 2018). In order to adopt an eHealth application, it needs to be widely accessible. Another barrier is the fact that there are participants that are not interested in the technology (Giunti, 2018). This could also be related to having little or no knowledge on eHealth. By implementing an eHealth application, a decrease in face to face communication between doctor and patient could be observed. According to HCPs and patients this is a major barrier which could have an

influence on the relationship between the doctor and patient (Anastasiadou, 2019; Giunti, 2018; Haluza, 2016). Therefore, this should be taken into account when implementing eHealth applications. Next to these barriers, also technology managing issues are a problem. For example, within the study of Anastasiadou (2019) a lack of support from the information technology team was observed and in the study of Haluza (2016), a lack of system interoperability was found. This suggests that the collaboration with ICT related teams is very important. Both HCPs and patients mentioned several customisation options of apps such as: increased playfulness in the app, clarity in features, promises and solid scientific backing, personal touch in the app and feedback from the app (Giunti, 2018; Goetz, 2017). These desired features could be integrated in future eHealth applications.

4.4.3 Monetary means

The third identified theme was monetary means. A common barrier was the lack of budget for eHealth app adoption due to scarcity of funding. Additionally, HCP's indicated that the return of investment is difficult to measure. Furthermore, eHealth app implementation requires an IT team to guarantee an up-to-date system and devices, which makes the process costly (Anastasiadou 2019; Jungwirth, 2019; Melchiorre, 2020). According to Jungwirth (2019), scarcity of funding ensures that money is more likely spent on direct health promotion than a costly implementation process.

However, eHealth apps could reduce patients' visits to HCPs. This could become more cost-effective in the long run (Anastasiadou, 2019). Additionally, when several actors such as patients, governments, and HCPs would collaborate together, the added value of eHealth could be enforced. Another monetary proposed facilitator for health app adoption was a tax-based financing system. This system would give monetary incentives to promote eHealth adoption and implementation (Melchiorre, 2020). Nonetheless, HCPs were not unanimous when they were asked if financial incentives would work as a driver of eHealth app adoption. Some would consider app adoption with financial incentives, others indicated they would like to see other kinds of incentives, such as training for HCPs, because monetary incentives would be less effective in the public sector (Melchiorre, 2020).

4.4.4 Data security

The fourth theme was data security. More than half of the articles agreed that data security was one of the greatest hurdles in eHealth app adoption. Five authors described that patients value their privacy. A large portion of existing eHealth apps do not have a transparent privacy policy, which makes it difficult for users to decide what happens to the data they share (Giunti, 2018; Goetz, 2017; Haluza, 2016; Jacomet, 2020; Jungwirth, 2019). On top of that, there were concerns about what the data could be used for. For example, patients are worried about unauthorised access to their data by third parties (Jacomet, 2020). Additionally, four articles describe that there are concerns about confidentiality, since patients

are sharing personal information in these apps. It is not always clear who owns the data that patients willingly share in their apps (Anastasiadou, 2019; Haluza, 2016; Jacomet, 2020 Knitza, 2020). Lastly, storage and safety of personal data is a barrier for app adoption. As technology develops, data security of eHealth apps could be compromised. For example, some patients are worried that personal data in eHealth apps could be viewed or used by other apps on their phone (Anastasiadou, 2019; Goetz, 2017; Haluza, 2016; Jungwirth, 2019; Knitza, 2020).

This stresses that data security, confidentiality and privacy should be addressed and ensured for eHealth app adoption. For example, Knitza (2020) described that these aspects were strict conditions for patients to share their data with eHealth apps.

4.4.5 Acceptance

The last identified theme was the acceptance of eHealth apps. Three authors stated that there is resistance and a lack of app acceptance from HCPs (Anastasiadou; 2019; Giunti, 2018; Haluza, 2016; Jungwirth, 2019). One reason for implementation resistance was that people who are not familiar with technology, would be less drawn to eHealth apps and chances are that they would never use them (Giunti, 2018). Another reason was fear of the unknown, which maintains the unfamiliarity with apps (Anastasiadou, 2019). Additionally, Jungwirth (2019) indicated that HCPs, patients and administrative personnel perceived a lack of patient advocates. However, it is unclear what the main barriers were for these patients. In order to overcome this barrier, Giunti (2018) and Haluza (2016) suggest that app endorsement of experts and HCPs is important: *'acceptance ultimately depends on its acceptance among health professionals and the general population alike'* Haluza (2016, p.2).

4.5 Actors' perspectives

4.5.1 Positive attitude

Patients' and caregivers' attitudes towards the usage of eHealth were assessed. In this literature review, a variety of eHealth interventions were included for several diseases and purposes. eHealth applications in colon cancer patients were perceived to have an increasing effect on raising awareness and recognition towards the symptoms and concerns of the disease (Nugteren et al., 2017). Rheumatology patients were also positive on the usage of mobile apps and diaries, since it helps improve medication adherence (Knitza et al., 2020). Connected health innovations appeared to help patients gain confidence in using health technologies, by highlighting the benefits and addressing the concerns. Additionally, this also helped the patients to become less sceptical towards connected health (Haluza, Naszay, Stockinger & Junwirth, 2016). Goetz et al. (2017) gathered data on the perspectives of pregnant women

on the use of Web sources to gain knowledge during their pregnancy. The majority of women prioritized the integration of technology to detect and prevent early pregnancy related complications.

4.5.2 Negative attitude

Patients also had negative attitudes towards integrating eHealth applications. The majority of pregnant women were critical about the lacking scientifically validated Web sources on relevant pregnancy related topics such as: foetal development, nutrition or pregnancy related complications (Goetz et al., 2017). In addition, doctors also had a negative attitude towards eHealth. The lack of acceptance of the implementation of connected health services by doctors was among the top three ranked most important factors for hampering the implementation of connected health services due to the usability deficiencies of the connected health services. Examples of usability deficiencies are system failures and lacking integration of the systems which lead to the reduction of efficiency of the clinical ICT use and thus it hampers the physician's routine work. It has also appeared that doctors are more sceptical in regard to innovative technology in comparison to other health-related professionals (Haluza, Naszay, Stockinger & Junwirth, 2016). In a study on the long-term effects of smartphone based self-monitoring it appeared that the participants never or rarely used the self-monitoring app since they found it to be not useful and requiring too much effort to use. Participants also reported that the disease managing purpose of the app was useless and therefore they stopped using the app (Steinert, Eicher, Haesner & Steinhagen-Thiessen, 2018). Finally, using eHealth in pain management was also negatively perceived. Patients with chronic pain found pain management apps to be too depressing to use (Ledel Solem et al., 2019).

4.6 Summary of results

For this review, 12 articles published between 2016-2020 were critically assessed, synthesised and analysed. These articles covered a variety of health indications, this indicates that eHealth app use is increasing among several medical specialisations, and it helped to get a broad overview in eHealth app use. The main barriers and facilitators of eHealth app implementation could be grouped in overarching themes:

- Human resources: there is an overall lack of time and knowledge among HCPs and patients and a lack of a strategic plan. Training professionals and using leaders who believe in eHealth would facilitate app adoption.
- Technology: main barriers are a lack of technical support and ICT knowledge, no interest in technology, a decrease in face-to-face communication and accessibility problems for end users. Main facilitators were interactivity and customisation options in apps, and the opportunity to connect with doctors and other patients through the apps.
- Monetary means: there currently is a lack of budget and funds. Economic incentives for HCPs and a tax-based financing system for healthcare incentives would drive app adoption.

- Data security: patients and doctors worry about data security, privacy, confidentiality and third-party access to personal data. Addressing these aspects in privacy policies of these apps would give more clarity.
- Acceptance: there is a lack of acceptance among HCPs and patient advocates. A possible facilitator would be to have more experts and HCPs who believe in eHealth to endorse these apps.

Among patients and caregivers, there were both positive and negative attitudes towards eHealth apps. Actors were mostly positive about the disease awareness the apps give, the confidence patients get from health technology use and the influence apps could have on medicine adherence and prevention and early detection of disease. The negative attitudes were mostly related to reduced acceptance among HCPs due to usability hurdles like system failures and scepticism about the added value of eHealth in healthcare. Patients were reported to have negative attitudes when app information was not scientifically validated.

5 | Discussion

This research contributed to a better understanding of eHealth and mHealth implementation by uncovering factors that drive or hinder app adoption. In this discussion chapter, §5.1 addresses the key messages, §5.2 elaborates on the strengths and limitations, §5.3 reflects on the theoretical model and §5.4 addresses implications and future research. The aim of this review was to contribute to the general understanding of factors that influence the adoption and implementation of eHealth and mHealth applications by investigating the added value of eHealth and mHealth apps and providing insight into actors' perspectives, barriers and drivers for app adoption. This objective was obtained by answering the research question: *From a healthcare perspective, what is the current role of various actors in the adoption or implementation of e-health interventions in Europe?*

With the sub questions:

1. *What types of apps are there and which medical indications?*
2. *What are barriers and benefits/facilitators of implementation?*
3. *What are the perspectives (usability, adherence, etc.) of different actors?*

5.1 Key findings

In this review, several key findings could be identified, which are stated below in Table 5. These key messages are derived from the results and are topics that occurred in the main findings of all 12 articles. In the following paragraphs the key messages of willingness to try eHealth applications, the lack of proven value and concerns of data security, will be further explained.

Table 5: Key findings derived from results

	1. Willingness to try eHealth applications Most people, both HCPs and patients, are open to the use of eHealth applications
	2. Lack of proven added value Across the reviewed articles, it became clear that there is a lack of proven added value of apps (what does it add for participants)
	3. Data security Data security is important and should be thought of carefully when implementing eHealth applications (many participants worry, HCP's are also worried)

5.1.1 Willingness to try eHealth applications

The first key message states that both patients and HCPs expressed an openness to the use of eHealth applications, regardless of the medical application or country. Although there is a strong willingness to try eHealth apps, this is rarely seen in practice since multiple reviews reported low numbers of patients who have used an eHealth app before. This finding suggests a discrepancy between patients' opinion on eHealth apps and how they actually behave when presented with the option to use them.

One reason for this discrepancy may be due to a lack of education and awareness on eHealth adoption for both the providers and patients. For the patients to actually use the app, there are multiple cognitive factors that have been investigated to bridge the gap between willingness to use and actual use (Cho, Park, & Lee, 2014). Such studies state that improved eHealth literacy and health consciousness both lead to a higher rate of adoption.

Along with patients, providers also stated their willingness to try eHealth applications to form their own opinions and evaluate the applications. For providers to recommend an app, they must feel comfortable with the accuracy and the scientific data presented by the app. One study argues that regulations or standards to evaluate eHealth apps' quality should be put in place and in doing so, providers would be more confident and willing to use such apps (Larson, 2018).

Lastly, this finding of a strong willingness to try eHealth applications could be explained by eight out of the 12 articles in this study only studying the hypothetical use of an app and not the actual use. When patients or providers are asked hypothetically if they would use an application, it is more likely for them to say yes than when committing to use the app, resulting in overly positive results. Therefore, this may lead to the discrepancy between the number of patients and providers who are willing to try out eHealth apps and usage rates of eHealth apps in practices. The low usage rates in practice despite a strong willingness to try eHealth apps initially may also be explained by other reasons such as a lack of proven added value, as explained in the following key finding.

5.1.2 Lack of proven added value

The results stated that for eHealth apps there is a shortage of proven added value. Some actors were sceptical about the potential benefits and others questioned what the long-term improvements would be for the healthcare system. Steinert et al. (2018), reported on the long-term use of a smartphone based self-monitoring application. In this study, 34.4% (n=21) reported to rarely or never use the self-monitoring smartphone-based application due to the disease managing purpose of it being not useful and requiring too much effort (Steinert, Eicher, Haesner & Steinhagen-Thiessen, 2018). In another study on patient perspectives on eHealth during pregnancy, 60% (n=18) of the participants had a positive attitude towards the rise of the eHealth movement. Despite the positive attitude towards the rise of the

eHealth movement, patients still thought that it cannot replace individual medical care (Goetz et al., 2017). In pain management patients, apps for pain management were perceived to be too depressing to use. However, patients also thought that using eHealth carries the potential to provide data and support (Ledel Solem et al., 2019). These findings are contradicting, since they show that although patients are interested in integrating eHealth in healthcare, it does not imply that they will use it. In addition to that, the findings also imply that the participants find that there is a lack of proven added value of the eHealth interventions.

The contradicting perceptions on eHealth and its usage can be explained by an overestimation of the positive perception of using the intervention and response bias by the participants. Prior to the release of a new product, a market-orientation process is performed. Market-orientation culture is perceived as a competitive means to launch the product and is therefore positively associated with the performance of the market performance of the product (Langerak, Hultink & Robben, 2004). This can explain how the users of eHealth applications show a positive attitude towards eHealth initially, which does not match the usage of the technology. In addition to that, positive attitudes of the participants can also be a consequence of response bias, in which the participants are providing socially desirable and untruthful answers in order to maintain a positive attitude towards the eHealth technology (Van de Mortel, 2008).

5.1.3 Data security

With regards to data security, it was considered important by both users of the app and HCP's to ensure the security of personal data. As mentioned earlier in this report, more than half of the included articles in this review mentioned that data security was one of the greatest barriers for adopting an eHealth app. Especially patients value their privacy and want to have control over what happens to their personal data. There should be no unauthorised access to the data by third parties and it should be clear where the data is stored.

According to Martinez-Perez et al. (2014), there are already some restrictive points stated in the EU law regarding security and privacy in mHealth. The main points of this are 1) data that contains information that could identify a person should be covered, 2) consent of the user should be obtained when collecting data, 3) a clear data retention policy should be mentioned by the organisation of the app, 4) a possible data breach should be notified to both the authority as the user whose data has been compromised, and 5) consent of the user is needed in order to transfer data to a third party. This implies that for adoption of an app, patients should be informed about this applicable law and associated safety requirements.

However, an analysis done by Adhikari et al. (2014) indicates that there still are mHealth apps available in app stores which have privacy and security issues. For improving this, alterations should be made in

app development guidelines and security authentication. For instance, passwords, encryption mechanisms and informative privacy policy. For these reasons, the study also stresses the importance to both HCP's and users of being cautious when adopting mHealth apps.

5.2 Strengths and limitations

In this review several strengths could be distinguished. One strength of this review was the use of two scientific databases, which resulted in an increase in the diversity of articles found. Moreover, it increased the breadth of articles reviewed and created a thorough review of published articles. Another strength was the use of a research team consisting of five researchers, this allowed for multiple perspectives and ensured a consistent coding process (Berends et al., 2009). With the research team, each article was independently reviewed twice during the selection process and coded twice to ensure thoroughness and consistency.

The present review also has some limitations. Twelve articles were included that analysed actors' perspectives on eHealth applications. From these articles, only one provided information on how the revenue models of an application can influence adoption (Lupiáñez-Villanueva, 2020). This may be due to the type of databases that were used since no market research-based databases were used. The lack of information about revenue models of an application in this review could be a limitation because this factor is also important for the implementation of eHealth innovations (Hwang & Christensen, 2008). Another limitation was the lack of healthcare insurance companies as an actor since the articles included only focused on the perspectives of patients and healthcare professionals. This is a limitation since health insurance companies are still a major stakeholder and their perspective is relevant to holistically understand the factors influencing eHealth adoption.

5.3 Reflection on theoretical model

The conceptual model used in this literature review, Roger's DOI, is a very broad model and can be applicable to multiple topics besides the current topic (Rogers, 1983). Recently, Rogers' DOI has been used to study the adoption of new healthcare information technologies (Zhang et al., 2015). Several studies confirmed that this theory is useful for understanding technology adoption in the context of health technologies (Chew et al., 2004; Zhang et al., 2015). Therefore, this theory fitted well with the research objective. Because the framework is broad, the results of this review were also broad. However, during coding, the researchers identified complementing themes in the overall data which made it more specific. Therefore, the limiting framework was refined, by using partially a priori concepts and during axial coding new concepts emerged. This made the framework well-suited for this research.

Another disadvantage of Roger's DOI is that it does not allow for the consideration of social and personality factors that might influence the adoption (Rogers, 1983). Only perceived features of the eHealth application can be analysed. It is therefore suggested to adapt the current framework used in this research or choose another theory that can investigate the social and personality factors that may also influence adoption.

5.4 Implications and future research

5.4.1 Scientific implications

In the literature, there were many different criteria for the way that eHealth was evaluated. This suggests the need for greater standardisation of evaluation frameworks in eHealth. Therefore, a scientific implication is to create a standardised framework that can be used to evaluate eHealth. Another finding from this review is that only a few articles included multiple stakeholders. Proper evaluation and understanding of eHealth apps calls for perspectives of all stakeholders. This means that not only patients and HCPs are studied, but for instance also app developers, governments, and healthcare insurance companies.

5.4.2 Recommendations

This review found a willingness among patients and HCPs to try eHealth apps. However, in practice relatively few patients are actually using these apps due to a lack of awareness. Moreover, in some studies the willingness to use apps was studied hypothetically. However, this review also found a lack of proven added value. As a solution, it is recommended to let end users experience eHealth apps in practice with free trials of eHealth apps. Users can evaluate the application for themselves during this free trial and see what the benefits are of using this app in practice. Additionally, the free trial could increase eHealth app usage.

As presented in the results and discussed in §5.1.3, data security is imperative to app adoption and implementation. It is therefore recommended that eHealth apps have a clear privacy and data policy, which states how personal data will be used by the app distributor and which parties could gain access to their data. In order to give app users more control over their data, an additional consent form would be preferred. With this consent form users could, for instance, give consent to placing cookies on their devices, sharing data with third-parties or using data for app optimisation.

5.4.3 Suggestions for the MPA program

This review gave insight into the role of several actors in the adoption of eHealth apps. For the MPA program, there are interesting remarks that should be passed on to the students of this program who learn about eHealth app implementation, namely:

1. Be cautious when investigating apps in the pre-market phase, results and opinions may be biased and differ from what is occurring in practice, especially when the market research is from a hypothetical standpoint instead of probing real apps. This could give overly positive results in your market research.
2. Do not only try to convince HCPs about the benefits of eHealth apps, but also convince patients. In some studies, patients were asked about the added value of eHealth apps. A portion of the patients did not know why these types of apps were useful because they trusted their doctors' advice and tended to follow their instructions.
3. For app designers, it would be recommended to explore features app users would like to use, in order to make the app appealing to more users. The results described that people are willing to use eHealth apps and that there are certain features that they would like to have in these apps. In these studies patients indicated that these features and characteristics would create added value for them.

5.4.4 Future research

The included studies mostly had a hypothetical approach to eHealth apps instead of testing currently existing apps. In addition, the included studies followed their sample for up to 12 months. In order to gain insight into the adherence and user experiences over time. It would be useful to test these apps in practice over a longer period of time to gain more realistic results.

Furthermore, this research was mainly about the innovation process of app adoption and app implementation and actors' perspectives. In order to get a grasp on the financial aspects of this subject, more research should be done about business models that would make the implementation feasible for all actors involved, e.g. patients, HCPs, healthcare insurance companies and investors.

6 | Conclusion

In conclusion, this literature review showed that both HCPs and patients are open to trying eHealth applications in a healthcare setting. Moreover, there is a lack of proven added value of eHealth apps for patients, and during the implementation phase of eHealth applications data security should be handled carefully. Therefore, it is recommended that eHealth apps have a clear privacy and data policy, which states how personal data will be used by the app distributor and which parties could gain access to their data. Furthermore, free trial periods could give end users insight in the added value of eHealth apps. For app developers it is important to be cautious of pre-market phase investigations and to explore features app users would like. To get more acceptance for an app, not only HCPs but also patients should be convinced. Since this review only included patients' and HCPs' perspectives, it is suggested that future research should focus on the perspectives of other stakeholders as well, such as healthcare insurance companies and investors.

7 | References

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8 | Appendix

8.1 Data extraction form

Data extraction field	
Author(s)	Jacomet, C; Ologeanu-Taddei, R; Prouteau, J; Lambert, C; Linard, F; Bastiani, P; Dellamonica, P
Study title	Adoption and Attitudes of eHealth Among People Living With HIV and Their Physicians: Online Multicenter Questionnaire Study
Publication title	JMIR mHealth and uHealth
Year of publication	2020
Country	France
Context and participants	Analyzing the behaviors, benefits and barriers perceived by people living with HIV and their Physicians to determine whether any additional profiles of ehealth perception exist
Study design and methods used	Online multicenter questionnaire study by REDCap app (survey)
Findings	Findings revealed three distinct clusters of patients: (i) those for whom eHealth is part of a connected lifestyle; (ii) those who mistrust technology, although they are more averse to technology in general than to eHealth specifically; and (iii) those keen to adopt eHealth because they see it as a benefit for their health, and for whom eHealth does not represent any risk. Three clusters were also found for the physicians: (i) those strongly opposed to eHealth (resisters), (ii) those who believe in eHealth (enthusiasts), and (iii) those who are open to eHealth, and who rise to the challenge. This third group overlaps the second to some extent.

Data extraction field	
Author(s)	Melchiorre, MG; Papa, R; Quattrini, S; Lamura, G; Barbabella, F; Rijken, M; van der Heide, I; Snoeijs, S; Schellevis, FG; van Ginneken, E;

	Struckmann, V; Busse, R; Hujala, A; Rissanen, S; Taskinen, H; Clarke, A; Dyakova, M
Study title	Integrated Care Programs for People with Multimorbidity in European Countries: eHealth Adoption in Health Systems
Publication title	Health policy
Year of publication	2020
Country	Europe
Context and participants	expert organizations in 24 European countries, mapping of innovative and integrated care approaches for people with MCCs
Study design and methods used	Questionnaire on several dimensions.
Findings	85 programs (out of 101) adopted at least one eHealth tool, and 42 of these targeted explicitly older people.

Data extraction field	
Author(s)	Steinert, A; Eicher, C; Haesner, M; Steinhagen-Thiessen, E
Study title	Effects of a long-term smartphone-based self-monitoring intervention in patients with lipid metabolism disorders
Publication title	Assistive technology
Year of publication	2020
Country	Germany
Context and participants	100 patients with lipid metabolism disorders were asked to use a smartphone application over a duration of 12 months
Study design and methods used	Self-monitoring intervention, the use of an app
Findings	43% of the patients that were asked to use the app stated that they never started to use the app. The reasons cited were lack of time, health problems, lack of motivation, and technical problems. The number of patients with high medication adherence increased significantly due to the use of the app.

Data extraction field	
Author(s)	Anastasiadou, D.; Folkvord, F.; Serrano-Troncoso, E.; Lupiañez-Villanueva, F.
Study title	Mobile Health Adoption in Mental Health: User Experience of a Mobile Health App for Patients With an Eating Disorder
Publication title	JMIR mHealth and uHealth
Year of publication	2019
Country	Spain
Context and participants	Investigates attitudes of healthcare providers and mHealth experts toward mHealth tools in the health context in general and tests the acceptability and feasibility of a specific mHealth tool for patients with an eating disorder (ED), called TCAApp, among patients and ED specialists.
Study design and methods used	An explorative qualitative study with 4 in-depth group discussions with several groups of stakeholders: the first focus group was conducted with 11 experts on mHealth from the Catalan Association of Health Entities; the second focus group included 10 healthcare professionals from the Spanish College of Doctors of Barcelona; the third focus group involved 9 patients with an ED who had used the TCAApp over a 12-week period, and the fourth and last focus group involved 8 ED specialists who had monitored such ED patients on the Web.
Findings	The focus groups showed that healthcare providers and mHealth experts reported barriers for mHealth adoption more often than facilitators, indicating that mHealth techniques are difficult to obtain and use.

Data extraction field	
Author(s)	Solem, IKL; Varsi, C; Eide, H; Kristjansdottir, OB; Mirkovic, J; Borosund, E; Haaland-Overby, M; Heldal, K; Schreurs, KMG; Waxenberg, LB; Weiss, KE; Morrison, EJ; Nes, LS

Study title	Patients' Needs and Requirements for eHealth Pain Management Interventions: Qualitative Study
Publication title	Journal of medicinal internet research
Year of publication	2019
Country	Norway
Context and participants	This study aimed to explore the experiences of patients with chronic pain with regard to information and communication technology, understand how an eHealth intervention can support the everyday needs and challenges of patients with chronic pain, and identify possible facilitators and barriers for patients' use of an eHealth pain management intervention
Study design and methods used	This study used a qualitative design involving individual semi-structured interviews with patients (n=20) with chronic pain and their spouses (n=5), to explore patients' needs and preferences for designing and developing eHealth interventions.
Findings	The participants were generally experienced technology users and reported using apps regularly. They were mainly in favour of using an eHealth self-management intervention for chronic pain and considered it a potentially acceptable way of gathering knowledge and support for pain management. The participants expressed the need for obtaining more information and knowledge, establishing a better balance in everyday life, and receiving support for improving communication and social participation. They provided suggestions for the eHealth intervention content and functionality to address these needs. Accessibility, personalization, and usability were emphasized as important elements for an eHealth support tool. The participants described an ideal eHealth intervention as one that could be used for support and distraction from pain, at any time or in any situation, regardless of varying pain intensity and concentration capacity.

Data extraction field	
Author(s)	Jungwirth, D; Haluza, D

Study title	Information and communication technology and the future of healthcare: Results of a multi-scenario Delphi survey
Publication title	Health informatics journal
Year of publication	2019
Country	Austria
Context and participants	The present scenario-based study aimed at identifying prevailing perceptions regarding telehealth applications among Austrian healthcare experts. During a two-round online Delphi survey, panelists rated perceived benefits, obstacles, innovativeness, desirability, and estimated implementation date of 10 telehealth scenarios.
Study design and methods used	The online Delphi survey questionnaire in German language consisted of two autonomous sections. The first part assessed socio-demographic characteristics. The second part evaluated each of the 10 scenarios in ascending order using the corresponding fixed questionnaire items for benefits, obstacles, degree of innovation, desirability, and implementation date. In total, 73 participants (74% males; mean age 43.9 years, standard deviation [SD] 9.4 years) fully completed both Delphi cycles.
Findings	Panelists (n = 73, 74% males) perceived that the implementation of telehealth scenarios could especially improve patients' knowledge, quality of social healthcare, and living standard. In contrast, the three top-ranked obstacles were costs, technical prerequisites, and data security. Survey participants rated innovativeness of the presented future scenarios as quite high, whereas perceived desirability was moderate.

Data extraction field	
Author(s)	Giunti, G.; Kool, J.; Rivera Romero, O.; Dorrnoro Zubiete, E.
Study title	Exploring the Specific Needs of Persons with Multiple Sclerosis for mHealth Solutions for Physical Activity: Mixed-Methods Study
Publication title	JMIR Mhealth Uhealth
Year of publication	2018

Country	Spain
Context and participants	The aim of this study was to (1) explore MS-specific needs for MS mHealth solutions for PA, (2) detect perceived obstacles and facilitators for mHealth solutions from persons with MS and health care professionals, and (3) understand the motivational aspects behind adoption of mHealth solutions for MS. A total of 12 persons with relapsing-remitting MS and 12 health care professionals from different backgrounds participated in the study.
Study design and methods used	A mixed-methods design study was conducted in Kliniken Valens, Switzerland, a clinic specializing in neurological rehabilitation. We explored persons with MS and health care professionals who work with them separately. The study had a qualitative part comprising focus groups and interviews, and a quantitative part with standardized tools such as satisfaction with life scale and electronic health (eHealth) literacy.
Findings	Desired mHealth features were as follows: (1) activity tracking, (2) incentives for completing tasks and objectives, (3) customizable goal setting, (4) optional sociability, and (5) game-like attitude among others. Potential barriers to mHealth apps adoption were as follows: (1) rough on-boarding experiences, (2) lack of clear use benefits, and (3) disruption of the health care provider-patient relationship. Potential facilitators were identified: (1) endorsements from experts, (2) playfulness, and (3) tailored to specific persons with MS needs.

Data extraction field	
Author(s)	Goetz, M; Muller, M; Matthies, LM; Hansen, J; Doster, A; Szabo, A; Pauluschke-Frohlich, J; Abele, H; Sohn, C; Wallwiener, M; Wallwiener, S
Study title	Perceptions of Patient Engagement Applications During Pregnancy: A Qualitative Assessment of the Patient's Perspective
Publication title	JMIR Mhealth and Uhealth
Year of publication	2017
Country	Germany

Context and participants	Examines the perceptions and expectations of mobile and Web-based patient-engagement pregnancy applications. Assessed usability requirements, general acceptance of eHealth, and the impact of eHealth and mHealth pregnancy applications on the doctor-patient interaction and daily clinical routine.
Study design and methods used	A mixed-method study with quantitative and qualitative approaches was carried out among 30 pregnant women who attended prenatal care at the university hospital of Heidelberg The extent and frequency of Web- and mobile phone app usage were assessed. Semi-structured interviews were conducted and analysed using systematic thematic analysis.
Findings	Patients had a high demand for Web-based pregnancy applications. Study findings suggested a strong request for personalization, monitoring, and accessibility for frequent use as main themes derived from the interviews. Fostering patient empowerment in the doctor-patient relationship was also highly valued for a pregnancy app. Participants favored further integration of medical apps in their daily routine and pregnancy care. However, concerns were raised about content quality, trustworthiness of Web sources, and individual data security.

Data extraction field	
Author(s)	Knitza J., Simon D., Lambrecht A., Raab C., Tascilar K., Hagen M., Kleyer A., Bayat S., Derungs A., Amft O., Schett G., Hueber A.J.
Study title	Mobile Health Usage, Preferences, Barriers, and eHealth Literacy in Rheumatology: Patient Survey Study
Publication title	JMIR mHealth and uHealth
Year of publication	2020
Country	Germany
Context and participants	193 German patients with rheumatic diseases.
Study design and methods used	Patients (recruited consecutively) with rheumatoid arthritis, psoriatic arthritis, and axial

	spondyloarthritis were asked to complete a paper-based survey. The survey included questions on socio-demographics, health characteristics, mHealth usage, eHealth literacy using eHealth Literacy Scale (eHEALS), and communication and information preferences.
Findings	More than two-thirds of the patients (132/193, 68.4%) believed that medical apps are helpful for their health; however, only 4.1% (8/193) patients currently used medical apps, of which none were rheumatology specific apps. Regarding preferred app functions, patients were most interested in information about medications and diseases and were least interested in direct exchange such as chats with peers with the same disease.

Data extraction field	
Author(s)	Haluza, D; Naszay, M; Stockinger, A; Jungwirth, D
Study title	Prevailing Opinions on Connected Health in Austria: Results from an Online Survey
Publication title	International Journal of Environmental Research and Public Health
Year of publication	2016
Country	Austria
Context and participants	562 Austrian adults (58.9% females).
Study design and methods used	Cross-sectional, online survey to collect self-reported data from non-convenience sample. This cross-sectional study assessed knowledge, awareness, and perceptions regarding eHealth and telemedicine among a non-probability convenience sample of Austrian adults.
Findings	While most participants already used mobile devices, they expressed a quite low desirability of using various telemedicine applications in the future. Study participants perceived that the most important overall benefits for implementing connected health technology were better quality of healthcare, location-independent access to healthcare services, and better quality of life. The respective three top-ranked overall barriers were data security, lack of acceptance by doctors, and lack of technical prerequisites.

Data extraction field	
Author(s)	Lupiáñez-Villanueva F., Folkvord F., Abeele M.V.
Study title	Influence of the business revenue, recommendation, and provider models on mobile health app adoption: Three-country experimental vignette study
Publication title	JMIR
Year of publication	2020
Country	Spain, The Netherlands and Germany
Context and participants	The aim of this study was to examine factors that have been suggested to play a role in Mhealth adoption. 400 consumers surveyed from both Spain and Germany and 416 consumers from the Netherlands.
Study design and methods used	Every participant was exposed to four different vignettes, each describing one specific aspect of the business model of an mHealth app. Next, the likeliness to adopt the health app and willingness to pay were assessed as outcome measures. For each vignette, a different version was randomly assigned to participants. Vignettes describe a hypothetical situation to which participants respond thereby revealing their perceptions, values, attitudes, and intentions.
Findings	The results showed that in all countries there was no effect of the different revenue models on both willingness to pay and intention to download the health app. People are not less willing to pay and do not have a reduced intention to download a health app when the revenue model is based on data sharing or advertising and data sharing, compared to that based on advertising only. Finally, in all three countries, men, younger individuals, people with higher levels of education, and those with a health information orientation were willing to pay more for adoption of the health app and had a higher intention to download the app.

Data extraction field	
Author(s)	Nugteren, IC; Duineveld, LAM; Wieldraaijer, T; van Weert, HCPM; Verdonck-de Leeuw, IM; van Uden-Kraan, CF; Wind, J
Study title	Need for general practitioner involvement and eHealth in colon cancer survivorship care: patients' perspectives
Publication title	Oxford Academic
Year of publication	2017
Country	Netherlands
Context and participants	To investigate patients' opinions on the use of e-health applications (such as Oncokompas) to support self-management. Twenty male patients diagnosed with stage I-III colon cancer treated with curative intent in five Dutch hospitals
Study design and methods used	Qualitative study with semi-structured interviews
Findings	Participants who viewed eHealth positively, believed it would increase awareness and recognition of symptoms and concerns. Furthermore, it was expected that Oncokompas2.0 would provide insight into supportive care possibilities. Participants mentioned expectations that eHealth applications, such as Oncokompas2.0, would be able to reduce the workload of doctors and that it is more accessible than face-to-face contact. Participants mentioned requirements for Oncokompas2.0 and eHealth, such as that it had to be easy to use for all users, not provide too much information and use short and simple sentences, so that all individuals could understand the information. It should provide personalized advice, to support survivorship care. Privacy issues were also mentioned.