Barriers and Facilitators of mHealth Application Use in Routine Clinical Practice: Perspectives from Healthcare Professionals

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Abstract

The use of decision aids and patients' experiences with these aids has been extensively researched by many medical disciplines, but fewer studies exist on trauma healthcare professionals' experiences and opinions. A trauma (e.g., a fracture) has a substantial influence on a patient since it frequently interferes with their daily activities. Mobile Health (mHealth) applications have been developed to support patients through this process. Some mHealth applications inform patients about all available fracture surgeries so that they can make a shared decision with the healthcare professional whilst others provide post-operative exercise. As there are several elements to consider when designing mHealth applications, barriers and facilitators of mHealth application use is an interesting topic to consider. Therefore, this study aimed to identify the barriers and facilitators that are associated with the implementation (or lack of implementation) of mHealth applications into routine clinical practice in trauma departments. Eight semi-structured interviews were conducted with healthcare professionals working at the Tilburg's Elisabeth-TweeSteden Hospital. The thematic analysis of the transcripts showed that there are four major themes: individual, patient, organisational and technical. A total of sixteen elements could be identified, with six being the most important. Increased workload, patients' ability to keep up with technology and lack of infrastructure were the key barriers, whereas support for digitalisation, support for standardisation and pre- and post-procedure information were the main facilitators. Future frameworks for implementing mHealth applications should consider the patient theme, especially considering how highly healthcare professionals value this theme. For future implementations, the above-mentioned factors should be carefully examined to have a successful implementation of mHealth applications in routine clinical practice.

Keywords: barriers; facilitators; implementation science; mobile health (mHealth); qualitative analysis; trauma department

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Introduction

Every year, approximately 175.000 people in the Netherlands visit the emergency department (ED) due to a bone fracture (Nederlandse Vereniging voor Traumachirurgie, 2022). The most common fractures are fractures in the arms and legs (Patel et al., 2021; Pettersen et al., 2022). After a patient with a fracture is discharged from the ED, often a follow-up consultation with primary care is needed (Vinson & Patel, 2009). It is key that patients return within a few days for an evaluation of their fracture, as these fractures often do not subside in a brief period (Vinson & Patel, 2009).

Traditional healthcare models focus on the healthcare professionals' knowledge to make appropriate decisions for the treatment of their patients whereas modern healthcare models or approaches try to place patients at the centre of all decisions (Fureman et al., 2021). A so-called modern healthcare approach is shared-decision making (SDM). SDM is a treatment decision-making and information-sharing technique that involves both the healthcare professional and the patient. Both the healthcare professional and patient are encouraged to discuss treatment preferences and jointly agree on the final treatment plan that will provide the greatest potential healthcare outcome (Dobler et al., 2019; Elwyn et al., 2017; Légaré et al., 2018; Pollard et al., 2015; Stiggelbout et al., 2015). SDM frequently involves 'preference-sensitive' decisions; there are often two or more effective treatment plans available, but the patient's personal preferences and values determine which option is selected (Woltz et al., 2017). For example, a dislocated midshaft fracture could be treated in two ways: a conservative treatment or an operative treatment. This is similar to other types of fractures and therefore, SDM is a valuable method that can be used for trauma care (Woltz et al., 2017).

The process of SDM can be supported by different mobile health (mHealth) applications, one of these being decision aids (DAs). DAs inform patients on the course of treatment as well as the

potential risks and benefits of certain treatments. They also assist patients in choosing the type of treatment that will enhance their lifestyle or health outcome (Simmons et al., 2010; Stacey et al., 2017). The purpose of DAs is to facilitate healthcare professional-patient discussions and increase SDM rather than to replace healthcare professionals' knowledge (Simmons et al., 2010). Stacey et al. (2017) mention that patients who have used DAs, feel more at ease when they are informed ahead of the clinic visit about all possibilities, become more active during consultations and it increases patients' views on SDM with regards to their treatment. The extensive review of Stacey et al. (2017) included fifty different DAs, ranging from prostate cancer screening to medication for diabetes and vaccines for infants. Despite the substantial number of DAs that were evaluated and included in the Cochrane review, none were meant exclusively for the ED.

A recent study by Billah et al. (2022) reveals that although healthcare professionals see SDM as a process that could effectively be used in the ED and see that other mHealth applications benefits colleagues, the implementation of both SDM and mHealth applications seems not to be applied in trauma clinical practice. Subsequent research has been done on facilitators and barriers related to the implementation of SDM and mHealth applications in clinical practice, but specific research on the implementation of DAs in the ED is limited (Billah et al., 2022; Légaré et al., 2008; Stacey et al., 2019). This shows that, although 175.000 people in the Netherlands visit the ED due to a bone fracture, there is little research itself available about the development and implementation of DAs for bone fractures. This is also noted by Houwen et al. (2021): there is a substantial amount of studies that indicate the success of mHealth applications in healthcare, but limited literature is available related to a traumatic topic.

Therefore, the present study aims to explore healthcare professionals' perceived barriers and facilitators associated with the implementation of mHealth applications in the trauma department. This knowledge is of crucial importance for developers of mHealth applications and

those who utilise mHealth applications as mHealth applications developed for a certain department do not necessarily function equally as efficiently in another department. By taking the perceived barriers and facilitators into consideration when developing and utilising mHealth applications in the future, the implementation of mHealth applications in the trauma department could become more effectively and successfully. This study describes the perspective of different trauma healthcare professionals from a Dutch hospital on mHealth application implementation in the trauma department. Thus, the following research question is formulated: *What barriers and facilitators are associated with the implementation (or the lack of implementation) of mHealth applications into routine clinical practice in trauma departments?*

Theoretical Framework

eHealth and mHealth

Internet and digital applications have become an important part of our lives and these modern technologies are also emerging in healthcare (Ambalam, 2022). The capacity of healthcare professionals to provide healthcare with the help of "the Internet and communication technology" is referred to as electronic health (eHealth) (Tran et al., 2017, p. 1701). It is not just about adopting new technology, but also about developing new ways of working, enhancing healthcare and doing other things by utilising new technologies (Boogerd et al., 2015). For example, the paper patient records changed into electronic health records so healthcare professionals can access health records via the computer instead of having to carry multiple maps of patient records.

Similarly, to eHealth, mobile health technologies or mobile health (mHealth) is defined as electronic applications that assist medical health practice and eHealth. These electronic means can be patient mobile phone applications, digital patient files or online digital assistants such as medical chatbots (Timotijevic et al., 2020). One of the unique features of mHealth is that many

applications can collect medical, health-related and non-medical information (Timotijevic et al., 2020). Likewise, mHealth tools can facilitate communication between the patient, partners and the healthcare professional (Carhuapoma et al., 2021). mHealth applications can help with data gathering outside of the medical environment, such as collecting data on patients' pain levels or educating patients about their forthcoming surgery and what actions they must take to prepare (Moss et al., 2019). For example, Rathnayake et al. (2021) designed a mHealth application for caregivers of people with dementia. This mHealth application was developed to support caregivers at home with all diverse types of information, also including the physicians' advice for feeding for example.

This process, of preparing a patient for their forthcoming surgery and sharing information, is part of shared decision-making (SDM). SDM is defined as a "truly shared approach that requires both the physician and patient to be involved in the decision-making process and information exchange, both the physician and the patient express treatment preferences, and finally, the physician and patient agree on treatment decision" by Pollard et al. (2015, p. 1047). Elwyn et al. (2017) build on this definition, by mentioning that informed preferences are the key element of SDM. Informed preferences refer to the personal concerns, circumstances and context of patients that are important for them when deciding on a treatment plan (Elwyn et al., 2017). Elwyn and Vermunt (2020) created an integrated model for SDM that included three stages and during each stage, three-level goals should be established. mHealth applications can be of use during the second stage (goal-option talk) and the last stage (goal-decision talk). mHealth applications can support these stages by informing patients about the available options for their procedure. Patients can prepare themselves for the follow-up consultation by reading all the necessary information in plain language for making an informed decision afterwards (Elwyn & Vermunt, 2020; Stacey et al., 2017).

The use of eHealth and mHealth applications can be, similar to SDM, divided into goals (van Lettow et al., 2019). As goals change over time, different eHealth and mHealth applications can be used for each different goal as a support tool. A specific mHealth application could be useful for the first stage of the intervention (e.g., what type of surgery does my bone fracture need), but another mHealth application would be more appropriate for the last stage of the intervention (e.g., how can I stimulate a positive recovery of my bone fracture) (van Lettow et al., 2019).

Previous literature has addressed mHealth applications with for example Parkinson's disease (Timotijevic et al., 2020), advanced prostate cancer (Carhuapoma et al., 2021) or chest pain (Anderson et al., 2014; Bean et al., 2021; Billah et al., 2022; Hess et al., 2016). However, so far only two have directly addressed more trauma-related mHealth applications (Houwen et al., 2021; McGrath et al., 2018). As there are studies that indicate the success of mHealth applications in healthcare, there is limited literature available related to the trauma department (Houwen et al., 2021). Billah et al. (2022) studies the implementation of DAs for SDM in the ED but focused on DAs developed for patients with low-risk pain and unexplained syncope. These DAs are trauma care related but could also be used in other departments, such as

Implementation of mHealth Applications into Clinical Practice

Implementation of mHealth applications is often done after designing the application but important barriers should also be taken into account before actually designing the application (Gemert-Pijnen et al., 2011). To evaluate the barriers and facilitators that can be present before, during or after implementation, a framework adopted by Schreiweis et al. (2019) and Stacey et al. (2019) can be used.

The goal of this framework is to identify barriers and facilitators that can eventually help to successfully implement mHealth applications in clinical practice, such as in the ED (Schreiweis et al., 2019).

Schreiweis et al. (2019)'s and Stacey et al. (2019)'s Implementation Frameworks

Both Schreiweis et al. (2019) and Stacey et al. (2019) looked at the implementation of mHealth applications, concluding that there were many facilitators and barriers present for this design phase. Within their research, the main goal was to identify what obstacles are currently present in mHealth application usage and also what makes the use of mHealth applications such a success. Both studies focused on the same topics: individual, technical and organisational. The focus of this research is to identify barriers and facilitators of mHealth application usage in trauma departments by taking these themes into account. As mHealth applications in trauma care are still upcoming, these frameworks can be used as a starting point to discover what current trauma healthcare professionals consider as barriers and facilitators of its use.

The first framework by Schreiweis et al. (2019) was based on the study by Griebel et al. (2015) and a literature analysis. Griebel et al. (2015) conducted research at the 2015 Medical Informatics Europe (MIE) conferences in Europe. During this day, a workshop took place to discuss "factors that support a successful dissemination of electronic health services" (Griebel et al., 2015, p.1). The findings of these workshops show that there were three major barrier topics important to conference attendees: individual, technical and organisational. Individual barriers were, for example, willingness to keep up with the latest technology. The lack of security was, for example, a technical barrier and no finances available were, for example, an organisational barrier. After the 2017 eHealth Innovation Days (EHID) conference took place, the facilitators from that workshop were grouped into the same topics as the barrier topics. Lastly, Schreiweis et

al. (2019) conducted a literature analysis that, in combination with the results from Griebel et al. (2015), the findings from the 2017 EHID conference resulted in a mind map that can be found in Appendix A. This framework was used as a basis for this study.

The second framework used by Stacey et al. (2019) was based on the levels of the Ottawa Model of Research Use (OMRU) designed by Logan and Graham (1998). The OMRU framework was designed for "policymakers seeking to increase the use of health research by practitioners" (Logan & Graham, 1998, p. 228). Similar to the framework by Schreiweis et al. (2019), the OMRU was established through conferences and workshops. The framework consists of six key elements, of which Stacey et al. (2019) used three: innovation, potential adopters and environment. With these first three steps of the framework, the barriers and facilitators can be identified. Within the environment, the focus lies on everything that can influence the practice environment; ranging from hospital policies to advocates of mHealth applications. For the potential adopters, the focus lies on all potential people that come in contact with mHealth applications. Lastly, for the innovation, the focus lies on the attributes used in clinical practice, in this case, mHealth applications. For Stacey et al. (2019), the innovations were decision aids; the potential adopters were clinicians, and the environment was the hospital as an employer.
The framework of this study consists of three categories, namely:

Individual Barriers and Facilitators. Within this category, the focus lies on the barriers and facilitators of the mHealth application that healthcare professionals experience. Barriers could be that, for example, there is a linguistic barrier (the mHealth applications' language is not in their native language), there is no motivation to use the mHealth application, SDM is already happening so a mHealth application is not needed or healthcare professionals place their trust in their knowledge above a mHealth application (Billah et al., 2022; Schreiweis et al., 2019; Stacey et al., 2019). Facilitators could be that, for example, healthcare professionals see the mHealth

application as an improvement of their (risk) communication, patient satisfaction with the healthcare professional can be increased, and that healthcare is keeping up with technology advancements which decrease the workload (Billah et al., 2022; Schreiweis et al., 2019; Stacey et al., 2019).

Organisational Barriers and Facilitators. Within this category, the focus lies on the barriers and facilitators of the hospital's organisation that are important for the implementation of such mHealth applications. Barriers could be that, for example, the mHealth application is only available online which could refrain older generations of patients and healthcare professionals from using the applications, people in higher management do not support mHealth application use or there are no financial resources to implement the mHealth application (Billah et al., 2022; Schreiweis et al., 2019; Stacey et al., 2019). Facilitators could be that, for example, the health outcomes are improved, patients are more informed before their follow-up consultation which results in more focused conversations and having a mHealth application be supported and promoted by other professional organisations or management guidelines (Billah et al., 2022; Schreiweis et al., 2019; Stacey et al., 2019).

Technical Barriers and Facilitators. Within this category, the focus lies on the barriers and facilitators of the technical design factors of the mHealth application. Barriers could be that, for example, the system language is not the patient's mother tongue, there is no online assistance available when something goes wrong with the mHealth application or there is no direct connection between the patients' medical records and the mHealth application (Billah et al., 2022; Schreiweis et al., 2019; Stacey et al., 2019). Facilitators could be that, for example, all end-users were involved in the development of the mHealth application, the mHealth application is easy to use for all end-users (patient, healthcare professionals and other support staff) or that

higher management makes the use of the mHealth application part of the standard routine clinical practice (Billah et al., 2022; Houwen et al., 2021; Schreiweis et al., 2019; Stacey et al., 2019).

To conclude, there is a lot of research available on DAs and SDM, but little research is available on the implementation of mHealth applications in trauma care. There are several mHealth applications for the trauma emerging but there has not yet been any significant research conducted. Based on the information discussed in this theoretical framework, it can be concluded that there is yet information lacking on the mHealth applications in trauma care. There are two frameworks developed in prior work that can form a basis for barrier and facilitator implementation research that will be used. To see what barriers could be improved for the implementation of mHealth applications, it is important to identify these but also identify what facilitators are considered important in mHealth applications.

Method

To gain a better insight into the factors that influence the implementation mHealth applications (or the lack of implementation) into routine clinical practice at ED, it was the goal to conduct nine semi-structured interviews with three trauma surgeons, three surgical residents, and three physiotherapists. Semi-structured interviews were held as these allow both the interviewer and interviewee to have the freedom to move in topics and ask follow-up questions that could contribute to gaining more knowledge (Treadwell & Davis, 2019). This study is part of a larger study that is approved by the Medical Ethical Review Committee Brabant under number L1443.2021.

Participants and Recruitment

As there is a connection with the Elisabeth TweeSteden hospital (ETZ) in Tilburg, the Netherlands, a physician-researcher helped with the recruitment of the participants which eventually lead to a purposive network sample of healthcare professional participants. All

participants have a certain amount of knowledge about mHealth applications: they did not need to work with them directly.

On two separate occasions, the researcher visited the ETZ. Together with the physician-researcher, several potential participants were approached. After enough participants were recruited and the ethical documents were approved, the participants were officially invited via email to participate in an interview (see Appendix B). A total of eight interviews were held with three trauma surgeons, three physiotherapists, and two surgical residents (62.5% male; mean age = 36.75 years; *SD* = 4.77). These eight interviews were conducted between May 10 and May 25, 2022.

Table 1:

Overview of participants' characteristics

Participant	Gender	Age	Profession
P1	Male	33	Physiotherapist and manual therapist
P2	Female	44	Orthopaedic surgeon with a trauma specialism
P3	Female	39	Physiotherapist with a trauma specialism
P4	Female	29	Physiotherapist with a trauma specialism
P5	Male	38	Surgical resident
P6	Male	36	Trauma surgeon
P7	Male	34	Surgical resident
P8	Male	41	Orthopaedic surgeon

Procedure

After participants had agreed to participate, an information letter and the informed consent letter were sent to them (see Appendix C and D). In this informed consent letter, it was pointed out that the interview was confidential and that their opinions and motivations would

have no influence or consequences on their job. The transcripts were only shared with the first and second reader of the Tilburg University and the researcher. Within the master thesis, participants were anonymised to avoid any recognition. The interviews were recorded with an online voice recorder (Olympus WS-311M) and stored on an extended personal hard drive and the Tilburg University server. After the participants had agreed to the conditions, an interview was planned. All informed consent letters were signed via DocuSign, a website that allows agreements to be safely signed online by all involved parties. All interviews were conducted in Dutch and three interviews took place at the ETZ while five interviews took place via Zoom. Zoom was chosen as Tilburg University provides free Zoom services for students and the researcher is familiar with this platform.

Materials

The interview guide was separated into three parts: background information, participants' opinion and experience with decision aids and mHealth applications in general and lastly, participants' experience with the decision aid '*Herstel na botbreuken'* (recovery after fracture).

Within the first part of the interview, participants were asked to tell something about themselves: their age, current profession, and something about their medical specialism history. Next, the interviewer explained what mHealth applications are and how they can be used. Following that, the participant was asked whether they had any experience with mHealth applications in their current profession.

The second part of the interview focused on the participants' opinions and experiences with mHealth applications. This part of the interview guide was based on the two previously mentioned frameworks by Schreiweis et al. (2019) and Stacey et al. (2019). Individual barriers and facilitators (e.g., *"What do you think the goal of mHealth applications should be?"* or *"Could you tell me something about your daily experience with mHealth applications, what*

makes it easier or harder for you?"), organisational barriers and facilitators (e.g., *"Could you tell me something about the role of the hospital in facilitating or limiting the use of mHealth applications?*" and technical barriers and facilitators (e.g., *"Which issues around the technical infrastructure do you experience as facilitating or limiting for the implementation of mHealth applications?*) were discussed in this part of the interview. To obtain as much useful information as possible, the interviewer continued to ask follow-up questions about the participants' responses. The interviewer was not always required to ask pre-determined questions since participants spoke about their own experiences and opinions on the subject.

Lastly, in the third part, the decision aid *Herstel na botbreuken* was discussed. The decision aid *Herstel na botbreuken* was developed in 2021 per initiative of the ETZ, ZorgKeuzeLab and Network Acute Zorg Brabant (NAZB) (Elisabeth-TweeSteden Ziekenhuis et al., 2021). These three organisations together decided to develop a decision aid that is meant for patients "in whom the trauma has a major impact on their daily functioning and who face a long rehabilitation" (Elisabeth-TweeSteden Ziekenhuis et al., 2021, para. 2). As this decision aid was briefly introduced at the ETZ, it was decided to discuss this decision aid during the interview. Although not all participants had prior experience with this specific mHealth application, many had prior experience with other types of mHealth applications. As a result, it was agreed to talk more about those experiences. The interview guide can be found in Appendix E.

Analysis

The analysis of the data was done with the help of the six phases of thematic analysis by Braun and Clarke (2006). In the first phase, familiarisation with the data is important. The interviews were transcribed in a combination of verbatim and non-verbatim. Uh's and Uhm's were transcribed but, for example, coughing was not transcribed. Also, in two interviews, the interviewer had to pause the recording as participants received a patient-confidential phone call

from another healthcare professional. In the second phase, initial codes were generated. The interviews were thoroughly read, and general facilitators and barriers were marked. In the third phase, themes were searched for. A deductive approach was taken for this thematic analysis as the analysis was based on the previously mentioned frameworks. The following three themes were used: Individual, Organisational and Technical. All relevant barriers and facilitators were collated into one of these three themes. In the fourth phase, the themes were reviewed. Each theme was read thoroughly to see whether the codes matched that specific theme. Some barriers and facilitators were more fit for a different theme, so these were changed. Also, it became evident that another theme had to be added: Patient. These barriers and facilitators did not necessarily fit the previously mentioned three themes, so this extra theme was created. Initially, a deductive approach was taken for this study as the themes were based on existing frameworks, however, as it became evident that another theme had to be added, an inductive approach was also taken in this study. Also, the barriers and facilitators were identified with an inductive approach instead of a deductive approach to identify the present factors based on the current data. Lastly, in the fifth phase, the themes were defined and named and within each theme, the barriers and facilitators were revised. This led to a total of sixteen factors that could be established, based on the data. An explanation of each factor can be found in Appendix F. In the final phase, the result section of the master thesis was created with the help of illustrative quotes.

Results

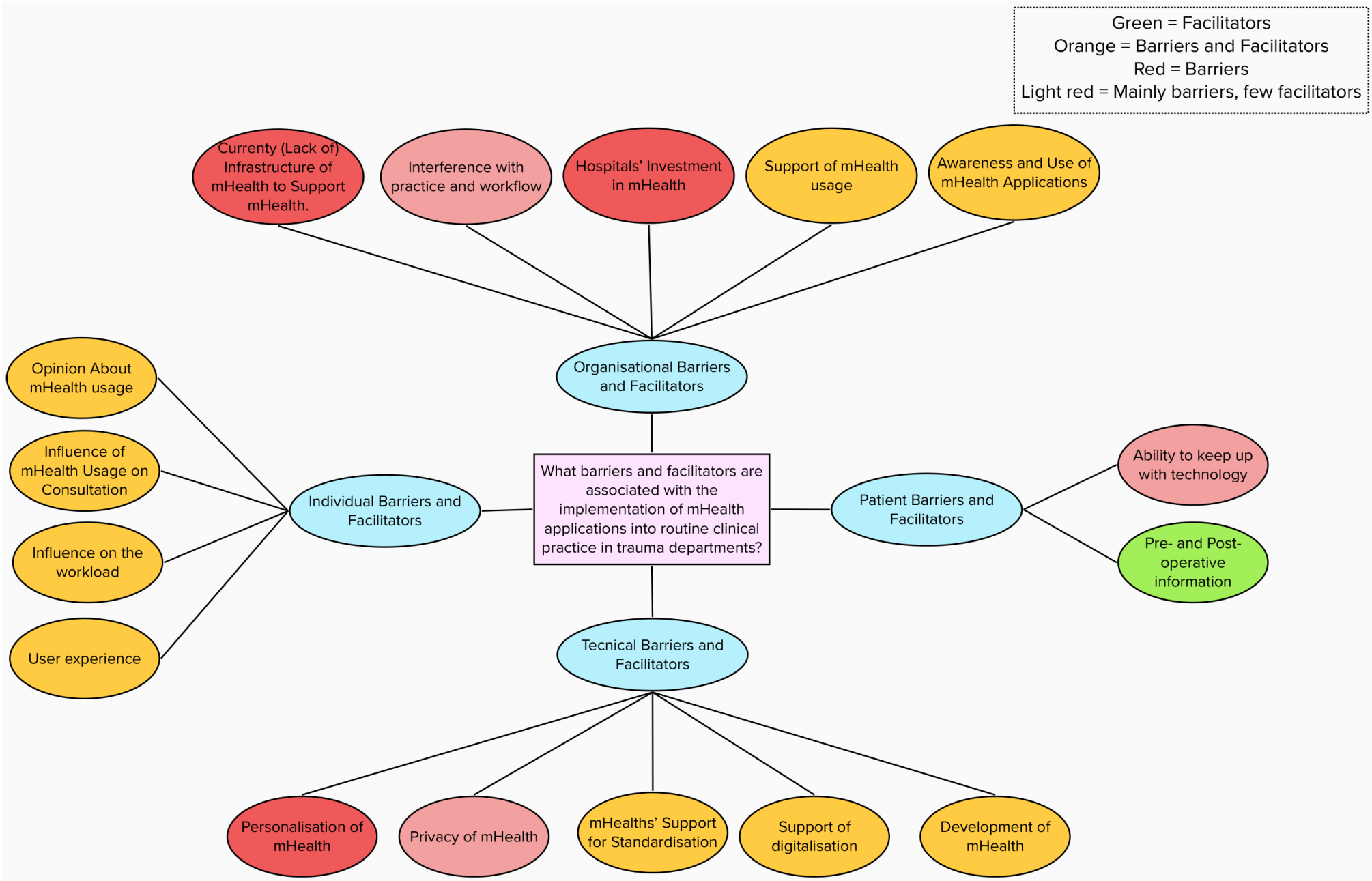
For this study, both an inductive and deductive approach was taken to analyse the data. The deductive approach led to three themes based on prior work, these three themes are *individual barriers and facilitators, organisational barriers and facilitators* and *technical barriers and facilitators.* The inductive approach led to one additional theme, this theme is *patient barriers and facilitators.*

The general conclusion from the analysis is that participants are in favour of using mHealth applications in their routine clinical practice. Participants often emphasise the benefits of using mHealth applications for patients, but they also see long-term benefits for their routine clinical practice. These long-term benefits were mostly focused on reducing the workload and making mHealth applications more accessible in the existing medical infrastructure. Currently, several glitches reduce most participants' mHealth usage, despite their desire to use them consistently and effectively.

Based on the previously mentioned four themes, a total of sixteen barriers and facilitators were identified that are associated with the implementation (or lack of implementation) of mHealth applications into routine clinical practice in trauma departments (see Figure 1). Some factors contain both barriers and facilitators while others only contain barriers or facilitators, these will be discussed in more detail.

Figure 1

Overview of barriers and facilitators of this study's results



Theme 1: Individual Barriers and Facilitators

Within this theme, the focus lied on the barriers and facilitators for each healthcare professional. Participants discussed factors related to the *Opinion about mHealth usage, the Influence of mHealth Usage on Consultation, Influence on the Workload* and *User Experience.*

When participants were asked about their *opinion about mHealth application usage*, all participants were open to making use of mHealth applications and saw it as a facilitator for their routine clinical practice (e.g., "*It is the future, and I am definitely in favour of using it,"* P.3). Although there is no direct research available yet about the improvement of patients' care who use mHealth applications according to the participants, most of them do believe that it is a great facilitator for them as well (e.g., "*It improves the care for the patients I think too,"* P.1, *see p. 13 for the profession of each participant*). On the other hand, half of the participants find it a barrier that, although the use of mHealth applications is an excellent technological improvement, the application's goal should always be providing the best care possible. It is a significant barrier when mHealth applications do not support improving care: if they are just present to collect data, it serves no purpose for the participants.

When discussing *the influence of mHealth application usage on healthcare professionals' consultation*, some healthcare professionals saw mHealth applications as a facilitator. When a patient was given a mHealth application before their consultation, the consultation was often more efficient compared to patients who did not receive a mHealth application (e.g., *"[…] it adds up to an efficient consultation and a better-informed patient. I do see the potential for it,"* P.5). Participants think that when patients fill in the medical history before the consultation, it would decrease the consultation time and therefore the workload. Although participants see the potential benefits of their consultations, they still find it a barrier during their consultations: they spend a significant amount of time trying to explain to a patient why a certain procedure is not fit for

them while the application might have otherwise Another barrier mentioned by numerous participants is that mHealth applications are frequently designed for a broader population of patients. As a result, participants did not always feel compelled to use mHealth applications during consultations.

A prominent factor that was identified by many participants was that mHealth applications *influence the workload*. Many found it a barrier that using eHealth systems and mHealth applications take time (e.g., *"[…] but then we have to write a mobility order while the OR (operating room) report and the summary to the department already state what the patient is allowed to do,"* P.2). Also, a barrier mentioned by participants is that the usage of mHealth applications still involves a lot of administrative tasks, which increases the workload (e.g., *"But, you know, the universally lamented administrative burden is enormous.,"* P.7). This is related to another barrier stated by participants. Some participants mention that additional effort is required to obtain data from mHealth applications, monitor the mHealth applications and analyse the data to respond accordingly. If participants wanted to discuss these discoveries during the consultations, the consultation duration increases, adding to the workload while other consultations are delayed. On the other hand, five participants agree that although mHealth applications could be time-consuming, they find that they facilitate a decrease in workload. They believe that when patients are better-informed and able to ask questions up-front or read frequently asked questions, sometimes consultations can even be skipped or become shorter (e.g., *"[…] but that could save you an appointment. All those phone calls you receive, people are worried and do not know what it means when something strange occurs,"* P.8).

When discussing the *user experience* of participants with the mHealth application in the current clinical practice, most of them mentioned both facilitators and barriers. Participants are open to the usage of mHealth applications, but it would be a barrier if the mHealth application

did not have added value to the clinical practice. For example, using coloured matrices to represent patients' progress, or a microphone feature that allows healthcare professionals to transcribe their verbal notes into the Electronic Health Record (EHR) are seen as facilitators or it should make their job simpler by allowing them to search things up quickly and simple. The user experience of mHealth applications in clinical practice is also described in the other factors from this study.

Theme 2: Patient Barriers and Facilitators

Within this theme, the focus lied on the barriers and facilitators for patients but from the point of view of healthcare professionals. Participants discussed factors related to *Patients' Ability to Keep Up with Technology* and *Pre- and Post-operative Information.*

Patients' ability to keep up with technology was seen as a barrier for participants sometimes. Three participants consider it a barrier that mHealth applications are not suitable for every type of patient since they are unsure which patients can and cannot use this new technology (e.g., *"People who are clumsy with their phones […],"* P.1). Furthermore, when the participants show the mHealth application to the patient, they frequently demand further information on how to use this application, which is not the participants' primary duty and appears to be a barrier to continuously using mHealth applications with other patients.

When discussing the importance of mHealth applications for patients, all participants agreed that the mHealth applications serve as a facilitator for *pre- and post-operative information*. Participants believe that when patients receive pre-operative information, they feel more confident in making a better decision and can ask more thorough questions about their treatment plan during consultations (e.g., *"So they do indeed ask more specific questions and they also understand more,"* P.4). In addition, mHealth applications can support the healing process after a patient has been discharged. The applications may present all of the information in plain

language, which patients can read at their own pace, giving them confidence that they did not neglect to ask questions about specific topics. Lastly, the applications can provide a sense of security and understanding for the patients (e.g., *"[…] and then you get the feedback 'you are in the normal limit,' and then patients are reassured and can go on,"* P.8).

Theme 3: Organisational Barriers and Facilitators

Within this theme, the focus lied on the barriers and facilitators related to the daily practice environment and the hospital as an employer. Participants discussed factors related to the *Interference with Practice and Workflow*, *Support of mHealth usage, Hospitals' Investment in mHealth, Awareness and Use of mHealth Applications* and *Current (Lack of) Infrastructure of mHealth to Support mHealth.*

When discussing mHealth applications' current *interference with practice and workflow*, participants mentioned some facilitators and barriers. Some participants find mHealth applications a facilitator for reminders of small procedures (i.e., when to stop with blood thinners before procedure X) or to find information quickly in the EHR. However, participants do agree that the use of a mHealth application feels like a burden sometimes: it adds extra workload, not everyone can work with mHealth applications, or explaining a mHealth application consumes time during the consultation that could have been used for different things. The ability to have all information delivered to each patient, in the same way, is a potential facilitator for the usage of mHealth applications according to the participants. Participants agreed that having a single application that can always be used would benefit both patients and healthcare professionals. Participants consider it a barrier that the deployment of a new mHealth application is dependent on a single individual rather than a team of professionals that can assist the project collaboratively. Two participants mentioned that the implementation of a new decision aid failed

in their department (e.g., *"[…] She was far too busy and had far too much work so this could not be added to her workload,"* P.3).

A total of seven participants shared their views on the *hospitals' support of mHealth usage*. Five out of seven participants agree that the hospital does not facilitate or support mHealth usage (e.g., *"but they are just poor facilitators, I dare to say,"* P.8). Participants feel that the hospital does not have a policy that supports them to use mHealth applications. On the other hand, participants that work in the orthopaedics department do not share that viewpoint. They believe that the hospital facilitates and supports mHealth usage; they have been working with smart devices that can open the HER and with the mHealth application 'the Patient Journey' for several years with success (e.g., *"So yes, the hospital is working very hard to encourage that*," P.3).

While the hospital has positively invested in the Patient Journey App, participants do feel that the *hospital's overall investment in mHealth* is lacking. Participants acknowledge the barrier that the implementation of some EHR components are insufficient, and that greater effort should be made to improve this. However, a barrier, as most participants highlight, is that there is often insufficient budget available to make such investments (e.g., *"I can understand that people who are in charge of money think other things are important,"* P.8). Furthermore, participants also noted that a substantial amount of time, money and energy was committed to the development of the decision aid *Herstel na botbreuken* and that the implementation failed, which they perceived as a barrier and disappointment because of the large investment. Finally, participants said that the hospital themselves do not invest enough in mHealth applications; typically, healthcare professionals engage in the investment rather than a team of hospital investors (e.g., *"[…] It is nice if people take the lead but, in the end, the hospital should facilitate it,"* P.7).

When discussing mHealth application usage in routine clinical practice, participants mentioned barriers related to *the awareness and use of mHealth applications*. In some way or another, all participants were unaware of certain regulations of mHealth applications. More than half of the participants had heard about the decision aid *Herstel na botbreuken* (recovery after fractures) but had never seen it in action. This is connected to the fact that some participants were unsure if the hospital had a formal policy regarding mHealth application usage. Furthermore, participants find it a barrier that there is no clear guideline for who would receive such decision aids (e.g., *"[…] you should have an unambiguous policy with this kind of thing,"* P.6). Participants saw that patients who were not initially eligible for surgery, requested surgery after reading the information on a decision aid that was supplied to them. As a result, healthcare professionals were frequently required to explain why it was not essential to do that specific procedure and how their fracture may be treated differently (e.g., *"[…]We never operate on such cases. That patient should have never been given such a choice […],"* P.2).

When participants were asked about their current experience with using mHealth applications in clinical practice, all participants identified barriers related to *the current (lack of) infrastructure of mHealth to support mHealth applications*. The most frequently mentioned barrier is that integrating mHealth applications into the EHR's current infrastructure is inefficient (e.g., *"This is inefficiency at its best, […],"* P.6). According to the participants, the hospital's Wi-Fi is also not operating properly. Data received by mHealth applications cannot be automatically integrated into the EHR and healthcare professionals must perform several additional clicks to access the necessary information. The EHR's infrastructure is slow, it takes time to upload and load photos and participants must move across the corridors to acquire a stronger Wi-Fi connection. Also, participants see the existing system as a barrier since it creates a lot of chaos and it increases the workload, even though the system should make their work easier, not harder.

Finally, while the infrastructure for healthcare professionals has gotten more complex, access to healthcare professionals has improved. This is seen as a facilitator by some participants, as patients who receive general information might strive to obtain more information specifically related to them. However, because it affects the workload, this is also perceived as a barrier.

Theme 4: Technical Barriers and Facilitators

Within this theme, the focus lied on the barriers and facilitators related to the technical side of mHealth applications. Participants discussed factors related to the *Personalisation of mHealth, Privacy of mHealth, mHealths' Support for Standardisation, Support of Digitalisation* and *Development of mHealth.*

All participants agreed that it is a barrier that there is a *lack of personalisation of mHealth* present which disrupts their clinical practice. Many healthcare professionals do not ask the same questions to their patients, resulting in the mHealth applications not being tailored enough to their wishes which is seen as a barrier (e.g., *"Because my questions are slightly different than what my colleague {…} asks or for colleague trauma {…} who only asks one question,"* P.2). Lastly, for example, the decision aid *Herstel na Botbreuk*, is not tailored to the hospitals' colours and their corporate identity. By adjusting this, the application could feel more like something specifically and personally made for the hospital that their patients and healthcare professionals could benefit from.

Some participants were concerned about *the privacy of mHealth* applications. They were unsure whether the current mHealth applications and open Wi-Fi networks protect their privacy: they find it a barrier to when the applications have access to their data or when they discuss patient details with colleagues if the information is not stored in an unsafe location. The participants do find it a facilitator that if the privacy aspect of the mHealth application is improved, they would use the applications more.

mHealths' support for standardisation is seen as a facilitator by participants to improve treatment communication with patients. Patients tend to be worried about irregular occurrences in their recovery which leads to them calling the hospital. This however could be solved by having all the information about postoperative occurrences in an application, which could then lead to patients feeling more confident in their recovery process. Also, participants find it a barrier that different healthcare professionals draft different reports: when this is all standardised with smart texts, for example, this could facilitate patients' general understanding of the notes and instructions.

Digitalisation is seen as an important facilitator for mHealth by six out of eight participants. Participants agreed that having doctors' orders typed out instead of written down is much more professional and readable. Also, the ability to provide patients with applications in which they can re-read all the information is seen as a significant facilitator. However, there are still barriers to the current hospitals' increase in digitalisation. Participants find that having an overview of the new technological systems is hard. Also, for example, some activities that are currently done by phone could be digitalised faster (i.e., *"[…] whereas you could actually just load that information on your EHR or another app. You could see that the request is orange, which means that the request for care has been made[…],"* P.5).

When discussing the current status of *mHealth development*, several things were noted by the participants. Participants consider it a barrier that the development of mHealth applications is now done by colleagues rather than the hospital. Colleagues who are interested in this topic and prepared to commit time to its development form the backbone of these projects (e.g., *"That is something that was started by {…} and {…}, not by the hospital,"* P.2). As healthcare professionals already have a full timetable, they find it a barrier that they are the primary investors in these projects rather than the hospital. Also, participants find it a barrier that there is

not a centralised organisation developing such mHealth applications. Participants see one primary mHealth application that contains all of the information and data that is preferred as a facilitator compared to many different applications.

Discussion

Main Findings

When looking at the results from this study, sixteen factors were identified that are associated with the implementation (or lack of implementation) of mHealth applications into routine clinical practice in trauma departments. The influence on the workload, individual user experience, individual opinion about mHealth usage, patient pre-and post-operative information, and current (lack of) infrastructure of mHealth tend to play the greatest role when looking at the facilitators and barriers. Healthcare professionals are in favour of using mHealth applications, but several things must change before they continue to use it confidentially. Healthcare professionals find facilitators in the use of mHealth applications in their routine clinical practice for themselves but also for patients. However, they do believe that the greatest barriers are present in the current infrastructure of the hospital; the current system does not provide the right guidance for optimal use of mHealth applications.

Some barriers and facilitators of mHealth application usage of patiental nature, for those with fractures, from the perspective of healthcare professionals. Specifically, healthcare professionals mentioned that because patients receive much information during their hospital stay, mHealth applications can help them by offering a summary of everything in plain language. Healthcare professionals also noticed that patients were more aware of their illness and able to cope with it when they were actively using a mHealth application. This was also confirmed in the review by Stacey et al. (2017) about decision aids. However, healthcare professionals of this study also stated that when patients were given mHealth applications before their consultations,

patients were more prepared and could ask more questions compared to patients who had not received a mHealth application. This was similar to what Billah et al. (2022) found. In addition, a new patient-related barrier was identified. The fact that mHealth applications are not suitable for all types of patients is a barrier for healthcare professionals. Healthcare professionals had quite some experience with elderly patients who were not able to work with modern technology whilst healthcare professionals are eager to implement mHealth applications and see this modern technology as the future. Other theoretical findings from technology adoption in older adults might serve as the foundation for more effective techniques for overcoming this barrier (Cajita et al., 2018).

The findings revealed a newly identified facilitator, which is part of the pre- and post-procedure information, called medical history Healthcare professionals see the benefits of obtaining medical history before the consultations. This possible new addition to the literature could be explained by the fact that participants discussed the influence of mHealth applications on their daily practices. During this discussion, healthcare professionals with prior experience with mHealth applications noticed that consultations with patients who did not use a mHealth application took longer. Healthcare professionals could also prepare their consultations more efficiently since they had already obtained the patients' medical history.

Some barriers were more of individual nature. Healthcare professionals from this study find that mHealth applications should only have two goals: to provide patients with information and make their work easier. This is contrasting with the results from van Lettow et al. (2019), who state that mHealth applications can serve different goals. Healthcare professionals from this study did not feel the need to have mHealth applications that can support the patient in all ways: providing the information is most important. Consistent with prior work from Bean et al., (2021); Friedberg et al., (2013) and Stacey et al., (2019), healthcare professionals from this study find it a

barrier when using mHealth applications take too much unnecessary time; they should make their work easier, and it should not require additional tasks beyond their regular activities. However, healthcare professionals do think mHealth applications contribute to a decrease in workload. The influence of mHealth applications on the workload was identified as a facilitator in the literature framework, however, the results showed that most healthcare professionals see the barriers of mHealth applications' influence on their consultations in their routine clinical practice. This might be because the majority of participants do not use the applications regularly, believe that the present applications do not meet their needs, or do not see the value in utilising the applications.

Other significant barriers were more of organisational nature. . Consistent with prior work from Billah et al., (2022), Schreiweis et al., (2019) and Stacey et al., (2019), the lack of infrastructure to support mHealth was a frequently mentioned barrier by healthcare professionals. Another barrier found in the current study was that the Wi-fi is currently not properly working, which resulted in participants not being able to use the mHealth application as easy as hoped. Having Wi-Fi problems might be a small inconvenience, but participants do perceive this as a significant barrier. This inconvenience leads to an increased workload which again leads to irritation amongst healthcare professionals which does not improve the healthcare they provide. Additionally, Schreiweis et al. (2019) found that having a proper design and fast-working system is perceived as an enormous facilitator for healthcare professionals. Hence, when this is improved most healthcare professionals are more likely to use mHealth applications regularly.

In this study, all healthcare professionals favoured adopting mHealth applications in their everyday clinical practices, and the majority did so. This is in contrast with prior work from Billah et al. (2022) whose participants did not feel the perceived need of using mHealth applications. Healthcare professionals of the current study felt that mHealth applications could

positively contribute to the facilitation of decreasing workload and making clinical practice easier. One plausible reason for this could be that most participants in this study were between the ages of 29 and 44, whereas the participants in Billah et al. (2022)'s study were between the ages of 29 and 67. Technology is currently essential in many fields, including healthcare. The healthcare industry strives to adapt and stay up with the latest technology developments and the younger individuals are, the better equipped they are to deal with these technologies (Fox & Connolly, 2018; Litwin, 2020).

Theoretical and practical implications

The findings of this qualitative study have important implications for both research and practice. First, from a theoretical point of view, this study looked at two different frameworks. Most literature conducted a literature analysis study or used a descriptive method to analyse existing data (Dobler et al., 2019; Légaré et al., 2018; Schreiweis et al., 2019; Stacey et al., 2017, 2019). For this study, the frameworks from Schreiweis et al. (2019) and Stacey et al. (2017) were used as a starting point of this study. The considered framework consisted of three themes: individual (healthcare professionals), organisational (the hospital) and technical (mHealth application). By using two frameworks when analysing the data, a structured and theory-driven approach to looking at barriers and facilitators were established. These frameworks consisted of three themes, which gave an overview of the most important themes when analysing barriers and facilitators. These frameworks focused on the barriers and facilitators for healthcare professionals only. Their opinion about the mHealth application usage was the main focus. However, during the analysis of the data, it became evident that a fourth theme had to be added: Patients. Many healthcare professionals see the benefits of mHealth applications for patients as well. Although the applications should indeed make their work easier, their work also becomes easier when patients are better informed and able to ask more specific questions. It is interesting to note that

Stacey et al. (2019) used the OMRU model, which stated that potential adopters of mHealth applications could also be patients. However, Stacey et al. (2019) decided to focus on healthcare professionals exclusively. Therefore, as the healthcare professionals repeatedly mentioned barriers and facilitators for patients and the OMRU model also included patients as end-users, further research should consider this novel theme separately as healthcare professionals tend to value the implementation for patients strongly.

Secondly, from a practical point of view, this study showed many barriers related to the organisational nature. Decision aids, mHealth applications, and eHealth systems have become increasingly important nowadays. Although the healthcare industry is a traditional and partly public sector, their strive to implement the newest technology is present (Litwin, 2020). Currently, healthcare professionals struggle with the existing infrastructure. When mHealth applications are implemented, hospitals should consider updating the current infrastructure. Being able to transfer data from mHealth applications directly into the EHR would be a huge improvement. In addition, the EHR should have a function that allows for standardised texts and the ability to transfer data from the EHR directly into the mHealth application. Lastly, the hospital should take the lead in developing and implementing mHealth applications. This could be done by assuring that all involved staff members of a multidisciplinary team are actively involved in the distribution and use of mHealth applications in clinical practice (Joseph-Williams et al., 2021). Finally, when designing mHealth applications as a hospital, a team of healthcare professionals should be part of this. Many healthcare professionals find that the current mHealth applications increase the workload whereas they should decrease it; by taking their opinions, experiences and feedback into consideration, the implementations should become more successful.

Limitations and suggestions for future research

Several limitations should be taken into consideration. The first is the research population. This study included eight healthcare professionals with different specialities. Even though most participants had a trauma speciality, most of them worked with the orthopaedic department. The orthopaedics department has been using mHealth applications for years already with remarkable success. The reason for this success, as explained by participants, is that orthopaedic care is standardised. Trauma care, on the other hand, is not as standardised as orthopaedic care. Patients can break their hands in a lot of diverse ways which complicates standardised care information. As this study focused on trauma care, the results could have been biased regarding the number of barriers mentioned. For the results to be more generalisable and to get a more nuanced view of the barriers and facilitators associated with the implementation of mHealth applications in trauma departments, it would be recommended to conduct a study with healthcare professionals that only work in the trauma department.

Secondly, all healthcare professionals involved in the current study are currently working at the ETZ in Tilburg, the Netherlands. As this research is part of a larger research project in which the ETZ is collaborating with Tilburg University, it resulted in a homogeneous participant group when focussing on the organisation for which participants work. In this case, ETZ is a general hospital whilst in the Netherlands university hospitals also exist. University hospitals distinguish themselves from general hospitals by being linked to a university, training healthcare professionals and conducting scientific research. Also, they strive for continuous innovation in healthcare (Nederlandse Federatie van Universitair Medische Centra, 2022). A recent study conducted by (Treskes et al., 2019) showed that the type of environment a healthcare professional worked in (academic vs general hospital) did not influence the uptake expectations of eHealth systems and mHealth applications. However, it could be that healthcare professionals who work

in an academic hospital are more in favour of using mHealth applications, due to the innovative aspect of the hospital. It would therefore be suggested for future research to take different hospitals into consideration to gather more fruitful information.

Lastly, this research focused on the healthcare professionals who come in contact with such mHealth applications and previously mentioned literature also focused on how patients perceive mHealth applications (e.g., decision aids), but no research has been conducted on the impact these mHealth applications have on patient-doctor interactions in trauma care. As trauma healthcare professionals have a positive attitude towards mHealth application usage for patients and patients tend to value mHealth applications as well, it would be interesting to see how the dynamic between patients and healthcare professionals evolves when these applications are used in routine clinical practice. This future research could focus on how mHealth applications influence the recovery process of a patient when a mHealth application is actively used and encouraged by healthcare professionals. Along with this, future research could conduct observations of routine clinical practice consultations and see whether the pre-established barriers and facilitators for patients and healthcare professionals separately, also occur in the routine clinical practice consultations.

Conclusion

This study investigated the barriers and facilitators associated with the implementation (or lack of implementation) of mHealth applications into routine clinical practice in trauma departments. To gain these insights, eight healthcare professionals were interviewed. They were asked questions about their experience with mHealth applications and their opinion of mHealth applications. These interviews were transcribed, coded and analysed to answer the research question. Healthcare professionals are in general positive towards the use of mHealth

applications, but note a lack of infrastructure, increased workload and ability to keep up with technology as major barriers. Pre- and post-procedure information, support for digitalisation and standardisation are seen as major facilitators. Future research could focus on patient-doctor interactions in routine clinical practice consultations and including diverse types of hospitals could present a different list of barriers and facilitators.

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Appendix A

Figure 2:

Result mind map from Schreiweis et al. (2019)

Appendix B

Wervingsmail voor het onderzoek:
Een goed geïnformeerde patiënt? Een evaluatieonderzoek naar het gebruik van een E-health applicatie voor het revalidatietraject van patiënten met een botbreuk

Geachte heer, mevrouw,

Ik ben Merel Erkens, masterstudent Communicatie en Informatiewetenschappen aan de Tilburg Universiteit. In het kader van We Care doe ik een master afstudeeronderzoek naar de factoren die invloed hebben op de implementatie (of het gebrek aan implementatie) van eHealth applicaties op trauma afdelingen. U bent hiervoor benaderd omdat u zelf bekend met eHealth applicaties: dit kan variëren van daadwerkelijk ermee gewerkt te hebben tot alleen ervan gehoord te hebben.

Voor dit onderzoek ben ik op zoek naar verschillende personen binnen het Elisabeth TweeSteden Ziekenhuis om een goed inzicht te krijgen in wat mogelijke implementatie bemoeilijkt, of wat dit juist kan aanmoedigen.

Wat houdt meedoen in?
Als u nog steeds interesse heeft, zal ik u een uitgebreidere informatiebrief toesturen. Als u daarna instemt met het interview, zullen wij deze inplannen. Deze kunnen vanaf de week van 10 mei ingepland worden. In dit één-op-één gesprek zullen verschillende onderwerpen aan bod komen: uw mening over eHealth applicaties in het algemeen maar ook uw perspectief op de eHealth applicatie ‘Herstel na botbreuken’ zal besproken worden. Het interview zal 30 tot 45 minuten duren.

Het is mogelijk om het interview op locatie (het Elisabeth TweeSteden Ziekenhuis) of online (via Zoom) plaats te laten vinden. U mag zelf aangeven of u liever videobelt of op een andere gewenste locatie van uw keuze afspreekt.

Wat wordt er met mijn interview gedaan?
Tijdens het individuele interview zal een geluidsopname gemaakt worden, met uw goedkeuring, zodat na afloop het interview uitgeschreven kan worden. Het interview zal strikt vertrouwelijk behandeld worden: de enige personen die toegang hebben tot de uitgeschreven interviews zullen de eerste en tweede beoordelaar van de Tilburg Universiteit en ik zijn. In de master scriptie zelf zullen alle antwoorden voldoende geanonimiseerd worden zodat er niks terug valt te herleiden naar persoonsgegevens.

Graag zie ik uw reactie bij aanhoudende interesse per mail of telefonisch tegemoet.
Mocht u nog vragen hebben, dan kunt u mij bereiken op onderstaande gegevens.

Alvast heel erg bedankt en met vriendelijke groet,
Merel Erkens
Student Communicatie en Informatiewetenschappen, Tilburg Universiteit
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06-52552213

Appendix C

Informatie voor de zorgverlener over het onderzoek: Een goed geïnformeerde patiënt? Een evaluatieonderzoek naar het gebruik van een E-health applicatie voor het revalidatietraject van patiënten met een botbreuk

Geachte heer, mevrouw,

U ontvangt deze informatiebrief omdat u bent uitgenodigd deel te nemen aan een onderzoek naar het gebruik van de keuzehulp 'herstel na botbreuk'. In deze brief leggen ik u uit wat het doel is van het onderzoek, en wat ik precies van u zou willen vragen. Ik wil u vragen deze informatiebrief rustig door te lezen.

Door wie wordt dit onderzoek uitgevoerd?
Dit onderzoek is een samenwerkingsverband tussen onderzoekers van Tilburg Universiteit en het ETZ. Ik ben Merel Erkens, een masterstudent aan de opleiding Communicatie- en Informatiewetenschappen die haar afstudeerscriptie schrijft over de keuzehulp en een deel van het onderzoek zal uitvoeren.

Wat houdt dit onderzoek in?
De keuzehulp 'herstel na botbreuk' wordt sinds kort aangeboden aan alle mensen die recent met een botbreuk hebben opgelopen. Het doel is om patiënten meer inzicht te geven in wat herstel na een botbreuk inhoudt en welke keuzes zij daarin kunnen maken. Om te evalueren of patiënten en zorgverleners gebruik maken van de keuzehulp en zo ja, hoe, en wat hun ervaringen zijn met de keuzehulp voeren we een kwalitatief onderzoek uit. We maken hiervoor gebruik van interviews en observaties van poligesprekken. Het onderzoek wordt uitgevoerd door onderzoekers en studenten van Tilburg Universiteit en zal plaatsvinden in het voorjaar van 2022. De projectleiders van het ETZ krijgen geen informatie te zien die te herleiden is naar de deelnemers. Dat betekent dat u vrijuit kunt spreken over uw ervaringen met de keuzehulp, en hoe deze wel of niet een bijdrage levert aan de zorg voor uw patiënten.

Doel van het onderzoek
In deze studie zal ik onderzoeken hoe zorgverleners de keuzehulp gebruiken, wat hun ervaringen zijn met de keuzehulp, en welke factoren invloed hebben op de implementatie (of het gebrek aan implementatie) van een keuzehulp op trauma afdelingen. Ik zal dit doen door middel van interviews met zorgverleners.

U bent benaderd voor een individueel interview.

Interviews

Wat houdt een individueel interview in?
Het interview wordt individueel afgenomen. Ik (Merel Erkens) zal u in een één-op-één gesprek verschillende vragen stellen die gaan over uw huidige ervaringen met de keuzehulp in relatie tot de zorg voor uw patiënten. Uw eigen ervaringen en perspectief staan hierbij centraal, en er zijn geen foute antwoorden. In totaal zullen er ongeveer 5-10 zorgverleners deelnemen aan een interview.

Wat houdt meedoen aan een interview in?
Het interview duurt maximaal 30 tot 45 minuten. Het kan zowel online plaatsvinden (via Zoom) als op een locatie naar uw keuze (bijvoorbeeld in het ziekenhuis of op de universiteit). U mag zelf aangeven of u liever videobelt of op een locatie van uw keuze afspreekt. Als u dat wenst kan er tijdens het interview een pauze worden ingelast.

Tijdens het individuele interview zal er een geluidsopname gemaakt worden, zodat na afloop het interview uitgeschreven kan worden. Hiermee kunnen er geen waardevolle antwoorden en commentaren verloren gaan. U mag het altijd aangeven als u liever geen geluidsopname wilt, of als u de recorder even wilt pauzeren.

Mocht het interview via videobellen plaatsvinden dan zal het videobeeld van de online meeting niet opgenomen worden. U kunt deelnemen aan het online interview op een door u gewenste plek vanuit huis of in het ziekenhuis. Wel vragen wij u om in een rustige en afgesloten ruimte plaats te nemen en een stabiele internetverbinding te gebruiken.

Onderwerpen tijdens het interview
In het interview zullen de volgende thema's aan bod komen:
1. Uw ervaringen met eHealth applicaties in het algemeen, de keuzehulp 'Herstel na botbreuken' en de mate waarin u denkt dat dit een verschil voor patiënten en uw eigen werk maakt;
2. Hoe patiënten in uw beleving de keuzehulp wel of niet gebruiken, ook tijdens de poligesprekken

Wij zijn hierbij benieuwd naar uw mening en ervaringen, en er zijn geen foute antwoorden.

Indien u instemt met deelname, wordt u gevraagd uw toestemming aan te geven op het losse formulier.

Zijn er risico's verbonden aan dit onderzoek?
Er zijn geen risico's verbonden aan dit onderzoek. Het enige wat deelname van u vergt, is de tijd die het (online) interview in beslag neemt. Het is belangrijk om te weten dat u deelneemt op vrijwillige basis. U kunt dus altijd stoppen met uw deelname, ook als het interview al begonnen is, zonder opgave van redenen.

Wat gebeurt er met mijn gegevens?
De Raad van Bestuur van het ETZ heeft ingestemd met de uitvoering van dit onderzoek. De resultaten van dit onderzoek gebruiken wij om inzicht te krijgen in de wensen en behoeften van patiënten van het ETZ om zo de keuzehulp te verbeteren. Na afronding van het onderzoek worden de verzamelde gegevens geanalyseerd en gebruikt voor twee afstudeeronderzoeken en tenminste een wetenschappelijk artikel. In deze afstudeeronderzoeken en het artikel zullen geen persoonsgegevens worden gebruikt. Wij verzamelen uw gegevens volgens de AVG-wetgeving. Dit betekent dat alle informatie anoniem wordt verwerkt. Er worden geen namen of andere herleidbare persoonsgegevens verwerkt of opgeslagen. De antwoorden die gegeven worden tijdens het interview zullen dus niet naar de persoon herleid kunnen worden. De geanonimiseerde gegevens worden voor een periode van tien jaar opgeslagen in een beveiligd systeem van Tilburg Universiteit. We kunnen uw gegevens op elk moment uit het bestand verwijderen, tot het moment waarop dit onderzoek is gerapporteerd in een afstudeerscriptie en/of wetenschappelijk artikel.

Ontvang ik een vergoeding?
Voor uw deelname aan deze studie ontvangt u geen vergoeding.

Videobellen via Zoom
Mocht u hebben aangegeven dat u voor het interview graag wilt videobellen, dan zal het interview plaatsvinden in Zoom. Per email ontvangt u van mij een link naar het videobelgesprek. In de uitnodigingsmail zult u een instructie ontvangen over hoe het interview plaatsvindt en hoe u kunt deelnemen.

Bij wie kan ik terecht met vragen?
Als u nog vragen heeft over dit onderzoek, kunt u contact opnemen met:

- **Hoofdonderzoekers vanuit het ETZ: Koen Lansink en Mariska de Jongh.** Email: m.d.jongh@nazb.nl ; Telefoonnummer: 06-41429461
- **Onderzoeker Tineke Broer** (Tilburg University); E-mail: T.Broer_1@tilburguniversity.edu ; Direct telefoonnummer: 06-15215107
- **Masterstudent Merel Erkens** (Tilburg University); E-mail: m.erkens_1@tilburguniversity.edu; Telefoonnummer: 06-5255221

De contactgegevens van de verwerkersverantwoordelijke van het onderzoek zijn: Tineke Broer, T.Broer_1@tilburguniversity.edu. Voor algemene informatie over uw rechten bij verwerking van de gegevens verwijzen we u naar de website van de Autoriteit Persoonsgegevens en naar de website van het ETZ (www.etz.nl/privacy). Voor vragen of klachten over de verwerking van uw persoonsgegevens raden we u aan eerst contact op te nemen met de onderzoekslocatie. U kunt ook contact opnemen met de Functionaris voor de Gegevensbescherming van het ETZ (H. Candel, fg@etz.nl) of de Autoriteit Persoonsgegevens.

Met vriendelijke groeten, mede namens Mariska de Jongh, Nadine Bol, Koen Lansink en Tineke Broer,

Merel Erkens

Appendix D

TOESTEMMINGSFORMULIER VOOR DE ZORGVERLENER

Onderzoek: Een goed geïnformeerde patiënt? Een evaluatieonderzoek naar het gebruik van een E-health applicatie voor het revalidatietraject van patiënten met een botbreuk

Als u mee wilt doen aan dit onderzoek, kunt u hieronder uw toestemming geven. Uw deelname aan dit onderzoek is geheel vrijwillig. Dit betekent dat u het recht heeft om u te allen tijde terug te trekken, zonder opgeven van een reden.

Als u uw toestemming geeft voor deelname, dan geeft u aan dat u:

- Ouder bent dan 18 jaar;
- De informatiebrief heeft gelezen en heeft begrepen;
- Voldoende tijd heeft gehad om uw deelname aan dit onderzoek te overwegen;
- Voldoende tijd heeft gehad om vooraf uw deelname aan dit onderzoek vragen te stellen betreffende het onderzoek;
- Begrijpt dat uw deelname aan deze studie geheel vrijwillig is;
- Begrijpt dat u zich te allen tijde zonder opgeven van een reden terug kan trekken;
- Toestemming geeft dat er tijdens het interview geluidopnames worden gemaakt;
- Ermee instemt dat de verzamelde, gecodeerde gegevens 10 jaar worden opgeslagen zoals in de informatiebrief staat beschreven;
- Ermee instemt dat de verzamelde, gecodeerde gegevens worden gebruikt voor het huidige wetenschappelijk onderzoek welke gepubliceerd wordt in de online databank van de TiU, en welke gepubliceerd kan worden in een wetenschappelijk artikel;
- Begrijpt dat u uw gegevens zonder opgeven van een reden kunt laten verwijderen tot het moment van publicatie.

☐ Ik stem in met deelname aan een interview.
☐ Ik stem niet in met deelname aan een interview.

Naam: ……
Telefoonnummer: ……
Emailadres: …….
Datum van vandaag: …….
Plaats uw handtekening in het vak hier onder:

Ondertekening onderzoeker
Ik bevestig dat ik alle relevante informatie over het onderzoek heb gegeven:

Naam onderzoeker: …….
Datum van vandaag: …….
Plaats uw handtekening in het vak hier onder:

Appendix E

Table 2

Interview guide

Deel 1 – Welkom (5 min, voordat de voice recorder aan gaat)

Welkom, fijn dat u vandaag aanwezig bent en wilt deelnemen aan het interview. Mijn naam is Merel Erkens en ik zal vandaag het interview bij u afnemen. Ik ben een masterstudent aan de Tilburg University en doe dit onderzoek in samenwerking met het Elisabeth-TweeSteden Ziekenhuis, samen met Koen Lansink, Mariska de Jongh, Nadine Bol, Tineke Broer en Thymen Houwen.

Ik heb u uitgenodigd om deel te nemen aan dit interview omdat ik benieuwd ben naar uw gebruik van de keuzehulp, wat er volgens u verbeterd kan worden in de keuzehulp, en uw mening in het algemeen over mHealth applicaties.

Voordat we beginnen, wil ik u graag uitleggen hoe het interview er ongeveer uit zal zien:

a. Ik zal u enkele vragen stellen en er zijn geen goede of foute antwoorden op de gestelde vragen. Ik ben geïnteresseerd in uw mening en ervaringen, dus alles wat u zegt is goed. Ik ben hier namelijk om van u te leren.

b. U bent niet verplicht elke vraag te beantwoorden. Wanneer er een vraag is waarop u liever geen antwoord wilt geven, hoeft u dit niet te doen.

c. Tijdens het interview zou ik graag audio-opnames maken, omdat ik niets van uw waardevolle antwoorden en commentaren wil missen. U kunt ook altijd aangeven om de recorder tijdelijk uit te zetten.

d. Er zullen geen namen of gegevens die tot identificatie van individuele personen kunnen leiden in mijn stukken verwerkt worden.

e. U heeft de informatiebrief en het toestemmingsformulier gelezen en via een online formulier heeft u mij toestemming gegeven om de gegevens uit uw interview te verwerken.

f. Heeft u nog vragen voordat we gaan beginnen? **Dan zet ik nu de audiorecorder aan**.

Vandaag wil ik graag met u de volgende thema's bespreken:

1. Uw mening en ervaring over keuzehulpen en mHealth applicaties in het algemeen
2. Uw ervaringen met de keuzehulp 'Herstel na botbreuken' en de mate waarin u denkt dat dit een verschil maakt voor patiënten

Voor elk van de thema's zal ik met een brede openingsvraag beginnen, en afhankelijk van het antwoord van u doorvragen of een nieuwe vraag stellen.

Deel 2 – Achtergrond informatie

1. Kunt u om te beginnen wat over uzelf vertellen? Uw leeftijd, wat uw achtergrond en huidige functie is?
    - *Vervolg vragen*: hoe lang werkt u al in het ETZ? Is dit altijd op de trauma-afdeling geweest?
2. Internet en technologie wordt steeds belangrijker, ook in de zorg. Mobile Health is een verzamelterm voor elektronische applicaties die de gezondheidszorg kunnen ondersteunen. Dit zijn bijvoorbeeld keuzehulpen of patient journey apps die de patiënt, familie en arts kunnen ondersteunen in het zorgpad; voor patiënten bijvoorbeeld in de voorbereiding op een behandeling. Kunt u wat meer vertellen over de rol van mHealth applicaties, zoals een keuzehulp, in uw huidige functie?
    - *Vervolgvragen indien ja*: Kunt u een voorbeeld geven van een mHealth applicatie waarmee u zelf heeft gewerkt of momenteel mee werkt?
    - *Vervolgvragen indien nee:* waarom denkt u dat u nog nooit met een mHealth applicatie heeft gewerkt?

Deel 3 – thema 1 *Uw mening en ervaring over keuzehulpen en mHealth applicaties in het algemeen*

1. Wat denkt u dat het doel zou moeten zijn van een mHealth applicatie?
    - Vervolg vragen: wat vindt u van het gebruik van een mHealth applicatie?
2. Voor wie denkt u dat mHealth applicaties van toepassing kunnen zijn?
    - Vervolgvragen: Zou dit alleen voor patiënten zijn? Kunnen zorgverleners hier ook toegevoegde waarde aan hechten?
3. Er zullen ongetwijfeld verschillende zaken zijn voor u als **individu** die het gebruik van een mHealth applicatie moeilijker of makkelijker maken in uw dagelijkse werkzaamheden. Zou u hier iets over willen vertellen, wat voor **u** een rol speelt?
    - Vervolgvragen: Zou u hier wat meer over willen vertellen? Wat zou het voor u makkelijker of moeilijker maken?
4. Naast zaken die voor u als individu een rol kunnen spelen, kunnen ook zaken op de **werkvloer** een factor zijn in het vergemakkelijken of juist bemoeilijken van het gebruik van een eHealth applicatie. Kunt u mij iets vertellen over de rol van het **ziekenhuis** in het faciliteren of juist beperken van het gebruik van mHealth applicaties?
    - Voorbeeld indien uitleg nodig: Over regelgeving, wat collega's vinden of wat hoger management implementeert?
    - Vervolgvragen: Zou u hier wat meer over willen vertellen? Wat zou het voor u makkelijker of moeilijker maken? Zou een positieve of juist negatieve invloed van de organisatie uw mening veranderen over het gebruik van mHealth applicaties in de dagelijkse praktijk? Waarom wel of niet?
5. Met de introductie van nieuwe technologie, speelt ook de **technische** infrastructuur een belangrijke rol. Zo moet de huidige infrastructuur van een organisatie de nieuwe technologie aankunnen en de medewerkers goed om kunnen gaan met de digitale technologie. Welke zaken rondom de technische infrastructuur ervaart u als faciliterend of juist beperkend voor de implementatie van mHealth applicaties ?
    - Vervolgvragen: Zou u hier wat meer over willen vertellen? Wat zou het voor u makkelijker of moeilijker maken? Vormen het doen van eventuele extra technische handelingen een obstakel in uw werkzaamheden? Kunt u dat toelichten?

Deel 4 – Thema 2 *Uw ervaringen met de keuzehulp 'Herstel na botbreuken' en de mate waarin u denkt dat dit een verschil voor patiënten maakt*.

1. Zoals u wellicht wel weet, is een tijd terug in het ETZ de keuzehulp 'Herstel na botbreuken' geïntroduceerd. Zou u mij kunnen vertellen over uw ervaring met specifiek deze keuzehulp?
    - Vervolg vragen: Wat heeft u als prettig of onprettig ervaren tijdens het gebruik?
2. Wat is volgens u de toegevoegde waarde van een keuzehulp voor de patiënt, maar ook voor uzelf en het ziekenhuis?
    - Vervolg vraag: Welke rol denkt u dat de keuzehulp kan spelen in poligesprekken? Denkt u dat er een rol weggelegd is voor de keuzehulp? Waarom wel/niet?

Deel 5 – Einde

We zijn bij het einde gekomen van het interview. Hoe kijkt u terug op het interview? Vond u bepaalde vragen lastig? Vond u bepaalde vragen vervelend? Zijn er nog eventuele dingen die u wilt toevoegen of wilt delen? Heeft u nog vragen voor mij? ***(indien geen extra informatie, opname stoppen)***

Ik wil u heel erg bedanken voor uw tijd en medewerking.

Appendix F

Table 3

Explanation of factors from the coding scheme

Individual Barriers and Facilitators	
Opinion about mHealth usage	This factor includes the opinion of healthcare professionals about mHealth usage.
Influence of mHealth Usage on Consultation	This factor includes healthcare professionals' experience with mHealth usage during their consultations and the benefits for a patient's anamnesis.
Influence on the workload	This factor includes healthcare professionals' view of the workload when mHealth applications are used.
User experience	This factor includes the barriers and facilitators related to the user experience of healthcare professionals with mHealth applications.
Patient Barriers and Facilitators	
Ability to keep up with technology	This factor includes healthcare professionals' experience with patients and their ability to keep up with technology.
Pre- and Post-operative Information	This factor includes the facilitators from the perspective of healthcare professionals regarding pre- and post-operative information for patients.
Organisational Barriers and Facilitators	
Interference with practice and workflow	This factor includes healthcare professionals' experience with how mHealth applications work in routine clinical practice.
Support of mHealth usage	This factor includes healthcare professionals' opinions about how the hospital supports mHealth.
Hospitals' Investment in mHealth	This factor includes healthcare professionals' opinions about the hospital's investment in mHealth.
Awareness and Use of mHealth Applications	This factor includes healthcare professionals' personal experience with utilising mHealth applications and its policies for routine clinical practice.
Current (Lack of) Infrastructure of mHealth to support mHealth	This factor includes the opinion of healthcare professionals regarding the current infrastructure of the EHR and the hospital and how they support (or do not support) mHealth

Technical Barriers and Facilitators

Personalisation of mHealth	This factor includes healthcare professionals' opinions about how mHealth applications should become more personalised.
Privacy of mHealth	This factor includes healthcare professionals' opinions about technological privacy.
mHealths' Support for Standardisation	This factor includes healthcare professionals' opinions about how mHealth applications could improve standardised healthcare.
Support of digitalisation	This factor includes healthcare professionals' experience with the hospital supporting digitalisation.
Development of mHealth	This factor includes healthcare professionals' opinions about the development of mHealth applications.