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Are M-health Applications Accessible for Elders?

**A Qualitative Study of the Accessibility of M-health
Applications**

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ABSTRACT (MAX. 200 WORDS):

The rapid advancements of technology have brought benefits to many sectors, including the health sector. Popular technologies related to e-health and m-health have transformed the traditional healthcare and are getting more popular among physicians and patients. Since these technologies, like any other, are constantly changing and improving, some groups of people who are not digitally literate enough to use them are getting neglected. One of those groups are elderly people, who are known for struggling with the use of technology. Considering that m-health applications have proven to be of big essence for elders, this raises a big issue. Therefore, this study aims to further explore the accessibility of m-health applications for elderly people. For this to be done, existing literature about this topic has been compared with empirical findings derived from conducting interviews. The research is based on the Senior Technology Acceptance Model (STAM) which helped us understand elders' adoption of technology. The study concludes that m-health applications are not accessible enough for elders. Therefore, we proposed the accessibility guidelines for the design of m-health applications which will help improve their accessibility. Along with providing these guidelines, we emphasized the importance of including elders at every stage of m-health development and testing processes and raising awareness about this issue among everyone involved in m-health development.

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1. Introduction

This chapter will start with an introduction, providing general information on the topic and stating the question and the problem it will be facing. The motivations and aims of the paper will also be alongside the first part, where they will display why such a problem is being questioned and present the limitations of such a question and how answering it needs much more in-depth analysis. The second chapter will cover the theoretical background of the research. In this part, e-health and m-health will be further explained, as well as the characteristics of elderly people and their adoption of technology, followed by accessibility guidelines for technology design of m-health applications. The third chapter of this paper will provide the research design alongside the research approach and philosophy and how the data collection and analysis of the chosen method will be handled. Furthermore, the ethical consideration and scientific quality of the paper will be presented. In the fourth chapter, the empirical findings will be presented based on the interviews with people with experience in this field. In the fifth chapter, we will discuss and compare the findings from the literature review and the interviews and suggest the best guidelines/recommendations for designing m-health applications and making them more adapted to elderly people. Finally, this paper ends with conclusions and future work.

1.1 Background

To reach a full understanding of the research problem that this paper will cover, it is imperative to first define one of its significant parts, e-health. According to Eysenbach (2001), e-health is a new field that rises from the interchange of business with public health and medical informatics through technology to get enhanced health services and improved health care. Silber (2003) also described e-health as the implementation of information and communication technologies (ICT) across the benefits and the multi-layers of healthcare to reach maximum responsiveness for the demand. Silber (2003) also added four opportunities in which e-health is covered, including the citizen or patient who uses e-health in self-medication and opinions on medical conditions, primary care, which includes the use of technologies by medical teams for the management of patients. Furthermore, human care provides home calls and hospitals that use e-health as a database for multiple hospital functions.

According to The World bank (2012), the world has over six billion mobile phone users, and estimations were made that 75% have mobile communications access. Considering that this study took place in 2012, it can be deduced that the numbers now increased significantly, and the usage of mobile communication is now more accessible and affordable. With the continuous development of e-health through the years, a new term, called Mobile Health (M-health) came into the market due to the increased mobile interactions. According to Nilsen et al. (2012), m-health is a rapidly growing science that has potentially improved different aspects of health, including the power of more advanced querying, disease prevention, treatment improvement, and lowering health costs due to easier accessibility. Nilsen et al. (2012) noted that with the power of the wireless technologies that m-health is implemented in, it could be used to monitor real-time cases of chronic diseases, as well as make databases that include all of the data that is being gathered by the monitoring for further usage.

Many researchers show that e-health and m-health are improving and enhancing health care and health services, alongside their help to hospitals and health professionals. However, there seems to be some resistance towards these technologies by elderly people (Agarwal & Prasad, 1999), alongside anxiousness and discomfort of the rapid technological rise (Tams, Grover & Thatcher, 2014). And with the decrease in the elders' cognitive skills and mental state, forcing such technologies could be a challenge (Rockmann & Gewald, 2015).

One of the important things is to design accessible user interfaces (UI) that consider senior citizens' needs, such as larger UI elements and simplified menus. These are some of the reasons why accessibility should be part of the UI design process, putting a special emphasis on making an interface usable by older people. The issue is that there are still not as many accessible websites and applications for them as there should be. Older generations have a way of thinking that differs from the current ones. They are used to things that were simpler and easier to use back in the day. However, the technologies are evolving more, and creating apps is more manageable than when it first started.

1.2 Research Problem

With the rapid advancement of information and communication technologies, it has become easier for people to track and monitor health-related measurements using various devices and services (Fletcher & Jensen, 2015; Kim et al., 2016). One of the ways that individuals are able to maintain and improve their health is through mobile phones. Thus, m-health, which is becoming more popular through the years, can be used by healthcare providers to empower, assist, and educate their patients on ways to access health information and improve their health (Fletcher & Jensen, 2015). It can also help people count the calories they have burnt, track the distance they have run, walked or cycled, and monitor the changes in physiological parameters, as well as enhance their ability to collect, review, and share data on health concerns and physical conditions with healthcare providers (Kim et al., 2016). One growing population that may have difficulty adapting to this new way of accessing their health information is the elderly population.

According to Kim et al. (2016), mobile technologies provide the possibility for advanced healthcare, especially by assisting self-management of chronic care. For these technologies to have an impact on the chronic care management practice, they need to be adapted for older adults, because most people with chronic diseases are older. Therefore, merging the suitable use of such technologies into the lives of older adults is very important. Today's generations of older adults have not grown up with information and communications technologies that are widely available these days. Thus, there is "a natural confound of age and experience, since today's older adults are exposed to these technologies at a different point in their lives than today's young adults." (Kim et al., 2016, p.1). Moreover, new technologies and applications are mainly built by younger developers and this approach has resulted in a number of older adults being disengaged.

In addition to lack of experience, older adults may also experience age-related perceptual, motor, and cognitive changes that affect their use of technology. It is well known that ageing brings about changes in a person's abilities. For example, vision changes will cause most of

elders to begin to use glasses even if they have not previously done so. For others, vision changes will be more severe, creating obvious difficulties in learning and using technologies. Registration and login processes are another big problem for older people, as well as forgetting how to use a device after some time. All of these problems need to be considered and included when developing and designing applications and services of m-health nature.

1.3 Research Purpose

The motivation behind writing this paper lies in the need for addressing the problems that elderly people face when using m-health applications by making those applications more accessible to them. As the global population is rapidly ageing, and many e-health services are now offered online through mobile applications, it is necessary to adapt those applications and services so older people can easily access and use them.

1.4 Research Question

- *How can m-health applications be more accessible for elders?*

1.5 Delimitation

This paper will conduct a qualitative research approach with interviews as the primary data collection method. Interviewees' opinions may differ and raise an issue since this paper aims to know if m-health is implemented in a way that has easier access to the elders demographic. Also, some answers will differ according to the education level that person has reached and his way of thinking. Furthermore, since this study has less time in data collection, that could affect the data analysis process and the findings in the long run. Also, some e-health and m-health developers and consultants may have less or biased information regarding this topic, which also presents potential limitations. Finally, since the interviews will be with the people who develop and design m-health technologies, direct opinions of the chosen demographic will not be present. The elders' views could have shown a lot of insights on this topic and the users' perspective of this issue.

2. Theoretical Background

This chapter presents the insights on this topic which are gathered from the literature. The first section covers the definition and characteristics of e-health and m-health. The second section of this chapter presents the current state of elderly people, including the elders' perception of technology and m-health. The third section covers the Technology Acceptance Model (TAM) and Senior Technology Acceptance Model (STAM). The final section presents the accessibility guidelines for the design of Web and mobile applications.

2.1 Defining E-health and M-health

Before 1999, e-health was just like any other electronic service, such as e-commerce, e-business and e-solution, and many others, but the difference is that e-health is mainly defined as anything with computers, medicine, and health care (Eysenbach, 2001). E-health throughout the years has gone through an evolution, challenges, and opportunities and to point out one main definition could be difficult. However, Eysenbach (2001) defined e-health as the rising field of the combination of medical informatics, public health, and business. Furthermore, e-health is the more refined delivery of medical care using the internet and a better commitment and communication through technology that will lead to better health care worldwide. Eysenbach (2001) also pointed out that the "E" in E-health is not just for electronics, as it also presents 10 characteristics upon which it is built, along with the fact that e-health must be easy-to-use, entertaining, and exciting and that will make it more accessible to many people and will provide healthcare in the best possible way. A study by (Schaffer et al., 2022) provided that 85% of patients and 75% of general practitioners agreed that the use of e-health tools is accessible and can be accepted.

Darley, Coughlan & Furlong, (2021), Ayyoubzadeh et al., (2020), and den Bakker et al., (2018) perceived e-health as a valuable tool for people with terminal diseases and discussed how the research on such a topic was increasing in the last two decades. E-health is also a tool that could help in reducing medical errors, since the United States alone counts 60 000 deaths per year due to medical errors, and two billion dollars are wasted on preventable medical cases (ed. Kohn, Corrigan & Donaldson, 2000). Ball & Lillis (2001) further pointed out that, with the evolved state of e-health, organizations are also changing their perspective on how to do business, from Business to Business (B2B), to Business to Consumer (B2C). According to Rauwerdink et al., (2020), along with the benefits and changes of perspective that e-health has for organizations, e-health is also benefiting patients and caregivers. However, they say that some aspects should be considered when developing e-health solutions for successful results. (Nymberg et al., 2019) conducted a study on the expectations and attitudes toward the use of e-health and concluded that further improvements must be done for e-health to be widely accepted.

According to Holman, (2022), m-health as a term is using mobile devices and other wireless technologies to access health and medical care. Birkmeyer, Wirtz & Langer, (2021) also defined m-health as a service that improves healthcare by using mobile technologies and added that those

technologies could improve the willingness of people to track their health. Cho, Park & Lee, (2014) pointed out that people with higher health consciousness have a higher rate of having more healthy habits and avoiding unhealthy ones, so both previous studies show that m-health could improve the overall healthy lifestyle of users. In addition, Hasan, Bao & Chiong, (2022) pointed out that m-health could provide awareness of health issues and assess in remote consultation and minimize the need for patients to meet doctors. Since m-health applications are based on mobile devices, there is a need for better personalization to make those applications more accessible (Birkmeyer, Wirtz & Langer, 2021). Park, (2014), Mohr et al., (2014), and Guo, Zhang & Sun, (2016), also concluded that personalization delivers a better tailored, more satisfactory m-health user experience. Finally, Tang et al., (2015) pointed out the importance of mobile application design and how crucial it is for the attitude and perception of users since it is the first line of contact between users and the applications (Lee & Chung, 2009).

2.2 Current State of the Elderly People

2.2.1 Elders' Perception on Technology

Most of the elderly population has a problem when it comes to using technology, especially today when technology is becoming way more advanced even for young people. Studies and many authors like Czaja et al., (2006) have shown that elders find it more challenging to deal with technologies like mobile devices and laptops than younger people have. A blog post in 2004 and 2005 posted that only 25% of elders above 65 use the internet, and a lower rate of them uses the internet just for email and information searches (Pew Internet and American Life Project, 2004, 2005). Elders also have less confidence and computer skills than younger people (The American Association of Retired Persons, 2002). Czaja et al., (2006) also pointed out that by not using current technologies, the elders will be put at a disadvantage from others, and that could decrease their quality of independent and successful everyday life, along with the fact that elders don't fully realize the benefits and how those technologies can increase their quality of life. A recent study by Zickuhr & Madden, (2012) showed that the percentage of elders that use the internet or mail has increased to 53%, which is a huge increase compared to the percentage in 2005. Therefore, it can be concluded that the evolution of technology is making the elders use technologies more. However, 47% of elders do not fully realize the benefits and/or do not accept new technologies.

Vroman, Arthanat & Lysack, (2015) pointed out that elders lack the capability to use or familiarize themselves with ICT because, for most of them, their life, education, and work were at a time when current technologies did not exist. Vroman, Arthanat & Lysack, (2015) also mentioned that the current advance in technology is primarily targeted towards the younger audience which benefited them, overlooking the fact that those technologies can also be advantageous for the elderly. Hill, Betts & Gardner, (2015) also mentioned that with the fast-paced transformation of technology, there should be an individualistic sense of increasing self-

digital literacy to stay within the coverage of technology inclusion. So getting to know the experiences and lifestyles of elders, can help in implementing their needs into today's technology. Leonardi et al. (2008) pointed out that the younger generation has been experiencing technology since their birth and dealing with interactive mediums is a norm for most of them, so that created a common ground of knowledge that the elderly have not faced or acquired with the technology in their age. Jun et al., (2008) implied that technologies, unlike a human, cannot change their language to suit different demographics or types of people, they can only do it if they are designed that way.

The use of technology can increase the convenience of life for elders by increasing their chances of communicating with their loved ones (Chopik, 2016). Cotten, Anderson & McCullough, (2013) introduced that while a person ages he tends to lose some of his social connections and relations, and that could lead to some socioemotional decrease, so they connected the use of technology with the increase in socioemotional outcomes of elders by overcoming the boundaries of time and place. Perkins et al., (2013) also supported this argument with the decrease in social ties and connections when the elderly move into assisted and independent living communities. So, technology can help them keep some of those ties and relations by keeping the communication way intact.

2.2.2 Elders and M-health

According to Xie and Kalun Or, (2020) and many other research and studies, population aging is a rising global phenomenon, and the number of older adults above the age of 65 has reached 703 million and is expected to double by 2050 to 1.5 billion (United Nations, 2019). And according to Christensen et al., (2009) the presence of chronic diseases and other physical and mental conditions for elders are also on the rise. So, this rise of both aging and chronic diseases in elders will put a lot of pressure on healthcare systems (Maisonneuve & Martins, 2013). The use of m-health with these issues could be proven to be very helpful and handle some of the burdens that healthcare systems are facing (Xie & Kalun Or, 2020).

The following table (Table 2) will present Research studies on the effectiveness of m-health toward elders.

Authors and Year	Used Technology or Device	Intervention	Findings
Changizi & Kaveh, (2017)	None	Assessing the effectiveness of m-health in improving health behaviors among an elderly population.	M-health improves the health behaviors of elders by helping them have more control of their conditions, improving and giving them a better lifestyle, reducing the risks of chronic diseases, and overall, it proved that it can help elders reach a desirable physical and mental health outcome.
Hurmuz et al., (2022)	Virtual Coaching System-Council of Coaches	Assessing the use, user experience, and potential health effects of a conversational agent-based eHealth platform implemented in a real-world setting among older adults.	The use of the virtual coaching system proved to be easy to use for elders, improved their lifestyle, may help in preventing chronic diseases, and ease some of the burdens from health care systems. The Researchers noted that elders are willing to use VCS more if it is more personalized.
M. Ghazal et al., (2015)	Inertial and medical sensors found in commercial smartwatches and smartphones	Maintenance of accurate and updated health history, prevention of inappropriate dietary options, and detection of major fall accidents by elders and their caregiver.	Facilitated the tracking of users' activities and health monitoring. Fall detection proved to have excellent accuracy, but the authors noted that it could be improved by adding more sensors.
De Oliveira et al., (2021)	MARS Scale	The Mobile App Rating Scale evaluates applications for Android and iOS that are focused on detecting and preventing falls in the elderly.	After a thorough evaluation using the MARS scale, fall detection and prevention apps for Android and iOS are of excellent quality. One potential drawback is that many older people may not use smartphones as frequently as young people, which may restrict the number of apps produced for this reason.

Z. Li et al., (2014)	Smart Wristlet and Fall Perception Algorithm	Providing 24 hours fall detection service for elderly.	It's a useful m-Health tool for preventing falls in the elderly. Fall detection accuracy may be increased, saving about 800 million dollars in direct medical expenditures each year. The authors also noted that this proposal could also improve the overall performance of the Smart Wristlet.
Cao et al., (2020)	stimulus-organism-response (SOR) framework and intergenerational support	Using the stimulus-organism-response (SOR) paradigm to investigate the influence of overload variables on m-health application resistance behavior and integrating intergeneration support to identify the buffer factors.	According to the findings of this study, perceived information overload and perceived system feature overload (stimulus) would cause weariness and technostress (organism) in elderly users, which will lead to resistance behavior (response). Intergenerational support, on the other hand, acts as a considerable buffer between unpleasant feeling and resistant action.
Isaković et al., (2016)	Two M-health applications for Diabetes Management	Investigate how older individuals utilize mobile applications for diabetes control on a practical level. Discussing and illustrating how existing apps may be changed to boost usability and adoption rate, as well as the obstacles that may be limiting them from implementing such digital m-health solutions.	Applications designed for the general public are not always appropriate for elderly users. To better accommodate older users, a current app can be greatly upgraded. Creating several profiles to optimize the app for different accessibility groups (e.g., bad eyesight and limited dexterity) might also help. The app would be set to the user's preferences when they selected their profile. Personalization features like this would have a far bigger impact and reach if they were deployed consistently across all major mobile operating systems.

Table 1 Summary of studies about m-health and elders

2.3 Technology Acceptance by Elderly People

2.3.1 Technology Acceptance Model

Explaining user acceptance of new technology is one of the most grown research areas in the modern Information Systems (IS) literature (Venkatesh et al., 2003). There are multiple well established theoretical models related to the acceptance of technology (Kim et al., 2016; Venkatesh et al., 2003), which mainly originate from Information Systems, Psychology and Sociology, but our focus will be on the Technology Acceptance Model, since we want to understand users' behavior towards technology. Technology Acceptance Model (TAM) was developed by Davis (1985) and is derived from the Fishbein Model which provides most of the theoretical foundation for TAM (Davis, 1985). TAM has been widely accepted and used in many industries which integrate Information Technologies (Holden & Karsh, 2010), and Kwon and Chidambaram (2000) argue that is well applied to the healthcare as well. According to Rose and Fogarty (2006), TAM has become a powerful model for predicting user acceptance of Information Technology.

Holden and Karsh (2010) argue that, according to TAM, the most common motive for the use of IT is the Behavioral Intention (BI), which is often referred as an acceptance of technology (Davis, Bagozzi & Warshaw, 1989; Szajna, 1996). Behavioral Intention is impacted by the attitude for using the IT (as seen in Figure 1), and the attitude depends on Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) (Holden & Karsh, 2010). Davis (1989) insists that PU and PEOU are the two most important variables which determine if the user will accept or reject Information Technology. He defined Perceived Usefulness (PU) as "...the degree to which a person believes that using a particular system would enhance his or her job performance." (p.320). In other words, people decide whether to use an application or not based on their opinion about that application (will it help them perform desired tasks or not) (Davis, 1989). He also defined Perceived Ease of Use (PEOU) as "...the degree to which a person believes that using a particular system would be free of effort" (p.320). He adds that even if the application helps them complete their tasks, they may decide not to use it if they feel that it is too hard or complicated to use it. That's why he claims that the users will rather accept an application which is easier to use than the one which has a better performance.

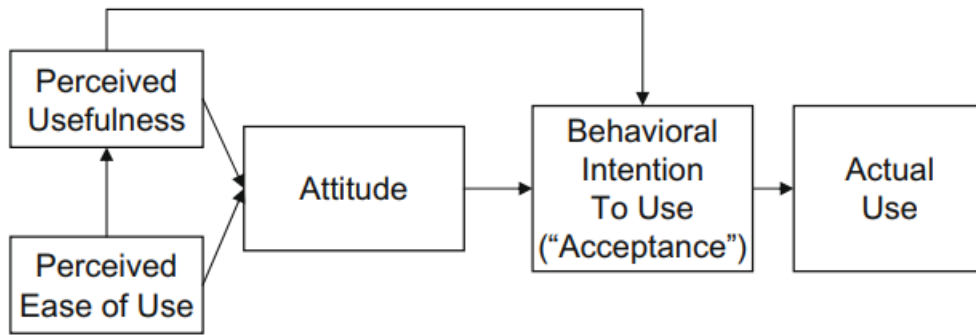


Figure 1 Technology Acceptance Model (TAM) (Holden & Karsh, 2010, p.161)

Renaud and Van Biljon (2008) insist that it is important to understand a difference between *adoption* and *acceptance* of technology. They define the technology adoption as a process in which a user goes from becoming aware of the technology to embracing it and using it regularly. On the other side, they define acceptance of technology as the user's attitude towards it, and say that acceptance has a big influence on the user's adoption of technology.

The theory of the Technology Acceptance Model went through some changes through time and different versions of this model have emerged, such as Unified Theory of Acceptance and Use of Technology (UTAUT) which was developed by Venkatesh et al. (2003) and Technology Acceptance Model 2 (TAM2). In TAM2, a new variable which influences the user's decision to use certain technology was presented (Figure 2).

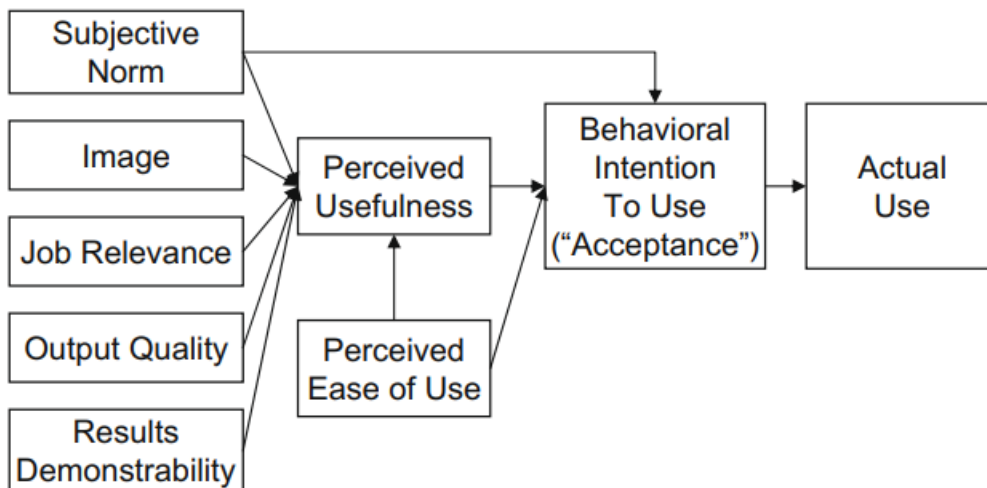


Figure 2 Technology Acceptance Model 2 (TAM2) (Holden & Karsh, 2010, p.161)

This variable covers a social influence on users, such as the influence of people around them and the environment, and is often referred to as Subjective Norm (Holden & Karsh, 2010; Venkatesh et al., 2003).

2.3.2 Senior Technology Acceptance Model

Although the research about the Technology Acceptance Model is well developed and widely applied, not enough emphasis is put on the adoption and usage of the technology by elderly people. Renaud and Van Biljon (2008) studied elders' behavior towards technology and proposed a model that covers the findings from their research. The model they proposed is the Senior Technology Acceptance Model (STAM) and it extends the TAM. Its main components are: User Context, Perceived Usefulness, Intention to Use, Experimentation and Exploration, Ease of Learning and Use, Confirmed Usefulness, Actual Use and Acceptance or Rejection (Figure 3). They didn't include Attitude as a relevant factor since they found no correlation between the attitude towards using technology and other factors.

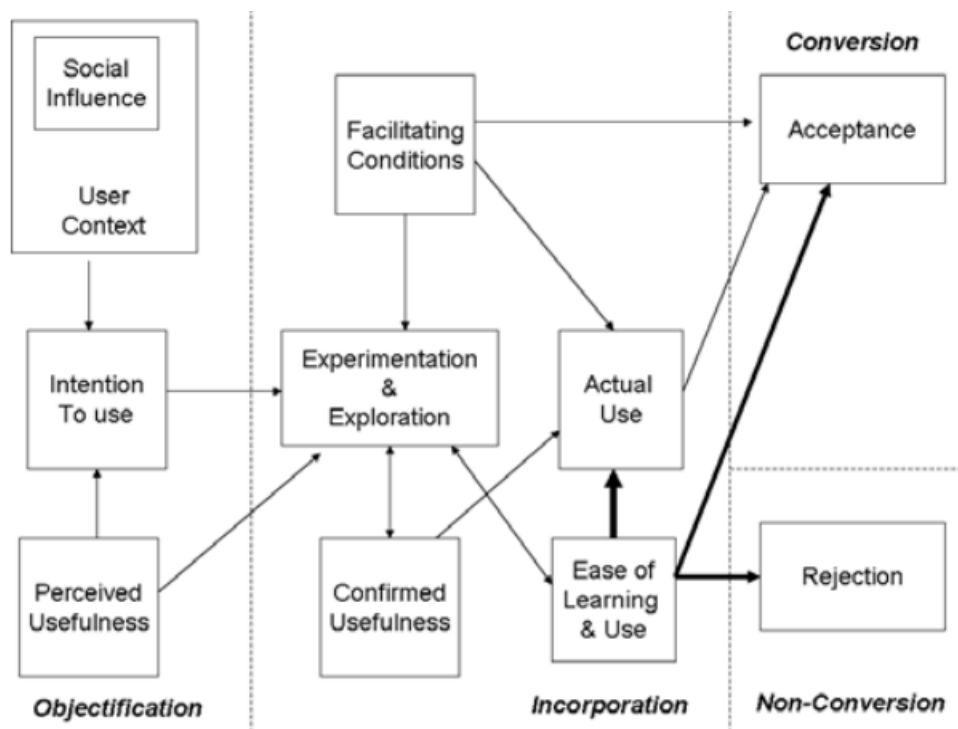


Figure 3 Senior Technology Acceptance Model (STAM) (Renaud & Van Biljon, 2008)

Guner and Acarturk (2020) believe that the STAM covers the technology acceptance of the elderly mobile phone user in a better way since it relates technology acceptance factors to the adoption phases adapted to the elders. For elderly people the appropriation phase is often skipped because they rarely buy mobile phones and often get them as a gift (Guner & Acarturk, 2020). In the objectification phase, deciding the role the technology will play depends on the behavioral intention which is impacted by social factors and perceived usefulness (Davis, 1989). The incorporation phase describes the interaction with the technology which is shown in the experimentation and exploration module (Renaud & Van Biljon, 2008). It is well known that the elderly consider spending very carefully and the price of a device or service often determines if they decide to use it or not, as shown in the facilitating conditions module (Renaud & Van Biljon, 2008). Facilitating conditions, perceived usefulness and ease of learning & use all influence actual use (Guner & Acarturk, 2020). An elderly person will accept the technology if neither of these factors hinders their use of it (Guner & Acarturk, 2020). However, if the elder's experimentation experience with the technology is poor and if they conclude that it is too hard to use, they will probably reject it (Guner & Acarturk, 2020). From Figure 3, it can also be seen that the Ease of Learning and Use is the crucial factor for elders that determines whether they decide to continue using certain technology or not (Renaud & Van Biljon, 2008).

2.4 Accessibility Guidelines for Technology Design

While the previous section focused on the adoption of technology by elderly people, this section will cover the challenges that companies face when they integrate elders' needs while developing m-health products and services. Lee et al. (2013) state that it is important to include elderly people while designing applications which are of use to them in order to integrate their needs and requirements correctly.

In the past years, the accessibility for the usage of technology by people with cognitive disabilities has improved massively (Friedman & Bryen, 2007). Nevertheless, the needs of those people are far from being met (Sloan et al., 2006). The concerns about the accessibility of the World Wide Web (WWW) usage date back to its creation (Friedman & Bryen, 2007). In 1997, the Web Accessibility Initiative (WAI) was launched with the purpose of removing accessibility barriers for people with disabilities (Sloan et al., 2006). This initiative contained three approaches: the development of screen readers, specialized Web browsers and Web design guidelines (Friedman & Bryen, 2007). As the Web has evolved from presenting static informational content to being much more interactive, additional technologies are being developed to support this interactivity. In order to help the digital evolution, the Web Content Accessibility Guidelines (WCAG) 2.0 have been designed to further improve the accessibility of WWW (Arch, 2009). WCAG 2.0 includes many aspects that provide good usability, as well as good accessibility. Applying the WCAG techniques within all Web technologies will help ensure that older people and people with disabilities, and in fact most of the population, are better able to read and comprehend the information being provided (Lazar, Dudley-Sponaugle, & Greenidge, 2004). Power et al. (2012) insist that the WCAG 2.0 needs to be applied sensibly in

order to develop good accessibility with the appropriate techniques. WAI also recommends usability testing with people with disabilities, in order to further optimize the usability of the accessibility features in Web and online applications, (Power et al., 2012).

Ballantyne et al. (2018) suggested four main principles for accessibility design for mobile applications: Perceivable, Operable, Understandable and Robust. *Perceivable* principle requires that the content is visible and recognizable by every user, especially those with some kind of disabilities. *Operability* ensures that every component of the system is accessible to all users in a way that the users can use alternate ways to use or control certain features of a system. *Understandability* of the system means that the presented information should be easy to comprehend by all users. Also, it ensures consistency of elements and the guide through actions. *Robust* principle requires that the system is compatible with various technologies and versions of technologies. This is especially important to elderly people since they often use older devices. After gathering the literature review, we presented some recommendations (see Table 3) that need to be considered in order to make the Web and mobile applications more accessible to older users.

Principles	Recommendations	Mistakes	Reference
Perceivable	<ul style="list-style-type: none"> ● Use clear and simple text ● Use larger fonts ● Use headings, titles and prompts ● Support screen readers. Use alternate text tags 	<ul style="list-style-type: none"> ● Too much material on the page making it harder to find what the person was seeking ● Advertisements and movement distracting the users from their goals 	Friedman & Bryen, 2007; Arch, 2009; Ballantyne et al., 2018
Operable	<ul style="list-style-type: none"> ● Enable users to change the size of the elements on the screen or their appearance (light/dark mode, style of elements etc.) ● Enable audio assist for users ● Enable different types of input for users, other than text 	<ul style="list-style-type: none"> ● Making an application which doesn't allow any alternatives for its design or functionalities 	Friedman & Bryen, 2007; Arch, 2009; Ballantyne et al., 2018
Understandable	<ul style="list-style-type: none"> ● Use simple screen layout ● Consistent navigation and design on every page ● Use exit, home, help, next page buttons on every page ● Use pictures, icons and symbols along with text 	<ul style="list-style-type: none"> ● Hypertext navigation providing non-linear paths through the information thus reducing comprehension ● Changing layouts, navigation structures 	Friedman & Bryen, 2007; Arch, 2009; Ballantyne et al., 2018

		and interaction within and between sites causing confusion	
Robust	<ul style="list-style-type: none"> • Use universal design which can be applied to different technologies and be accessible by everyone 		Ballantyne et al., 2018; Friedman & Bryen, 2007

Table 2 Accessibility Guidelines for Technology Design

Arch (2009) states that it is also important to know the level of elders' technology experience in order to understand their needs. He adds that elders' technology skills can improve over time but they still may struggle to use certain technologies due to constant changing and development of interfaces. Sloan et al. (2006) argue that despite the big effort towards making technology more accessible, web sites and applications rarely meet the acceptance level of older users.

3. Methodology

In this part of the paper, an overview of the research design will align with the topic and question used. It will start with the research approach and method used, as well as the philosophy considering that data collection and data analysis methods will also align with our research method. Furthermore, a brief overview of the ethical consideration for the choice of method and its scientific quality will rate this paper's effectiveness.

3.1 Research approach

This paper will use the qualitative research method to solve the problem addressed. Unlike quantitative research methods, qualitative research methods focus on words (Recker, 2013) for most of the data collected and depend on the quality rather than the quantity of the applied research. Patton (2015) pointed out that although quantitative methods provide the researcher with massive amounts of data on what happened, it could not show the how, and that's why choosing the qualitative method for such cases is preferable. The topic at hand revolved around m-health; it would be imperative to choose a qualitative method for researching this topic since an abundance of data regarding this subject is available, and collecting would be much easier.

However, developers and consultants of m-health have close contact with the chosen demographic, so capturing their opinions or "words" could be proven to be much better in this case. According to Sofaer (1999), qualitative methods can be used to describe interactions and settings in health services. This can be applied to our topic, since we are investigating the accessibility of the applications which allow the interaction between patients and health professionals. Sofaer (1999) says that qualitative research plays a good role in connecting prompts, values, and voices of people on the different scales of organization structure so that consultants could have completely different answers to the questions, unlike the ones for the m-health developers. Since the question proposed in this paper may sound doubtful for the corresponding interview parties, holding out opinions can be present, which could be a disadvantage of choosing this method. However, some of the interviewees may have stories from some elder people describing their experience with m-health. Giving a piece of precise information on what was a big challenge in using those technologies could be proved helpful for the entirety of the research.

The purpose of this paper is to know if the m-health applications are accessible to elderly users. Thus, collecting and analyzing data from e-health and m-health developers and consultants should have a philosophical ground. Since the developers and consultants have experience with these kinds of applications and services, they should know how people reacted to these technologies. And with that in mind, the best research philosophy for this topic is interpretivism. According to Saunders, Lewis & Thornhill (2009), interpretive research focuses on finding more profound meanings, interpreting social events in context with a given plot, and looking at things differently. It is important to emphasize the difference between qualitative and interpretive research. The main reason is because researchers often make no clear distinction between these

two. Qualitative research may or may not be interpretive, depending on the philosophical beliefs of the researcher (Klein & Myers, 1999). There are several interpretive research approaches that have been used in IS research, but for this paper we will use a deductive interpretive approach. According to Hyde, (2000) Inductive approach is based on building and testing a new theory, while the deductive approach is based on testing an already built theory. Therefore, choosing deductive approach is suitable for our research, since we are testing an already existing theory and we are trying to connect it with the findings.

3.2 Data Collection Methods

3.2.1 Literature Review

For the literature review, a thorough and complete search was done through well-known websites such as Google Scholar, Scopus, LUSEM Library and Science Direct with keywords like “e-health”, “m-health”, “technology acceptance model”, “mobile development challenges”, “elders’ perception of technology”, “elders’ perception of health”, “elders’ perception of e-health”, “accessibility guidelines for web development”. Many articles were chosen and went through it carefully to gather insights about the questions that should be done in the interviews.

3.2.2 Interviews

In order to gain in-depth understanding of the underlying topic, a qualitative research approach is selected. Following this selection, we chose interviews because they are one of the most effective methods as they allow a deeper understanding of the researched topic.

Our interviews were semi-structured. According to Recker (2013), in these types of interviews, the interviewer asks questions about the topics of the study following a predefined interview structure. He adds that the interview starts with some general questions and, depending on what interviewee says, new questions can emerge and the interview takes a new direction, bringing the possibility of new and unexpected findings. This allows the interviewer to ask follow-up questions and take bidirectional discussions about the topic, or even other topics and links that emerge during the interview (Recker, 2013). Patton (2015) says that the quality of the information acquired during an interview is mainly dependent on the interviewer. He adds that skilled interviewing is about asking questions well so that interviewees want to share their stories, as well as asking open-ended and follow-up questions, for greater depth and detail, and making smooth transitions between sections of the interview or topics.

For our interviews, we targeted developers and consultants because they can give us a deeper understanding of the current state of elderly people’s inclusion in e-health and m-health development and the accessibility state of today’s m-health applications. For this to happen, we

had to ask relevant questions that could extract desired answers from respondents which could give us information we need, and preferably some new insights on the topic. In order to formulate those questions, we gathered information from academic journals and official statistical sources to get clear insight on the topic. It was crucial to avoid some common mistakes that interviewers make. According to Recker (2013), interviews can lead to inaccuracy, reflexivity and artificiality. These occur due to poorly constructed questions, which could lead to the interviewer getting responses that he would like to hear and then poorly interpret the answers. Therefore, our questions were well-structured based on thorough literature review. We have decreased prejudices and judgements and have let the respondents express themselves as much as possible, which gave us more relevant and valid information.

3.2.3 Selecting Respondents

The selection process of respondents was the most time consuming part since most of the potential respondents that we contacted didn't have time or were not willing to participate in interviews. Our primary goal was to find the developers in the area of m-health, but none of them wanted to participate. In the end we conducted seven interviews with four consultants that have knowledge in the e-health and m-health sectors, and three developers with general knowledge about app design and development. Our search for interviewees mainly was through LinkedIn and current social connection. The summary table of the interviews (Table 4) is presented below.

Respondent	Respondent Role	Interview Date	Type
R1	Consultant	26. April, 2022.	Microsoft Teams
R2	Consultant	26. April, 2022.	Microsoft Teams
R3	Software Developer	4. May, 2022.	Zoom
R4	Software Developer	4. May, 2022.	Zoom
R5	Software Developer	4. May, 2022.	Zoom
R6	Consultant	6. May, 2022.	Microsoft Teams
R7	Consultant	15. May, 2022.	Zoom

Table 3 Interviews Summary

A brief description of our respondents is presented below:

Respondent 1

R1 has been working with [Company Name] for five years, two years as a student and three years as a consultant. He works in the field of quality and compliance within life science and healthcare. His current project and expertise are related to the implementation of medical device regulations at one of his organization biggest clients.

Respondent 2

R2 is currently working on financial services and other related industries, and previously in his master's studies, he was working on algorithm of an application that monitor heart rate and other cardiac parameters by using smartphones.

Respondent 3

R3 has a master's degree in computer science and has 10 years of experience around business and IT. He started as a developer for windows then moved into Web design and game development. After finishing with game development, he solely focused on Web development and became a lead developer. And his current focus is on e-commerce solutions.

Respondent 4

R4 is a developer working for [Company Name] and he is currently the team lead of the e-commerce department.

Respondent 5

R5 have nine years of experience in multiple fields including full stack development, front-end development, and mobile application development.

Respondent 6

R6 works at [Company Name] and worked on projects that were related to healthcare. She had a keen interest in her master's studies on [Country Name] eHealth, environment, and climate.

Respondent 7

R7 is currently working at a large IT-consultant company in [Companies Location]. His area of expertise is e-health with specific focus on improving customer experience connected usage of electronic health journals. He studied cognitive science at the University of [University name] and brought that perspective with him to his professional life.

3.3 Data Analysis Methods

After collecting the data through interviews, the next step was to do a thorough analysis and interpretation of the new information. The interviews were documented and transcribed. The transcription was done using the Otter.ai software. Due to semi-structured interviews, a huge amount of data was gathered and it was important to extract the relevant information from it. Thus, we used coding as our data analysis technique. Recker (2013) says that coding is the most commonly used data analysis technique for transforming qualitative data to valid information. It is used to organize and categorize data around concepts, assigning labels with meanings to data segments. According to Mai and Steffen (2019), coding can be inductive or deductive. For our

analysis we used deductive coding, since it's based on predefined codes which are used for the coding process of the data. Since the aim of the study is to understand if m-health applications are accessible for elders, we created codes based on the main aspects that are relevant to our study from the literature and interviews.

Theme	Sub-theme	Code	Color
Technology Design	<ul style="list-style-type: none"> • Accessibility • Feedback 	TDA TDF	Yellow Blue
Inclusion of Elders		IOE	Pink
M-health	<ul style="list-style-type: none"> • Benefits • Challenges 	MHB MHC	Green Red
Other	<ul style="list-style-type: none"> • Education, assistance and support 	EAS	Grey

Table 4 Codes for Data Analysis

The coding process was done manually without the assist of any software, since we believed that the manual way of coding can be more accurate than using a software. According to Recker (2013), even though the use of software for coding can be time-saving, it should not be seen as a replacement of the interpretive work that the researchers have to conduct.

3.4 Ethical considerations

Patton (2015) insists that interviews need stronger ethical considerations than other data collection approaches because they investigate people's lives. He adds that a good interview should disclose the feelings and thoughts of respondents together with their personal experience and knowledge on the subject. This is one of the reasons why this research needs to include ethical aspects. Recker (2013) states that, considering that information systems research is a social science, we need to be aware of having the responsibility to assure the permission and interests of all the people involved in the study. He adds that we should not exploit any of the information gained, and there should be a moral responsibility maintained towards the participants. We have a duty to protect the rights of people in the study as well as their privacy and sensitivity. He furthermore says that "...the confidentiality of those involved in the observation must be carried out, keeping their anonymity and privacy secure." (p.143).

According to (Patton, 2015), we should give an informed consent form to the interviewee before the interview starts. The form would explain the purpose of the interview, information on how the interview will be conducted, and how the information will be used. Patton (2015) also suggests that we need respondents' permission in order to record the interview and that otherwise it cannot be recorded. The same applies for their confidentiality. The respondents need to be informed that their names and the names of their company will not be mentioned within the

research paper to assure anonymity. Patton (2015) says that "...the privacy of research subjects should always be protected." (p.731). The interviewees will be met in person if possible. Participants need to be informed that the interviews will be available online to the public, if that's the case. Informing a respondent about ethical considerations has to be done before the actual interview starts (Patton, 2015).

3.5 Scientific quality

According to Recker (2013), qualitative methods have the lowest rates of research strategies compared to quantitative or design science. For instance, Recker (2013) defined controllability as the amount of power or control a researcher has when doing a study. Quantitative studies have high rates of controllability since the researcher has an abundance of data to work with and no restriction whatsoever. However, there is much less control over the process of interviews for a qualitative researcher. In our study, we are focusing on interviewing e-health and m-health consultants and developers, and some of them may not have the same amount of experience with this topic, so their answers may differ. Hence, complete control over this process is absent. A good amount of deductibility should be present to ensure that our paper is scientifically accurate since deductibility refers to the extent a researcher can deduct from a given study (Recker, 2013). That also presents challenges for a qualitative researcher, especially in our case, since some deductions can be based on biased or uninformative answers that could not be deduced as scientifically accurate. Moreover, Recker (2013) defined generalizability as the study's reach to be taken generally, which is also a pitfall for the qualitative researcher since we will only focus on the context of the research problem. However, our exportability and complexity will be high since we follow a qualitative approach. According to Recker (2013), exportability "refers to the extent to which a research strategy encourages or enables the discovery of previously unknown or unconsidered observations or findings" and since our study questions a particular part of e-health and m-health, some answers can open up a new horizon of studies that can be explored. Furthermore, according to Recker (2013), complexity is how far research can be studied and provide more knowledge. Complexity could be driven out of our topic with our approach, data collection, and data analysis.

4. Empirical Findings

This chapter contains the main findings that were collected from the interviews. The first section talks about the benefits and challenges of m-health applications for elders. The second section discusses the inclusion of elders in software development, with the emphasis on m-health applications. The third section covers the accessibility features that m-health applications should have, including the users' feedback. Finally, other findings that were not identified in the literature review are presented in the last section. It is important to note that we referred to our respondents as R1, R2, R3 etc., and when we included the exact row from the interview transcription we referred to it as, for example R1:10, where R1 means respondent 1 and 10 means row 10.

4.1 M-Health

In this section we will present our findings on the benefits of using m-health services, as well as the challenges that elderly people face when using them. Consultants that we interviewed had a slightly different perspective from the developers in the sense that they had a more critical view on this topic.

4.1.1 Benefits of M-Health

Questions about the benefits of m-health were rather crucial for our study since they will support the research problem by identifying how m-health can help the elderly improve their health and be more self-sufficient. Our respondents varied from consultants to developers, so points of view differed a bit, but most of them pointed out a concrete use of m-health benefits.

A common benefit that we found is the easier health monitoring and tracking (R2:4, R3:18, R4:36, R6:18, R7:12). R6 talked about illness prevention that can be achieved by real-time tracking of health:

“Well, when it comes to benefits, definitely more continuous real-time tracking of their physical condition, and of the progression of the illness or even prevention in some areas...” (R6:18)

R7 pointed out an app that he worked on which enables better health monitoring:

“We have one app that helps with their telehealth. Telehealth, which is like health monitoring while the patient is at home, and, for example, the physician is at the hospital or the clinic. the physician will be able to monitor the patient's health even when they're not nearby.” (R7:12)

R2 identified health monitoring and remote healthcare (which will be presented later) as the biggest benefits of m-health:

“So of course, in the benefits category, they bring easier monitoring and easier access to certain services or functionalities. In the case of a mobile app, these functionalities are, of course, monitoring, as parameters, or simplifying the way you access as providers and services, such as telemedicine and video consultancy, and stuff like that.” (R2:4)

“...and the last part is that as a benefit for, as companies or national health systems, mobile devices bring a wider coverage and monitoring. So it's a lot of data points that can be used and analyzed.” (R2:4)

R3 also talked about a project for health tracking and monitoring that he was working on:

“For example, there is one product that we work on, and I think there are lots of different kinds of projects where people use some kind of bracelets to be tracked. And if something happened to them, they are able to click on it, so that someone can help them or something like that. They probably have different kinds of numbers that they can easily manage to call if something happens to them.” (R3:18)

Another very common benefit that we identified was the remote healthcare (R2:4, R6:18, R7:24). As mentioned above, R2 pointed out telemedicine and video consultancy as the examples of remote healthcare. R6 emphasized that the remote healthcare is specifically important for elders:

“...and also the distances, for example, that an elderly person would have to cover if they wanted to visit doctors, sometimes it's not super necessary, and they can just stay at home and be monitored from distance. And only in case their health deteriorates, they visit a doctor or the doctor visits them or vice versa.” (R6:18)

R7 shares the same opinion as R6:

“So the benefits are that the elderly people will be offered better health care for them by having these new solutions that are tailored towards them, for example, telehealth, like one nurse can monitor several people at their own house so the elderly don't have to take the bus and get into the clinic just to get a blood pressure test. They can do that at home and save time and money and headache, for example.” (R7:24)

Next benefit was mentioned by R5 and R7, where they talked about switching from traditional outdated methods for healthcare:

“They can check for the next prescription when it's due, or either on some kind of making appointments, easier than on some kind of remembering those dates or writing them on a piece of paper.” (R5:26)

“A lot of benefits. How the society is moving right now, it's moving towards fewer doctors, fewer stations, fewer nurses, but a larger and larger number of older population. And that's an issue because then we can't offer good standardized health care for these elderly people that are increasing, and the workforce is decreasing. And that means that more, they will have a lot of pressure on their physicians and nurses and health care personnel.” (R7:24)

Among other benefits, we identified lower costs (R2:4, R7:24), memory games (R3:18), better doctor-patient communication (R6:18) and better healthcare services (R7:24).

The summary of the benefits of using m-health services is shown below (Table 3).

Benefits	Respondents
<ul style="list-style-type: none"> ● Easier monitoring ● Remote healthcare ● Lower costs 	R2
<ul style="list-style-type: none"> ● Easier health tracking ● Memory games 	R3
<ul style="list-style-type: none"> ● Easier health tracking 	R4
<ul style="list-style-type: none"> ● Switching from traditional methods 	R5
<ul style="list-style-type: none"> ● Continuous real-time tracking of health ● Better doctor-patient communication ● Remote healthcare 	R6
<ul style="list-style-type: none"> ● Health monitoring ● Switching from traditional methods ● Better healthcare services ● Remote healthcare ● Lower costs 	R7

Table 5 Summary of M-health Benefits

4.1.2 M-health Challenges for Elders

Challenges that elders face when using m-health applications are directly connected with our research problem, and our two groups of respondents gave very similar answers, but in some kind of different perspective, since the consultants are focused on checking objectives while the developers focus on the technicalities of an issue. However, both perspectives seem to be helpful in understanding the challenges.

The main challenge that came to the surface by our respondents is digital literacy, or how R1 pointed it out as “Digital Know-How”. Almost all of the respondents pointed out digital literacy as a challenge (R1:4, R2:4, R5:26, R6:4, R6:16).

When asked about m-health challenges, R1, who is a consultant, directly points out digital literacy by saying:

“So I think for elderly people, the issue is the digital knowledge, the digital know-how. I think that will be one of the main challenges for elderly people that they do not understand how to work with it, use it correctly, which will be one of the main challenges.” (R1:4)

R2 was also asked about the challenges of m-health and also pointed out digital literacy:

“Whereas for the challenges, I would say that there is a barrier, especially with older people in ease of use, and in general, if they are not proficient in digital literacy, and using smartphones and apps, that can be an obstacle” (R2:4)

R5, just like the two previous respondents, pointed out digital literacy, but it was from a different perspective:

“But this comes with some kind of must-have education, I think. So the elderly need to know how to use the application correctly. Because if it happens that you get the application to a group of people, which do not think they know how to use it, but they're using it wrongly that they will miss out on that opportunity for the application” (R5:26)

R6 mentioned digital literacy on multiple occasions pointing out its importance by saying first “Or they would, just, I mean, skip using them because of the difficulty or because they are simply going to be confused” (R6:4). Then R6 mentioned digital literacy again in another perspective “...the typical problems that we see in society that the elderly people don't know how to use modern technology, so they have to be assisted, a lot of things need to be explained” (R6:16)

Furthermore, another challenge was raised by two respondents which was the lower quality of m-health remote care compared to traditional methods. R2 mentioned this while pointing out another two challenges:

“And also for them, for the health aspect of mobile technology, there is an issue with data quality, so the measurements that are performed, or the services are not always at the same level

that can be achieved with a doctor's appointment in person or hospital visit and things like that.”
(R2:4)

R5 also mentioned this challenge when he said “...it will be kind of more of an issue than if they were using traditional methods” pointing out that using traditional methods of healthcare is a better choice for elders with low digital literacy and concluding this as a challenge for m-health.

The third challenge, which is M-health availability was mentioned by (R6:16, R6:18, R7:26). R6 pointed out m-health availability by saying:

“And it depends on whether they have the information about the availability of an app, or if they have it available, how to navigate it better like they can ask their family members because they are not so good in looking for information about modern technology and on the internet, I am sure of it. So they can either ask their relatives or the doctor, but it depends how knowledgeable and how helpful they are.”
(R6:16)

Then R6 mentioned m-health availability again alongside other challenges:

“Also, the possibility to buy it or to have it, first of all, to have a doctor to recommend new technology, a new application for the elderly and then the fact that there is or there should be someone to pay for it. So for example, a health insurance company. So those are the challenges because sometimes they are not present.” (R6:18)

R7 also mentioned m-health availability as the main challenge when he was asked if those technologies are well adapted for elder needs, and reflected on his previous experiences:

“No, I don't think so. I haven't seen so many but the ones I have seen are usually lacking in usability. Usually, elder people need a specific view or a specific presentation for them that is tailored to their shortcomings so to speak. They don't see so well, they don't hear so well, and sometimes they don't understand so well either. And the apps today, they're not really tailored for that target to be as much as I think they need. I think there's still a lot of progress that needs to be made.” (R7:26)

The final challenge of m-health was mentioned only once by R6 when she simply said “And when it comes to challenges, definitely the acceptance of the technology” (R6:18)

Below is the summary of the challenges that respondents identified (Table 4).

Challenges	Respondents
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<ul style="list-style-type: none"> ● Digital Literacy 	R1
<ul style="list-style-type: none"> ● Digital Literacy ● Lower Quality compared to traditional methods 	R2
<ul style="list-style-type: none"> ● Digital Literacy ● Lower quality compared to traditional methods 	R5
<ul style="list-style-type: none"> ● Digital Literacy ● M-health Availability ● Technology Acceptance 	R6
<ul style="list-style-type: none"> ● M-health Availability 	R7

Table 6 Summary of M-health Challenges for Elders

4.2 Inclusion of Elders in Application Development

We asked our respondents a couple of questions about elders to see if they have emphasized their needs, or even considered them as potential users while working with e-health and m-health applications and services.

When asked if the current m-health applications are well adapted to elderly people, the respondents' opinion was divided. R6 and R7 think that those applications are not well adapted to elders. R6 believes that they are more adapted to younger people:

“I mean, general customer, that is something you said, in the end, maybe yes, but more towards younger people, younger generations. But that doesn't mean that they are super adapted because younger generations are naturally more inclined towards using technology. So maybe it's just the fact that they are interested in new technology and are already well adapted to using it. So definitely, there is a huge need to adapt the technology that we use, including e-health applications to the life and lifestyle of older people.” (R6:20)

R6 also adds that adapting the communication to elders is very important:

“And there are things like you have to adapt a communication to the elderly people, because for example, if you talk about the benefits of an application for young people, it might be just speed, connection, sharing of information, being able to track your performance. This is all very cool. But it's not something that the elderly are interested in, unfortunately. So we have to change the context or the message to their needs. So you really need to talk about their lifestyle in specific. So I believe there could also be space to change the communication, so they really understand how it might facilitate their lives, not lives of the population in general.” (R6:22)

Furthermore, R6 thinks that elders “...are gradually becoming really discriminated or pushed from society when they don't use some things, some technological devices or something” (R6:28).

On the other hand, R4 said about m-health applications that “...they look fine” (R4:38), while R2, R3 and R5 didn't have knowledge on this question. Finally, R1 had mixed opinions about the usability of these applications for elders and said “So I have two applications that I worked on in mind. One of them was well adapted [to elders], one of them not.” (R1:6).

The next question we asked our respondents was whether they included elders while testing their applications or services, and only two of them gave us a positive answer (R2, R7). R2 mentioned that they used elders for testing the accuracy of an application that he worked on:

“There was a wide group of people who were taking part in the app testing. And a certain part of them were elderly people, I think up to almost 90 years old. And they were just providing their availability to be measured using the app and then the results were compared to professional clinical measurements performed by physicians in the hospital.” (R2:20)

He adds that it is important to include elders in the testing of applications because “... they are a great part of the population that will make use of the services. So while it is challenging for the reasons I said before, they are a significant, significant part of the community” (R2:22). R3, R4, R5, which are all developers, don't include elderly people while testing their applications, but R4 said that the most interesting feedback they got was from elderly people (R4:34).

With the last couple of questions, we wanted to see if the respondents adapted their applications and services to elders and if they emphasized elders' needs and disabilities when working on their projects. Most of the answers we got were negative (R1, R2, R3, R4, R5). When asked if they developed any kind of applications that were used by elders, developers (R3, R4, R5) responded:

“Unfortunately, I didn't develop any kind of those things. In the company, there are a few. But I personally didn't develop any kind of software like that.” (R3:10)

“We are working on e-commerce applications, so they are for young and old users. Many people use e-commerce.” (R4:24)

“I don't think so. I did not develop anything for elders specifically.” (R5:16)

Response from R1 and R7 was similar to the ones from developers, but they looked at it from the consultancy perspective.

“For the applications I work on now, no. What I previously worked on, the application that I initially mentioned, that was very user friendly, there they did take it into consideration.” (R1:12)

“I think no, if they're not a target user, then we won't really focus on them. But like I said earlier, there is the standard that you have to fulfill to be able to sell the whole product, because there's a physical part to it also. And to sell that and be classified as a medically technical product, then it has to fulfill those standards, and one of them is to have it taken into consideration and make it readable for elderly people and usable for them also.” (R7:14)

R7 also gave an example of the project he is working with that is tailored towards elders:

“We have one app that helps with their telehealth. Telehealth, which is like health monitoring while the patient is at home, and, for example, the physician is at the hospital or the clinic. the physician will be able to monitor the patient's health even when they're not nearby. And most of those users are elderly people. Because those are the ones that need the most assistance with that.” (R7:12)

R6 gave us the positive answer when asked if they include elders in their customer group in projects she's working on.

“I mean, people that I've been working with included the elderly people, in the customers during the whole development, definitely.” (R6:14)

The summary of respondents' answers is presented below (Table 5).

Respondent	Are m-health apps adapted to elders?	Did you include elders in app testing?	Did you emphasize elders' needs in your projects?	Further notes
R1	Mainly not	/	Worked on only one project which emphasized elders' needs	<ul style="list-style-type: none"> Worked on two projects, one was well adapted to elders and the other was not. Emphasized elders' needs on one project before, but not currently.

R2	/	Yes	Yes	<ul style="list-style-type: none"> Worked on a project where elders were being tested for measurement accuracy of the application Insists that it is very important to include elders in e-health and m-health development
R3	/	No	No	<ul style="list-style-type: none"> Didn't specifically emphasize elders' needs on his projects or include them in testing
R4	Yes	No	No	<ul style="list-style-type: none"> Didn't specifically emphasize elders' needs on his projects or include them in testing
R5	/	No	No	<ul style="list-style-type: none"> Thinks that there should be more emphasis on elders' needs and the applications should be more adapted to them, but didn't specifically focus on elders on his projects
R6	No	/	Yes	<ul style="list-style-type: none"> Believes that the applications are more adapted towards younger audience Emphasized elders' needs during her study
R7	No	Yes	Only in projects which were tailored towards elders	<ul style="list-style-type: none"> Included some kind of assist for elders on the applications that were used by them, otherwise didn't put emphasis on them Took elders' needs into consideration in order to fulfill the standards required for the medical products

Table 7 Summary of Elders' Participation in E-health and M-health Projects

4.3 Technology Design

4.3.1 Users' Feedback

Users' feedback seems to have a positive view from the consultants and a critical view from the developers, but all of them agreed on the fact that it is important, with a different perception from each respondent.

R1 emphasized the importance of feedback by saying "Crucial, it's crucial" (R1:10) and then saying "Client feedback there is essential" (R1:10). Furthermore, R1 justified those two remarks by telling a personal experience story based on a major issue when not taking feedback into consideration:

"In our initial release, we developed a system based on our knowledge of the regulation, and how we would apply it. But what the system is doing, it's actually in distribution centers worldwide at the clients. They have to use the system to perform verifications on medical devices. We made those verifications based on our knowledge, but not with the end users' feedback in mind, the people who would perform the verification. So we went live with release one. What happened in release one, we noticed a lot, a lot of feedback from the end-users that it was not efficient, that it's not reflecting the real situation and the warehouses. The big gaps, very big gaps." (R1:10)

Then he explained the consequences of not implementing feedback from the beginning:

"And now we are at release four, so three releases further. Back then, in release one, we had like a whole list of end users' feedback. And we're still implementing that feedback into the system. Whereas if we just initially had our input from a quality and regulatory perspective, but then also the usability and the efficiency perspective, from the end users that use it, we would have avoided all of this stuff. And now it's causing issues in the sense that we need to foresee extra budgets and extra manpower to make sure that we have the development capacity to also on one hand foresee the system of new functionalities, but also make sure that the system is user friendly and living to the needs of the end users that use it in the distribution centers." (R1:10)

He concluded his answer by giving suggestions for the efficient use of feedback:

"So yes, it's crucial, and it should be implemented as early on as possible. That's why I like agile development, that you really ask for increments of your application, you get feedback from the end users. And do not wait till a big release. So continuously get feedback and build your application together with your end user to be successful." (R1:10)

R2 pointed out the importance of feedback by saying "Very much, I think. And it was our experience that you need to have constant feedback from our group of users to develop and refine the app. So that is mandatory, in my opinion." (R2:12), implying that constant feedback from users is a must for having more refined apps.

R6 shares the same view on user feedback as R1 and R2 and said “In general, is super important” (R6:10) and then shared an experience where users and developers were working on a project simultaneously:

“there is a center for energy-efficient buildings here in [University Name] University, and they have a life lab where they directly collaborate with developers, I mean, the researchers collaborate directly with developers, so IT engineers, doctors and also patients at the same time, so they iterate the process the partial solutions, they discuss this with patients also” (R6:10)

R6 then mentioned a new kind of feedback for the project mentioned before and emphasized the importance of feedback:

“So, they get real-time feedback and based upon that, they design the application, the banner, the processes, or the interface. So, this is getting even more important nowadays, with the number of applications that are gradually becoming available.” (R6:10)

R7, just like R1, R2, and R6 believes that feedback is important “Yes, of course, especially in this day and age, if we don't gather feedback, then we won't know if what we're doing is good” (R7:6) then he specified how feedback is implemented into multiple phases of project development:

“And one of the main steps in app development or other kinds of development nowadays is to have a final phase called the learning phase. That's when we gather the information, gather the feedback, and see how to know, I'm sorry, before the learning phase we have the measuring phase so we measure. So before we send out the product also, we check for what variables we are going to measure. And from there, we then couple that with the feedback and improve for the next iteration” (R7:6)

R3 was a bit skeptical about the user's feedback at first by saying “ I would say it's important, but not sure how much.” (R3:8) then he continued to explain his point of view “Basically, there are a lot of different kinds of users. So, someone likes this, someone likes the other. So you can't be loved by everyone. So basically, you need to choose some part of it.” (R3:8) He implied that not every feedback can be constructive and help in improving, some feedback can only be just for criticizing. After that, he concluded his answer with “But it's definitely important” (R3:8).

R5 shares the same opinion on feedback as R3, he first said “User feedback is welcome” (R5:14) then said:

“Some of the user feedback is not really relevant at some point depending on the goals of the application in which direction it should go. But every feedback from the users is something to consider and make adjustments if needed for the application ”

In that statement, R5 also implied that not every feedback is needed and only the ones that improve or share the goal of the project can be taken into consideration. Finally, R4 thought that feedback is really important and mentioned some technical points on why he thinks so:

“I think that is so important because we cannot find all bugs, and maybe all of the interesting, interesting features. So many times you can give us feedback, and we can improve the user interface and create better functionality for the application” (R4:12)

R4 then pointed out “But we received a lot of feedback from clients and mostly interesting feedbacks were from old people” (R4:34) which was very insightful to our findings.

Respondent	Is the users' feedback important?	Further Notes
R1	YES	<ul style="list-style-type: none"> • Feedback is considered very crucial • Feedback from an end-user before initial release is a must • Feedback should be implemented as soon as possible • Agile development goes well with end-user feedback
R2	YES	<ul style="list-style-type: none"> • Constant feedback is required for better results
R3	YES	<ul style="list-style-type: none"> • Feedback is important but good feedbacks are not always attainable
R4	YES	<ul style="list-style-type: none"> • Feedback helps in finding minor bugs • Feedback helps in improving applications features and functionalities • The most interesting feedback came from elders
R5	YES	<ul style="list-style-type: none"> • Feedback is welcome only if it supports the application's goal

R6	YES	<ul style="list-style-type: none"> • Importance of the Real-time Feedback which helps user and developer in developing applications at the same time
R7	YES	<ul style="list-style-type: none"> • Learning phase and measuring phase paired up with feedback to reach better results is important to have

Table 8 Summary of the Importance of Users' Feedback

4.3.2 Accessibility of M-health Applications

This part focuses on four aspects of accessibility: User Interface, In-app instructions, use of accessibility guidelines, and the most important aspect of the application for elders.

R1 first expressed how he thinks that the user interface of the application should be adapted to elders: "I think it needs to feel intuitive for these people and it needs to be very clear, concise and unambiguous to use it"(R1:16). Then he also mentioned how the functionalities of an app should be: "If you're going to have functionalities that need to be used by elderly people, make sure that they are not too complex, or that you do not require too many complex actions from the user in that situation"(R1:16).

R2 also pointed out that the user interface should be easy to use and easy to navigate by saying:

"Yes, very much. But it's mandatory that since these measurements were self-performed by the patient and the app users, it's very important that it's clear and easy to access and navigate the app to launch the measurement correctly. Yes, very important" (R2:8)

R3 started by mentioning how he feels when using a non-user-friendly application or website::

"Yeah, it's very important, especially depending on the client. But if you want something to be used, then definitely it's very, very important for every button to be in its place. Because for me, let's say if I open some kind of website, if I can't find what I want in the first few seconds, I usually leave."(R3:4)

R3 then highlighted the importance of the consistent design and gave more detailed explanation about it:

"Definitely, definitely. It's not only for elderly people, it should be a pattern for any kind of application. Regarding the different kinds of design that I mentioned before, It's dependent only on different applications. I always use, and everybody should use like that, we in the company also, if you have some kind of design and you need to stick to it from the beginning to the end.

Basically, if your button is green, try the button to be green. On every page, different kinds of colors need to represent something. For example, if you know the design right now Bootstrap if you use or something similar, the Success button is always green, the Primary button is usually blue, the Warning button is usually orange and the Danger button is always red. So few colors like that are very important to be used. I mean, it depends, for example, on my profile website, it's all black. But I distinguish different kinds of buttons by size. So there always should be something, for example.”(R3:16)

In addition, R3 mentioned how the UI should look for elderly people specifically “But the application should be adapted to the elderly people, probably to have bigger forms, or buttons or something like that. Regarding the UI.” (R3:20)

R4 had three statements about the user interface, one about the design and two about features and functionalities that were added to help the users “Yes. I think it should be consistent”(R4:18), “Almost in every case designers think about user experience, for example, when we have our old users, for example, we said that they can choose font size and sometimes they can change the look of the user-interface to look like a desktop”(R4:26), and “When I started my career, my first client wanted an application for old people. And we have so many times a problem with design because so many older people cannot notice some stuff on the website, so we focused on adding more filters to the site, so they hover quickly to the things they want.”(R4:30).

R5 first stated how the user-interface should look like to elders: “Yeah, I mean, if the application is simple enough for the elderly to use, it will be easy.” (R5:26), then he mentioned different functionalities for people with bad eyesight:

“Yeah. So for like, problems with eyesight, I mean, there's, you know that each phone has those settings for font, font size. When creating a mobile application, you can turn that off, which is easier for us developers that just turn it off. And you don't care about each letter on the site. Because sometimes the font can change and mess up your whole design. So you can create apps thinking about it, that the user will increase to the maximum number and see that everything is still there. So this will be helpful for people who don't see well. So that's one point also, you need to think about, since you have a bigger font, you will need to have bigger buttons. So that means that on one page, you wouldn't be able to, to add everything, all the buttons there. So it will be maybe one or two actions per page. And you'll think about it, okay, this device has a lot of text there, maybe I should divide it to more pages, which you can scroll with some button or whatever. So you need to think of it differently for eyesight specifically...But as for the eyesight, you can just think about it as a developer that you need to create your design flexible enough for all those sizes of fonts” (R5:32)

R6 mostly mentioned things to include and avoid when designing user-interface in two statements:

“And you brought me to an idea that even the application has to be, I mean, has to have only the most basic functions for an elderly person, like you're saying they are not interested in taking photos, for example, they just want to have a call. So there's no need to have an icon or like

picture anything, that functionality will just simply distract them. So having extra buttons and functionalities could be unnecessary for them” (R6:26)

“The screen on a phone has to be larger, numbers have to be larger. Maybe it might need to be a bit lighter, so that they can carry it with themselves” (R6:32)

Finally, R7 mentioned only one statement emphasizing on a few points that should be taken into consideration when designing mobile applications:

“Readability, they must be able to read and understand. So we can, for example, have two fields that are similar in name and usage. If they're too similar, then it will be difficult for them to differentiate and understand what they're going to register well. And also readability, usability. So, yeah, usability and readability. The font should be clear, the colors should be clear. Yeah, the elements, icons should be clear. Things like that.”

The respondents also gave us some helpful insight on the instructions for use that m-health applications should have. R1 and R5 had a similar view on this and reflected on the projects they previously worked on. R1 gave us examples of two applications he worked with, where one was very user-friendly, and the other not at all: “So I have two applications that I worked on in mind. One of them yes [adapted to elders], one of them no” (R1:6). First, he described the user-friendly application:

“That one is very user friendly, and also friendly for elderly people, because if you use the app, it really has like a button that you use, it has an information icon, where you can see okay, what happens, why the button is there, what happens if you click on it, and you even have a complete patient flow that the elderly person can understand. Just the end user in general can understand, okay, this is where you are now, this is where you need to go and these are the steps required to get there. And at every step, you have information related to that step to explain to the end user why that step is being performed.” (R1:6)

Then he referred to the other application:

“I had another application where I worked on that was not user friendly at all. It had general instructions for use. So for example, when I open the app, I get a very big text, like very big text, which explains all the instructions, but no structure, just plain text, no explanation. And I think for elderly people, if you want them to use the app effectively, giving them plain text will not work. You really need to work on including an interactive screen, or really screenshots showing what is located where and what it does.” (R1:6)

R5 talked about some complex applications that he worked on:

“...I did create some kind of onboarding guides for some complex operations on the application which weren't self-explanatory, but this one can also translate for the elderly or whatever market you want. So there will be some kind of like, overlay over the application explaining, you click this button this will happen and you connect like, this and just some kind of guide to show the most important part of the application. So it's really clear what the goal was. It's always good if

you don't need to do that, that the application is self-explanatory. But in some cases, it really needs to be some kind of guide.” (R5:20)

Then he mentioned how the instructions should look like:

“...I think this approach which I described where we have some kind of overlay around your UI, which is transparent, I mean, some kind of blurry, and then you explain, okay, you make a circle around the button, when you click this, this will happen and on the next button, you'll have focused on something else say, okay, this is important on the screen, and you can expect from it to do that. So more like some kind of mixed experience, not just text, which will explain everything and then you need to go inside the application and search where this button was, which was explained earlier. It's kind of confusing. It's better to have some kind of UI experience there to guide you.” (R5:22)

R4 and R6 gave us more specific recommendations for in-app instructions. R4 told us how he usually deals with the instructions for users: “For example, we use the toolbar for explaining in more detail. Some stuff for functionality of applications.” (R5:32). R6 mentioned applications that she came across while working:

“...based on my experience or knowledge, usually I could find apps that include some instructions either directly in the app, so like, introduction or technical settings or something, or there was also a website to directly search for specific in front information or a helpline to contact people from the company or from the center. Also, I think that in some cases when the doctors are more pro, pro eHealth, they can also help you navigate but this is rare...” (R6:12)

We then asked our respondents if they use the accessibility guidelines for the design of applications or if they worked on projects which used them. Developers gave us different answers. R4 said he sometimes uses the accessibility guidelines (R4:16), while R3 gave us a more specific answer:

“Yeah, for designing and for development, there are a lot of different guidelines. For example, last few years regarding the design, maybe Microsoft flat design is one of the most popular here, especially the Google material design, where they introduce the shadow elements, and like everything is paper on paper. So I think that's the most popular design even right now. But now it's more like in combination with flat design where you don't have anything. And before you use, people use more gradients, more like real look. Now, it's like more simple, just to be more accessible to the customer to use it.” (R3:12)

R5 stated that the designs for the applications he worked on were usually already done by the UI/UX designers.

“So as for the designs, they mainly come already done. We talk with the clients, how they like it to be, and with the guidance of the user UI and UX designer on which areas they should take points and look at. As for accessibility, nothing really special.” (R5:10)

He also emphasized the importance of the consistent design:

“Yeah, of course, when you are creating an application, that does a great deal about UX/UI designers, because they have that feeling to follow a certain theme. It also depends on if the application is intended for young people or elderly. So it really depends on the market where the application should be presented. It's really important.” (R5:12)

Consultants came across various projects which included accessibility guidelines for the application design. R1 mentioned that some of his clients use internal accessibility guidelines: “But I do know, for the client I work for, if they develop an application, they have Internal Accessibility Guidelines” (R1:8). R6 said that universities in her country have developed their own guidelines:

“...some of those centers that are in the [Country Name], for example, at universities, like their university centers, they have already developed their own guidelines, because of the specifics of the [Country Name] context. But I am sure they also follow some international guidelines because the [Country Name] is not a pioneer in this sphere. So, in a lot of areas the [Country Name] follows the trends of low, more developed markets or more developed climates in the world, like America, Germany, for example.” (R6:8)

R7 was involved in projects which had to conform different standards for accessibility:

“I have been involved in projects where we have an app that needs to conform to different standards. And one of them is EU standards specially made for accessibility for older people, for example, or people who don't see so well, and yeah, so when I work in those projects, I have come across these standards. And they are, I think they are the one that's coming along that you have to have reached this usability standard, high level of it to be able to sell the product, because this is a medical/technical product.” (R7:4)

This part will be focused on what the respondents think is the most important aspect of applications for elders. R1 simply answered with “I think for them, I think functionalities no, but I think more design.”(R1:16)

R2 had the same opinion as R1 with further notes about this question:

“In my opinion, the most important is ease of use. So usability, as I said, because if you don't have that, I don't think you can have a successful outcome unless people can use your app. Otherwise, you can have all the functionalities you want, but nobody is going to use them, especially elderly people.”(R2:24)

R3 had different opinion and perception on the most important aspect of application for elders that differs a bit from R1 and R2:

“I would only say it's equal, because depending on what you need. For example, if you need someone quick to make a call, then definitely it's better to have better performance than the quality. But also if you can't find where to click on it, then definitely it is a problem. So I would say also equally.”(R3:22)

R4 shared the same opinion as R1 and R2 on that question:

“I think it's more important to be user-friendly like user-interface, because so many people are essential users. And they can see only what you show an application they don't know so much stuff about performance.”(R4:10)

R5 had a similar opinion to that of R3 where he also think both performance and design are important:

“Yeah, it's kind of hard. Users expect performance as a standard now. It's not something where you can say, okay, I'll ditch the performance, I'll have better user experience, because those two are really linked together. So if you want to have a good user experience, you'll need to have your application performance at the best.”(R5:8)

R6 and R7 both share the same opinion about design being more important but with different perception:

“Without the applications being user friendly, the users are never going to use them, they will either not be able to get the information they want or get the treatment they want” (R6:4)

“Readability, they must be able to read and understand. So we can, for example, have two fields that are similar in name and usage. If they're too similar, then it will be difficult for them to differentiate and understand what they're gonna register well. And also readability, usability. So, yeah, usability and readability. The font should be clear, the colors should be clear. Yeah, the elements, icons should be clear. Things like that.”(R7:20)

Respondent	User Interface (UI)	In-app Instructions	Use of Accessibility Guidelines for App Design	The Most Important Aspects of the Applications for Elders
R1	<ul style="list-style-type: none"> • The app needs to be very clear, concise and unambiguous to use • Functionalities shouldn't be too complex 	<ul style="list-style-type: none"> • It's important to have really good instructions to use which are understandable to the audience • Avoid using big amounts of text with all the instructions in one place • It's important to have simple instructions at every step of the 	Has clients who use internal accessibility guidelines	<ul style="list-style-type: none"> • Design is more important

		action which are related to that step		
R2	<ul style="list-style-type: none"> It's very important to be able to easily navigate the app 	/	/	<ul style="list-style-type: none"> Ease of use is the most important aspect Good functionalities are useless if the app is not easy to use
R3	<ul style="list-style-type: none"> Adapt the design to the client Stick to one type of design from the beginning of the app to the end Different kinds of colors need to represent different types of elements Make bigger forms and buttons 	/	Uses various accessibility guidelines	<ul style="list-style-type: none"> Ease of use is equally important as a performance of the app
R4	<ul style="list-style-type: none"> Design should be consistent through the app Let the users change the font size and UI to look more user-friendly 	<ul style="list-style-type: none"> Use the toolbar to explain the app in more detail 	Sometimes uses accessibility guidelines	<ul style="list-style-type: none"> It's more important that the app is user-friendly

	<ul style="list-style-type: none"> • Add more filters to the app so that elders can find things they need easier 			
R5	<ul style="list-style-type: none"> • The app should be simple to use • Enable the font resize option, so that people with bad eyesight can make it bigger • Increase the size of other elements as well • Display less information on a single page to make it more readable 	<ul style="list-style-type: none"> • It's important to have some kind of UI that guides users through each step • Avoid using big text which contains all the instructions in one place 	Has guidance from UI and UX designers	<ul style="list-style-type: none"> • User Interface and application performance are equally important • Users expect good performance as a standard • Performance shouldn't be neglected in order to improve User Interface (UI)
R6	<ul style="list-style-type: none"> • Avoid using unnecessary functionalities that will confuse elders • Make only basic functions that are essential for elders • It's important to have a bigger screen and bigger font 	<ul style="list-style-type: none"> • Include a Search Button to search for specific information • Include a helpline to contact people who can answer potential questions 	Worked on projects which had guidelines which are following the international accessibility guidelines	<ul style="list-style-type: none"> • Ease of use is very important for elders • If the app is not user-friendly, it will not be used by elders because they won't be able to access the information or treatment they need

R7	<ul style="list-style-type: none"> • All the elements and icons should be clear, including the font and colors • Avoid using similar elements in terms of the name and usage, that will confuse elderly users 	/	Worked on projects which followed various standards, including the EU standard for accessibility for older people	<ul style="list-style-type: none"> • Readability and usability are the most important aspects for elders

Table 9 Summary of the Accessibility Features for M-health Applications

4.4 Other Findings

4.4.1 Education, Assistance, and Support

R5 mentioned a good point when asked about if developers should put emphasis on elder needs “So they know that they have these tools. Because younger people are already searching for them but the elderly don't know that it exists at all” implying that elders should be assisted in learning how to use mobile health applications and also assisted in finding them in the first place.

R6 provided a lot of insights when asked about elders and their needs, she started by pointing out how doctors could help:

“I would say that it's always important to have someone who they admire or look up to or respect as a professional. So potentially, the doctor might be the best place to start to explain to them the benefits, maybe even the challenges, but also in a way how to overcome them, so that they feel like they have all the information necessary to use it” (R6:22)

R6 then mentioned multiple people that can help elders:

“And definitely someone like assistance or something so that in the case when they don't know what to do, or don't know how to turn an app on or switch the settings, change the settings, so that they can always contact someone, maybe on a phone or in-person to help them. So definitely

even patients from their relatives, doctors and other people, maybe some contact centers, client centers would be necessary” (R6:22)

R6 also mentioned how to be more specific when educating elders about technology “So there was an example that if you want them to use an email, then you have to talk about why they can use an email, talk about relatives who are not visiting, who do not visit them all the time.” (R6:22) then she mentioned some other ways of educating and assisting elders:

“To help them to train the use of the application in a sense, for example, by providing some workshops or individual consultations, or including their family members to directly supervise and help them.”(R6:22)

R6 also narrated a story where she helped a relative of hers and expressed how much appreciation is received when helping elders learn about technology. and R6 also pointed out how some elders think

“Their mindset is already like “I don't want to learn anything because I've already learned everything I wanted and I need in life”, but they don't understand the change in the modern, modern world” (R6:28) and then proceeded to explain the importance of communication:

“So that's why communication is very important because you really need to help them understand how this can be useful, and why it is useful, why they are needed. I believe that when you explained this, and when you showed them that it also might be easy to use, they would be more inclined or more willing to use that”

R6 finalized her thoughts with “Although, from my experience, my elder relative forgets about the phone all the time, but at least we can put in the effort” which was also an important point.

Summary	Respondents
<ul style="list-style-type: none"> ● Elders should be educated and assisted in finding and using health applications 	R5:28
<ul style="list-style-type: none"> ● Doctors and relatives should assist elders more in using m-health applications and educating them on their usage ● Workshops and consultations for assisting and helping elders ● Supporting in finding applications that they don't know about that could help them 	R6:22 R6:32

- | | |
|---|--|
| <ul style="list-style-type: none">● Communication is a key aspect in education, assistance, and support● Putting in the effort to provide help | |
|---|--|

Table 10 Summary of Education, Assistance and Support

5. Discussion

In this chapter, we connect our findings from the literature review and the interviews, and discuss them in more detail.

5.1 M-health

5.1.1 Benefits of M-health

Most of the respondents including (R2, R3, R4, R6, and R7) pointed out that health monitoring or health tracking could be achieved by m-health and is considered a benefit for elders and general users of such technologies. Many recent studies supported the statements from the respondents by saying that m-health technologies could provide a better health tracking or monitoring for elders (Changizi & Kaveh, 2017; Hurmuz et al., 2022; M. Ghazal et al., 2015; De Oliveira et al., 2021; Z. Li et al., 2014). Our respondents are consultants and developers who did not have direct experience in m-health or elders, however, most of them have worked or currently working on a project that included elders as a customer group. So, their perspective of the proposed benefits fits very well with the literature review we did so far. Health monitoring most likely means that elders' health could be tracked by people other than themselves, including relatives and doctors, and that is supported by studies and R7 statement about nurses monitoring multiple patients at once and since most m-health applications can be tracked and produce backup data, being monitored by others could also be a benefit for the elders, where their health could be tracked by people with better grasp or ability on this topic. M-health providing better health tracking and monitoring also improves the doctor-patient communication, which was also mentioned by R6 as a benefit of m-health.

Remote health care was also mentioned as a benefit of using m-health by the respondents (R2, R6, and R7), whether remote health care is meant for elders to stay home and get healthcare or be monitored by doctors while there are at home is also supported by (Changizi & Kaveh, 2017; Hurmuz et al., 2022; M. Ghazal et al., 2015; De Oliveira et al., 2021; Z. Li et al., 2014; Cao et al., 2020; Isaković et al., 2016). Just like mentioned before about health monitoring, remote health care could include the health of elders or multiple elders being tracked by one person. Nymberg et al., (2019) pointed out that healthcare and access to a physician are important regardless of how you contact them. So, in some cases, remote health care should not be pursued if normal healthcare is not available. However, through the findings and the literature, remote health care is a big part of why m-health could be beneficial for elders.

Lower costs were a benefit of m-health mentioned by R2 and R7 and supported by (Hurmuz et al., 2022; M. Ghazal et al., 2015; Z. Li et al., 2014) were elders that use m-health applications and technologies could benefit from using them by paying fewer medical bills, and hospitals

from having high expenses on direct health care. So studies and respondents' answers support that m-health could lower the cost of traditional or direct healthcare. Along with m-health having lower costs than traditional health care, R5 and R7 mentioned switching from traditional methods of health care to m-health technologies as a benefit. Multiple pieces of research that study m-health technology concluded in a way that m-health methods are taking a drastic change from traditional methods of healthcare, where patients now are more self-managing and put less pressure on doctors, and we also return to the point that m-health has increased the communication between patient and doctor (R6). In conclusion, the respondent's answers about the benefits of m-health and the research that was included in the literature review are aligned well together and can prove to be a good asset in answering our research question.

5.1.2 Challenges of M-health for Elders

Challenges of m-health for elders are one of the main drivers of our research problem and purpose and trying to understand those challenges and have a way around them could help us in solving the research question. R1, R2, R5, and R6 emphasized digital literacy as one of the main challenges technologies could pose to elders, and much research supported this claim (Czaja et al., 2006; The American Association of Retired Persons, 2002; Zickuhr & Madden, 2012; Vroman, Arthanat & Lysack, 2015; Leonardi et al., 2008; Hill, Betts & Gardner, 2015). Since m-health is considered technology and learning it you should be digitally literate, we adapted the answers of the respondents to our literature review. Being digital literate is such an important aspect of understanding technology and is considered a tough challenge in the case of m-health, if elders did not have enough knowledge of digital technologies they could miss out on very important things (Hill, Betts & Gardner, 2015; Leonardi et al. 2008). Many elders do live alone and being digital literate could help them use m-health applications that could lead to better self-management and healthcare. R5 mentioned this point specifically where elders don't know about the existence of applications that could be helpful for them while younger people are natural in finding such technologies. Digital literacy as a challenge is connected with accessibility issues mobile applications have, and it could further worsen the case of elders understanding technologies when applications that are being developed are not accessible and easy to understand even for younger users.

Other challenges that we found are lower quality compared to traditional methods which were mentioned by R2 and R5, m-health availability which was mentioned by R6 and R7, and technology acceptance, mentioned only by R6. Our respondent's answers about lower quality compared to traditional methods were not supported by our literature review, since we focused more on the benefits of m-health and how it can be improved. R6 mentioned the acceptance of technology as another challenge for elders while using technology. She noted that elders have higher resistance to change than younger people, and that applies to the use of technology as well, which was also supported by Cao et al. (2020). This is another reason for making m-health

applications more accessible and usable for elders since they will not use them if they are too complicated. This was also the main point of R6 and R7 when they mentioned the availability of m-health.

5.2 Inclusion of Elders in Application Development

When asked if the m-health technologies are adapted to elders' needs, most of the respondents gave a negative answer as they think that m-health needs to be more adapted to their needs since they are the group of people that need this technology the most. This was also supported by our literature review, (Hurmuz et al., 2022; M. Ghazal et al., 2015; de Oliveira et al., 2021; Z. Li et al., 2014; Cao et al., 2020; Isaković et al., 2016). Furthermore, we found that none of the developers, and only a few consultants included elders in their projects or adapted their projects to them. This confirms the findings from the literature that elders are often neglected and pushed back as the technology is rapidly advancing. Thus, it is essential to raise awareness about the inclusion of elders in m-health development, especially among the developers, and make m-health applications more accessible to them. Understanding the Technology Acceptance Model (TAM) and the Senior Technology Acceptance Model (STAM) is also an important step towards the accessibility of technology, especially if it's related to e-health and m-health. That can help in understanding not only elders' behavior towards technology, but the technology users' in general.

5.3 Technology Design

5.3.1 Users' Feedback

Throughout our research we noticed that the feedback from the users of m-health applications might have a good influence for making them more accessible. Our respondents not only confirmed our beliefs, but also gave us important insights on how the feedback can be crucial for improving the applications, especially the ones of m-health nature.

As we could see from the experience of R1, if the users' feedback is neglected while developing technology applications and services, it could result in costly consequences. Gathering feedback from users at an early stage can help the developers see what has to be changed so the final product covers all the needs of the users.

Based on the knowledge gathered from the literature review and the interviews, we propose the use of the Real-Time Feedback for m-health development, as suggested by R6, which would

include elders' opinions and recommendations for improving the m-health applications and making them easier to use. This also supports the statement from Lee et al. (2013), who said that it is crucial to include elders while designing applications which are of use to them in order to integrate their needs and requirements appropriately. As told by R6, in the Real-Time Feedback, it is important to include the users' opinions and suggestions at every stage of the development process to ensure that the application is usable by everyone, especially by elders. R1 and R7 also confirmed the importance of gathering feedback at every stage of the development process, which is used in agile development. Furthermore, R4, who is a software developer, noted that the most interesting feedback came from elders. This increases the importance of including them while developing and designing m-health applications, because the developers often omit the accessibility features which are of essence to elders.

It is also important to compare the views of consultants and developers on the feedback. Namely, the developers didn't emphasize the importance of feedback as much as the consultants, as they said that they only take it into consideration if they think it will help them improve the application. On the other side, the consultants had a more broad view as they usually think outside of the box. Therefore, in order to exploit all the benefits of users' feedback, everyone who is involved in e-health and m-health development needs to be aware of the importance of users' needs.

5.3.2 Accessibility of M-health Development

Based on the accessibility guidelines and recommendations from the literature review and the inputs from respondents, we constructed the Accessibility Guidelines for the Design of M-health Applications (Table 9) which cover the important recommendations that need to be considered while designing those applications, as well as mistakes that should be avoided. These guidelines can also be applied to other areas of software development where accessibility plays a big role. While making this table, we followed the four main principles for accessibility design for mobile applications (Perceivable, Operable, Understandable and Robust) which were suggested by Ballantyne et al. (2018) and combined them with the accessibility recommendations from the literature and respondents' inputs.

Principles	Recommendations	Mistakes	Reference
Perceivable	<ul style="list-style-type: none"> • Use clear and simple text • Use simple screen layout • Use bigger fonts, forms and buttons • Use headings, titles and prompts • Support screen readers • Use alternate text tags 	<ul style="list-style-type: none"> • Too much material on the page making it harder to find what the person was seeking • Advertisements and movement distracting the users from their goals 	Friedman & Bryen, 2007; Arch, 2009; Ballantyne et al., 2018 R1, R2, R3, R4, R5, R6, R7

	<ul style="list-style-type: none"> • Stick to one type of design from the beginning to the end • Provide easy navigation of the app • Adapt the design to the client • Different kinds of colors need to represent different types of elements • Add more filters to the app so that users can find things they need easier • Display less information on a single page to make it more readable • Make only basic functions that are essential for elders 	<ul style="list-style-type: none"> • Using similar elements in terms of the name and usage, which will confuse users 	
Operable	<ul style="list-style-type: none"> • Enable users to change the size of the elements on the screen (font, buttons etc.) or their appearance (light/dark mode, style of elements etc.) • Enable audio assist for users • Enable different types of input for users, other than text 	<ul style="list-style-type: none"> • Making an application which doesn't allow any alternatives for its design or functionalities 	<p>Friedman & Bryen, 2007; Arch, 2009; Ballantyne et al., 2018</p> <p>R4, R5</p>
Understandable	<ul style="list-style-type: none"> • Use consistent navigation and design on every page • Use exit, home, help, next page buttons on every page • Use pictures, icons and symbols along with text • The app needs to be very clear, concise, and unambiguous to use • Functionalities shouldn't be too complex • Avoid using similar elements in terms of the name and usage, that will confuse elderly users • Have really good instructions to use which are understandable to the audience • Have simple instructions at every step of the action which are related to that step • Use the toolbar to explain the app in more detail • Include a Search Button to search for specific information 	<ul style="list-style-type: none"> • Hypertext navigation providing non-linear paths through the information thus reducing comprehension • Changing layouts, navigation structures and interaction within and between pages causing confusion • Using unnecessary functionalities that will confuse the users • Using big amounts of text with all the instructions in one place 	<p>Friedman & Bryen, 2007; Arch, 2009; Ballantyne et al., 2018</p> <p>R1, R3, R4, R6</p>

	<ul style="list-style-type: none"> • Include a helpline to contact people who can answer potential questions 		
Robust	<ul style="list-style-type: none"> • Use universal design which can be applied to different technologies and be accessible by everyone 	<ul style="list-style-type: none"> • The design is not applicable to different technologies 	Ballantyne et al., 2018; Friedman & Bryen, 2007

Table 11 Accessibility Guidelines for the Design of M-health Applications

We mentioned before how important it is for m-health applications to be accessible for elders, since they are of great essence for them and their health. That's why we believe that these guidelines for accessibility of m-health applications should be followed by everyone involved in m-health development. Our findings further support these beliefs, since only a few of our respondents put emphasis on the use of accessibility guidelines, and most of them were consultants. Also, almost every respondent stated that the design of m-health applications and their ease of use are the most important aspects for elders, which was also presented in the Technology Acceptance Model (TAM). Therefore, raising awareness among people involved in m-health development about the importance of these guidelines is essential to move to the more accessible future when it comes to elders' interaction with this type of technology. In order for that to happen, some legislations or standards about the accessibility of these applications should be made, at least to some extent, which was also mentioned by R7, who worked on projects which followed EU standards for accessibility. As we've seen from the literature, some initiatives for improving the accessibility of technology have already been in motion (WAI, WCAG 2.0), but another step needs to be taken in order to resolve this issue.

5.4 Other Findings

5.4.1 Education, Assistance, and Support

Other findings were mainly responses that supported our research purpose, but they could not be classified in any other chapter, so we chose to put education, assistance, and support of the elderly in other findings. Education, assistance, and support were mentioned by R5 once and R6 multiple times, where R6 emphasized the fact that elders need to be supported more to be able to accept technologies. This can be done by educating them on how to use those technologies,

raising awareness that those technologies exist and are available to them and giving them support when they need it (R6). This justifies the beliefs of Vroman, Arthanat and Lysack, (2015), who said that elders lack the capability to use or familiarize themselves with ICT because, for most of them, their life, education, and work were at a time when current technologies did not exist. Cao et al. (2020) also emphasized that intergenerational support is important to lower elders' resistance towards technology which also aligns with the response of R6.

6. Conclusion and Future Work

After gathering the literature review, we had more information about the current state of the accessibility of m-health applications and elders' perception on technology. First, the benefits of m-health applications for elders and issues they face when they use those applications were presented. The main issues for elders appeared to be connected to the accessibility of those applications, since elders have poor digital literacy. Thus, we gathered the accessibility guidelines and recommendations from the literature to understand what aspects need to be covered in order to make m-health applications more accessible to elders.

In the next phase of our research, we conducted seven interviews with consultants in the e-health and m-health area, as well as software developers, with the goal to get more insights on this topic. After analyzing the information from the interviews and connecting it to the literature review, we had a clear picture about the issue presented. The respondents confirmed the benefits of m-health applications for elders and users in general, highlighting the importance of those applications for improving patients' health in many ways, such as health monitoring and tracking, remote healthcare etc. However, in order to reach the full potential, m-health applications need to be more accessible and adapted to elderly users, for the reasons mentioned above. While conducting the interviews, we noticed that not many respondents specifically focused on elders' needs while working on their projects. Some of them only focused on them if their projects were intended for elders, which should not be the case. We believe that all m-health applications should have accessibility features made specifically for them. Therefore, legislations and standards for the accessibility of m-health applications should be made and followed by developers and designers.

To conclude our findings and answer our research question (*How can m-health applications be more accessible for elders?*), we propose the inclusion of elders at every stage of development process of m-health applications with a big emphasis on the users' feedback, raising awareness about the challenges that elders face while using m-health applications, following the accessibility guidelines for application design, educating and supporting elders on the usage of technology and making them aware that this technology exists and can help them improve their health in many ways.

This study had many limitations and it can be improved in the future work in many aspects. First, as mentioned before, the original aim of this study was to interview elderly people and physicians along with e-health and m-health consultants and developers. This would make our research more complete and help us observe the topic from elders and physicians' perspective. Their point of view is essential in order to completely understand the issue at hand and further improve the accessibility of m-health applications. Second, we didn't have time and resources to find suitable developers, preferably from m-health area, so we interviewed the developers from other areas. We are aware that m-health developers' opinions and insights may be different from the ones' we interviewed since they have probably put more emphasis on the accessibility of m-health applications in their projects. Our main conclusion related to the limitations of this study

is that this topic requires more time and resources (which probably extend those that we had for this Master's Thesis) in order to be complete. Nevertheless, we believe that this research covered a big part of this topic and that our findings are very important for resolving the issues related to the accessibility of m-health applications. We also believe that this topic is of high importance for social sustainability and that more research and studies should emphasize it.

Appendix

Interview Guide

Theme	Key Question	Interview Questions
<i>Opening</i> Introduction to the ethical considerations		
<i>Introduction</i>		<ul style="list-style-type: none"> ● Please introduce yourself and shortly describe your area of work/research
M-health Sector	How well is the mobile health sector adapted to the elderly people?	<ul style="list-style-type: none"> ● What benefits/challenges do you recognize that m-health can offer to elderly people? ● Do you think that today's m-health applications are well adapted to elderly people?
Accessibility	Are your applications user-friendly?	<ul style="list-style-type: none"> ● How important is it for your applications/services to be user-friendly? ● Do you use accessibility guidelines or recommendations for your app development or design? ● How much is the user's feedback important for developing your applications? ● Do your applications include some sort of guidelines/assist for people who find it harder to use them?
Inclusion of Elders	Are elders' needs considered while developing your applications?	<ul style="list-style-type: none"> ● Are elderly people included in your current customer group? ● How much emphasis do you put on elders' needs while developing applications? ● What challenges did you discover while integrating elders' needs in product development? ● Do you include elderly people while testing the applications?

		<ul style="list-style-type: none">• What are the main aspects of your applications that are important to older people?
<i>Closing of the Interview</i>		

Interview 1

Row	Person	Transcription	Code
1	Researcher	Can you please introduce yourself and shortly describe your area of work or research that you do?	
2	Respondent	Yeah. So I'm [Respondent Name] with [Company Name] company for five years, two years as a student and three years as a consultant. I work in the field of quality and compliance within life science and healthcare. In other words, implementation of medical device regulations at life science organizations. My current project is related to the implementation of medical device regulation at one of our biggest clients, I cannot say the name. But it's, I think, the biggest player worldwide within the medical device and pharma industry. What we're looking at there, I do have in scope software as a medical device, which sometimes can be an app as well, a mobile health app. So there is also look at, okay, how does the regulation apply to these apps, but also really about physical medical devices, the implant, a hip implant, a pacemaker. So I look at that those from a quality and regulatory perspective. In general, also, I'm mainly working within regulations and quality for medical devices.	
3	Researcher	What benefits do you recognize that mobile health can offer to elderly people? Or challenges on the other side?	
4	Respondent	I think, and it's also something I looked at in my thesis. So I think for elderly people, the issue is the digital knowledge, the digital know how. I think that will be one of the main challenges for elderly people that they do not understand how to work with it, use it correctly, which will be one of the main challenges. And therefore, when you develop a mobile health application, I think it's important that you really think about your instructions for use, that you want your application to have a very good instructions for use which are understandable for that audience. I think that will be your main challenge.	MHC TDA
5	Researcher	Thank you. And do you think that today's mobile health applications are well adapted to elderly people?	
6	Respondent	That's a good question. So I have two applications that I worked on in mind. One of them yes, one of them no. So, one application that I, for example, worked on is used actually already globally, or well, it's getting global penetration, if I can say like that. It started in Belgium, went on European level and now on US markets. That one is very user friendly, and also friendly for elderly people, because if you use the app, it really has like a button that you use, it has an information icon, where you can see okay, what happens, why the button is there, what happens if you click on it, and you even have a complete patient flow that the elderly person can understand.	IOE TDA

		<p>Just the end user in general can understand, okay, this is where you are now, this is where you need to go and these are the steps required to get there. And at every step, you have information related to that step to explain to the end user why that step is being performed.</p> <p>I had another application where I worked on that was not user friendly at all. It had general instructions for use. So for example, when I opened the app, I get a very big text, like very big text, which explains all the instructions, but no structure, just plain text, no explanation. And I think for elderly people, if you want them to use the app effectively, giving them plain text will not work. You really need to work on including an interactive screen, or really screenshots showing what is located where and what it does. Yeah.</p>	
7	Researcher	Did you use any accessibility guidelines or models for your app development?	
8	Respondent	I am not an app developer. I don't think this question will be applicable for me. But I do know, for the client I work for, if they develop an application, they have Internal Accessibility Guidelines.	TDA
9	Researcher	Okay. And how important is the user feedback for developing your applications?	
10	Respondent	<p>Crucial, it's crucial. Right now, the project I currently work on, I am actually on one hand, a quality associate on the project, I provide input from quality and regulations perspective. On the other hand, I also assist in the design of an ID system. So it's not really a mobile application, but I think there are similarities in the sense that I'm designing an IT system together with other people, for a large group of end users, about 400 end users and the clients. Client feedback there is essential. Why do I say this? In our initial release, we developed a system based on our knowledge of the regulation, and how we would apply it. But what the system is doing, it's actually in distribution centers worldwide at the clients. They have to use the system to perform verifications on medical devices. We made those verifications based on our knowledge, but not with the end users' feedback in mind, the people who would perform the verification. So we went live with release one. What happened in release one, we noticed a lot, a lot of feedback from the end users that it was not efficient, that it's not reflecting the real situation and the warehouses. The big gaps, very big gaps. And now we are at release four, so three releases further. Back then, in release one, we had like a whole list of end users' feedback. And we're still implementing that feedback into the system. Whereas if we just initially had our input from a quality and regulatory perspective, but then also the usability and the efficiency perspective, from the end users that use it, we would have avoided all of this stuff. And now it's causing issues in the sense that we need to foresee extra budgets and extra manpower to make sure that we have the development capacity to also on one hand foresee the system of new functionalities, but</p>	TDF

		also make sure that the system is user friendly and living to the needs of the end users that use it in the distribution centers. So yes, it's crucial, and it should be implemented as early on as possible. That's why I like agile development, that you really ask for increments of your application, you get feedback from the end users. And do not wait till a big release. So continuously get feedback and build your application together with your end user to be successful.	
11	Researcher	Thank you. And did you put emphasis specifically on elders' needs while developing applications?	
12	Respondent	For the applications I work on now, no, because they're not externally facing their internal company applications. That's what I work on now. What I previously worked on, the application that I initially mentioned, that was very user friendly, there they did take it into consideration.	IOE
13	Researcher	Okay, and what challenges did you discover while integrating older people's needs or people with some difficulties to use your applications?	
14	Respondent	I cannot answer that question. Because I was not involved in the implementation there. So I was only involved from a regulatory oversight to make sure that the application was fulfilling compliance with the regulation because it was actually a replication that was under the scope of the regulation on European level and it needed to fulfill those requirements. That was my role there. So I was not really in a development role. I was more in a regulatory compliance role.	
15	Researcher	Do you know any aspects or parts of the applications that were of big importance to older people?	
16	Respondent	I think for them, I think functionalities no, but I think more design. As I explained earlier, I think it needs to feel intuitive for these people and it needs to be very clear, concise and unambiguous to use it. I think that's an important one and that relates to me more to the look of the application, but then also, design-wise and development-wise, if you're going to have functionalities that need to be used by elderly people, make sure that they are not too complex, or that you do not require too much complex actions from the user in that situation.	TDA

Interview 2

Row	Person	Transcription	Code
1	Researcher	Can you please introduce yourself and shortly describe your area of work or research that you have done?	
2	Respondent	Yes. So, I'm working on other topics, such as financial services and other industries. But when I did my master's thesis, I worked on the algorithm that was used in an app that allows you to monitor your heart rate and other cardiac parameters by using a smartphone, pretty much the same way that is now being done by all the smartwatches and the Apple Watch that allow you to monitor your heartbeat.	
3	Researcher	What benefits or challenges do you recognize that mobile health can offer to elderly people?	
4	Respondent	Well, I think the benefits and challenges are, for the most part, pretty much the same of the general part. So of course, in the benefits category, they bring easier monitoring and easier access to certain services or functionalities. In the case of a mobile app, these functionalities are, of course, monitoring, as parameters, or simplifying the way you access as providers and services, such as telemedicine and video consultancy, and stuff like that. And they probably also bring lower economical barrier to entry. So it's, you know, it's cheaper, basically. Among the challenges, I would say, oh, and the last part is that as a benefit for, as companies or national health systems, mobile devices bring a wider coverage and monitoring. So it's a lot of data points that can be used and analyze. Whereas for the challenges, I would say that there is a barrier, especially with older people in ease of use, and in general, if they are not proficient in digital literacy, and using smartphones and apps that can be an obstacle. And also for them, for the health aspect of mobile technology, there is an issue with data quality, so the measurements that are performed, or the services are not always at the same level that can be achieved with a doctor's appointment in person or hospital visit and things like that.	MHB MHC
5	Researcher	Do you think that today's mobile health applications are well adapted to older people?	
6	Respondent	I really don't know. I don't have experience with that.	
7	Researcher	How much was it important for the applications you worked with to be user friendly?	

8	Respondent	Yes, very much. So, what I did specifically was the back-end part so I didn't really dive into the user accessibility bars. But it's mandatory that since these measurements were self-performed by the patient and the app users, it's very important that it's clear and easy to access and navigate the app to launch the measurement correctly. Yes, very important.	TDA
9	Researcher	Did you use any accessibility guidelines or some kind of models when you developed your apps?	
10	Respondent	I don't know the answer to that, because I was doing the backend, data analysis and not the front end development. So I don't know.	
11	Researcher	How much is the user feedback important for developing your applications and making them even better?	
12	Respondent	Very much, I think. And it was our experience that you need to have constant feedback from our group of users to develop and refine the app. So that is mandatory, in my opinion.	TDF
13	Researcher	And did the applications that you worked with include some guidelines or assist for people who find them harder to use?	
14	Respondent	I wouldn't know because we were not even in the beta version. So I think it was too soon to have that set of instructions.	
15	Researcher	Were elderly people included in your customer group?	
16	Respondent	Yes. Some of them were elderly people. Yes.	IOE
17	Researcher	Can you describe some projects or applications that they were included in?	
18	Respondent	Yeah, basically, they were part of the population sample or the testing users group, I would say, that was selected. So basically, there was a group of some patients. And some of them either self perform the assessment, or there was a professional who was running the app, actually. And they were just measuring their heart parameters.	IOE
19	Researcher	Did you include elderly people while testing the applications or services?	
20	Respondent	Yes. Pretty much similar to what I said earlier, There was a wide group of people who were taking part in the app testing. And a certain part of them were elderly people, I think up to almost 90 years old. And they were just providing their availability to be measured using the app and then the results were compared to professional clinical measurements performed by physicians in the hospital.	IOE

21	Researcher	And do you think that it's important to include elderly people while testing these kinds of services in mobile health?	
22	Respondent	Yes, absolutely. Because they are a great part of the population that will make use of the services. So while it is challenging for the reasons I said before, they are a significant, significant part of the community.	IOE
23	Researcher	What do you think are the main aspects of mobile health applications that are important for older people?	
24	Respondent	In my opinion, the most important is ease of use. So usability, as I said, because if you don't have that, I don't think you can have a successful outcome unless people can use your app. Otherwise, you can have all the functionalities you want, but nobody is going to use them, especially elderly people.	TDA

Interview 3

Row	Person	Transcription	Code
1	Researcher	So first, I would like to ask you to introduce yourself and shortly describe your area of work that you've done these years.	
2	Respondent	Well, basically, my name is [Respondent Name]. I have a master's degree in computer science. Basically, I think I have, like around 10 years of experience in business around IT. I did almost everything, every kind of work regarding IT technologies. I started as a software developer for the desktop application for Windows basically. After a while, I moved to the Web. I was also working with, I'm not sure do you remember the technology Flash. There are lots of different kinds of games there for the browser, so I used ActionScript to try to make a few games of mine, but technology went out pretty soon, so I moved totally to the web, and basically now for a while, I have become our lead developer. I worked on many kinds of different programs. For example, it was mostly for, like enterprise solutions for security. For example, one of the biggest programs that I work for is color and data. It's for recording a suspicious person with different registration plate. And basically, I worked with that program, I think, six years ago, and it's still being used, probably with a few better versions. And after a while I'm here at company [Company Name], I work here mostly for E-commerce solutions. After a while, I also become here a lead developer. And let's say that my hobby was to design, to be a web designer. So I do that in the meantime, all the time. Here in company [Company Name], I design, like a few different E-commerce solutions and of course, programming as well. After two years I become a CTO, so I have lots of work like paperworks and managing different kinds of teams and so on. And recently I've become business manager. And with that role, I'm only leading multiple different teams. But I'm not programming anymore, basically. Now the programming part is left like a hobby to me. It's short, I couldn't make it shorter.	
3	Researcher	That's fine. Now we'll start with the questions. So how important is it for your applications or services to be user friendly?	
4	Respondent	Yeah, it's very important, especially depending on the client. But if you want something to be used, then definitely it's very, very important for every button to be in its place. Because for me, let's say if I open some kind of website, if I can't find what I want in the first few seconds, I usually leave.	TDA
5	Researcher	And do you think that the usability is more important than the performance of the system?	

6	Respondent	Definitely not. I would say it's equally important, because you can't go without the other. For example here, If you know about SEO optimization, I'm not sure that you heard about it. So one of the main things in SEO optimization is speed. So there are also, I think, a few thesis or graphs that show you that if the site is not quick enough, usually a lot of clients will just leave it. So even Google ranking is determined mostly by speed. The faster your website is, the better ranking will be at the Google basically.	TDA
7	Researcher	And how much is the user's feedback important for developing your applications?	
8	Respondent	I would say it's important, but not sure how much. Basically, there are a lot of different kinds of users. So, someone likes this, someone likes the other. So you can't be loved by everyone. So basically, you need to choose some part of it. But it's definitely important.	TDF
9	Researcher	And did you ever develop some applications or services that have been used by elderly people or people who find it harder to use technology?	
10	Respondent	Unfortunately, I didn't develop any kind of those things. In the company, there are a few. But me personally didn't develop any kind of software like that.	IOE
11	Researcher	Okay. And did you ever use any accessibility guidelines or recommendations for the app development or the design?	
12	Respondent	Yeah, for designing and for development, there are a lot of different guidelines. For example, last few years regarding the design, maybe Microsoft flat design is one of the most popular here, especially the Google material design, where they introduce the shadow elements, and like everything is paper on paper. So I think that's the most popular design even right now. But now it's more like in combination with flat design where you don't have anything. And before you use, people use more gradients, more like real look. Now, it's like more simple, just to be more accessible to the customer to use it.	TDA
13	Researcher	Do you usually stick to the same style of designing when you design applications?	
14	Respondent	So, I design one thing, and after a while, I move to another and then another and another. So it's the same like programming, when you start doing it, when you finish, you always know like, you can do better. And you just progress like that. But, every kind of design is different, especially depends on the client, for example, ecommerce is totally different from, for example e-health. Also, you definitely don't want to design something to look like admin, if it's	IOE TDA

		going to be using a portal or something like that. There's a different kind of design and it mostly depends upon the client.	
15	Researcher	Talking about clients, if we speak about elderly people, do you think that it's better to keep the design consistent through the application? So it's, easier for them to, for example, remember the position of elements?	
16	Respondent	Definitely, definitely. It's not only for elderly people, it should be a pattern for any kind of application. Regarding different kinds of design that I mentioned before, It's dependent only by different application. I always use, and everybody should use like that, we in company also, if you have some kind of design and you need to stick to it from the beginning to the end. Basically, if your button is green, try the button to be green. On every page, different kinds of colors need to represent something. For example, if you know the design right now Bootstrap if you use or something similar, the Success button is always green, Primary button is usually blue, and the Warning button is usually orange and the Danger button is always red. So few colors like that are very important to be used. I mean, it depends, for example, my profile website, it's all black. But I distinct different kinds of buttons by size. So there always should be something, for example.	TDA
17	Researcher	The next few questions will be a bit different. It's about eHealth. So do you know any benefits or challenges that eHealth could offer to elderly people?	
18	Respondent	Well, to be honest, I didn't think about it. For example, there is one product that we work on, and I think there are lots of different kinds of projects where people use some kind of bracelets to be tracked. And if something happened to them, they are able to click on it, so that someone can help them or something like that. They probably have different kinds of numbers that they can easily manage to call if something happens to them. There are probably different kinds of games, like memory games all depending on what someone loves. So I didn't think too much about it.	MHB
19	Researcher	And also, if you maybe know, do you think that today's mobile health applications are well adapted to elderly people.	
20	Respondent	I couldn't say anything about it. Basically, I know a few projects that we've been working on in the company, but I'm not working on them to know any kind of specification to tell you a bit more. But the application should be adapted to the elderly people, probably to have bigger forms, or buttons or something like that. Regarding the UI.	TDA
21	Researcher	Do you think that for them it is more important for applications to be easy to use, or to have better performance?	

22	Respondent	I would only say it's equal, because depending on what you need. For example, if you need someone quick to make a call, then definitely it's better to have better performance than the quality. But also if you can't find where to click on it, then definitely it is a problem. So I would say also equally.	TDA
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Interview 4

Row	Person	Transcription	Code
1	Researcher	Can you please introduce yourself and describe your area of job that you've done briefly?	
2	Respondent	I'm [Respondent Name], I'm working for [Company Name]. I have been working in [Company Name] for eight years. I'm the Team Lead of the e-commerce department. I'm working as a developer. We use PHP and React for development. And we are working on [Project Name] ecommerce system.	
3	Researcher	You've been a developer for eight years?	
4	Respondent	Yes, yes. So, five years working From now.	
5	Researcher	Okay. And how important is it for your applications to be user friendly?	
6	Respondent	It's so much important. For me.	TDA
7	Researcher	Do you know why is it important for the users of an application to be user friendly? Why do they demand these days that they are more and more user friendly?	
8	Respondent	Because that way users will spend less time and maybe that is one of the reasons.	TDA
9	Researcher	Okay, and do you think that it's more important for an app to be user friendly than it is important to have good performance?	
10	Respondent	I think it's more important to be user-friendly like user-interface, because so many people are essential users. And they can see only what you show an application they don't know so much stuff about performance.	TDA
11	Researcher	And how much is the user's feedback important for the development of your applications?	
12	Respondent	I think that is so important, because we cannot find all bugs, and maybe all of the interesting, interesting features. So many times you can give us feedback, and we can improve the user interface and create better functionality for the application.	TDF
13	Researcher	Okay, and do your applications include some guidelines for people who find it harder to use them like some tips?	

14	Respondent	Now we are working on the X system, and they have pretty good documentation for customers. And we almost always send out official documentation. For Customers guidelines.	TDA
15	Researcher	And do they use any accessibility guidelines or recommendations while developing the apps?	
16	Respondent	Sometimes.	TDA
17	Researcher	Okay, do you think that the design of the app should be consistent and not have too many changes?	
18	Respondent	Yes. I think it should be consistent.	TDA
19	Researcher	Why do you think it's more important for the users that it's consistent and not like sometimes the button is bigger or sometimes smaller?	
20	Respondent	Because it looks more professional, if you have some good design and follow good designs, it is better for installation.	TDA
21	Researcher	Okay. And have you ever worked with some eHealth applications or mobile health?	
22	Respondent	No not for ehealth or mhealth.	
23	Researcher	Have you ever developed applications that are used by older people or people with disabilities?	
24	Respondent	We are working on e-commerce applications, so they are for young and old users. Many people use e-commerce.	IOE
25	Researcher	And do you need to maybe include something special while developing, when you focus on older people? Do they need something more than young people for the design?	
26	Respondent	Almost in every case designers think about user experience, for example, when we have our old users, for example, we said that they can choose font size and sometimes they can change the look of the user-interface to look like a desktop.	TDA
27	Researcher	Okay, and do you think that, for elders, it's more important for an app to be user friendly or that it has better performance?	
28	Respondent	I think they are both important, the interface and the performance.	TDA
29	Researcher	And did you discover any challenges when developing apps so they have to be implemented for older people, can you specify some challenges for that?	
30	Respondent	When I started my career, my first client wanted an application for old people. And we have so many times a problem with design because so many older people cannot notice some stuff on site, so we focused on adding more filters to the site, so they hover quickly to the things they want.	TDA
31	Researcher	Did you have to use explanations for every part of the app?	

32	Respondent	Yes. For example, we use the toolbar for explaining in more detail. Some stuff for functionality of applications.	TDA
33	Researcher	Did you include elders while testing those apps?	
34	Respondent	No, we didn't. But we received a lot of feedback from clients and mostly interesting feedbacks were from old people.	IOE TDF
35	Researcher	What benefits do you recognize that eHealth can offer to elder people to old people?	
36	Respondent	I think they can help them track their health.	MHB
37	Researcher	And do you think that mobile applications for eHealth are well adapted to elderly people?	
38	Respondent	They look fine.	IOE
39	Researcher	That should do it. Okay, Thank you, I will stop the recording now.	

Interview 5

Row	Person	Transcription	Code
1	Researcher	Okay I started recording now.	
2	Respondent	Maybe you can do some introduction, to fully understand the situation.	
3	Researcher	Our topic is the inclusion, the digital inclusion of elderly people in mobile field development. But since we couldn't find many mobile application developers, we decided to go with normal developers and adapt questions a bit. So maybe at the end, I will also ask you questions about elders and mobile health, but if you don't know it's fine. But first, I'll ask you the questions for the user-friendly applications, design, and stuff like that. Okay. So, you can introduce yourself and your job area and stuff that you've done so far.	
4	Respondent	Okay. Hello, my name is [Respondent Name], and I'm from [Company Name]. I have started to work as a full stack developer, at later parts more exclusively as a front-end developer and mobile developer. I've done some work with [Company Name] and [Company Name]. So I have almost nine years of experience, professional experience. So that's my expertise for that and mobile development lately.	
5	Researcher	Thank you. And how important is it for your applications to be user friendly?	
6	Respondent	Yeah, I mean, every application needs to be nice and have like a great user experience and design. So it's really important.	TDA
7	Researcher	Yeah, and what you think is more important for it to be user friendly, or that it should be a better performance application	
8	Respondent	Yeah, it's kind of hard. Users expect performance as a standard now. It's not something where you can say, okay, I'll ditch the performance, I'll have better user experience, because those two are really linked together. So if you want to have a good user experience, you'll need to have your application performance at the best.	TDA
9	Researcher	And do you use any accessibility guidelines or recommendations when designing the apps?	
10	Respondent	Nothing really, specific. So as for the designs, they mainly come already done. We talk with the clients, how they like it to be, and with the guidance of the user UI and UX designer on which areas they should take points and look at. As for accessibility, nothing really special.	TDA
11	Researcher	And do you think it's important for the design to be consistent for the application?	
12	Respondent	Yeah, of course, when you are creating an application, that does a great deal about UX/UI designers, because they have that feeling to follow a certain theme. It also depends on if the application is intended for young people or elderly. So it really depends on the market where the application should be presented. It's really important.	TDA

13	Researcher	And how much is the user's feedback important for developing your applications?	
14	Respondent	User feedback is welcome. Some of the user feedback is not really relevant at some point depending on the goals of the application in which direction should go. But every feedback from the users is something to consider and make adjustments if needed for the application.	TDF
15	Researcher	And did you ever develop some apps that were used by elderly people?	
16	Respondent	I don't think so. I did not develop anything for elders specifically.	IOE
17	Researcher	Okay. But did you ever use some, for example, guidelines on some part of the app or tips that explain this part does this, this part does that?	
18	Respondent	Like some kind of onboarding guide you mean?	
19	Researcher	Yeah I think that could help them better understand how to use such an application.	
20	Respondent	Yeah, it was not like, specifically towards elderly people. But I did create some kind of onboarding guides for some complex operations on the application which weren't self explanatory, but this one can also translate for the elderly or whatever market you want. So there will be some kind of like, overlay over the application explaining, you click this button this will happen and you connect like, this and just some kind of guide to show the most important part of the application. So it's really clear what the goal was. It's always good if you don't need to do that, that the application is self explanatory. But in some cases, it really needs to be some kind of guide.	TDA
21	Researcher	Do you think that it's better for it to have a few steps of explanations or just like the plain text at the beginning and you read it, and then you just use the application?	
22	Respondent	No, I think this approach which I described where we have some kind of overlay around your UI, which is transparent, I mean, some kind of blurry, and then you explain, okay, you make a circle around the button, when you click this, this will happen and on the next button, you'll have focused on something else say, okay, this is important on the screen, and you can expect from it to do that. So more like some kind of mixed experience, not just text, which will explain everything and then you need to go inside the application and search where this button was, which was explained earlier. So it's kind of confusing. It's better to have some kind of UI experience there to guide you.	TDA
23	Researcher	And did you ever develop any kind of e-health or mobile health applications?	
24	Respondent	Currently, I'm not really developing an application. It's more like managing the team. the application, which conserves the like, it's somehow market like therapists for women specifically. Okay. So it's on those lines, I'm kind of like a manager there. I'm not doing any real, like front-end work. Just to see that everything in the team is working correctly.	
25	Researcher	And what benefits do you recognize that e-health offered to elderly people compared to the traditional health?	
26	Respondent	Yeah, I mean, if the application is simple enough for the elderly to use, it will be easy. They can check for the next prescription when it's due, or either on some kind of making appointments, easier than on some kind of remembering those dates or writing them on a piece of paper. But this comes with some	TDA MHB MHC

		kind of must have education, I think. So the elderly need to know how to use the application correctly. Because if it happens that you get the application to a group of people, which do not think they know how to use it, but they're using it wrongly that they will miss out on that opportunity for the application, it will be kind of more of an issue than if they were using traditional methods.	
27	Researcher	And do you think that, while developing mobile health applications, developers should put more emphasis on elders' needs since it's crucial for their health?	
28	Respondent	Yeah, I mean, if we like, look at statistically, I think the elderly are more of a patient than younger people. So they will have more benefits of using the application. So I think it would have been like, a better idea to market it in that area, specifically towards the elderly. So they know that they have these tools. Because younger people are already searching for them but elderly don't know that it exists at all.	IOE EAS
29	Researcher	Do you have a good experience in developing user interfaces?	
30	Respondent	I mean, I've developed a lot of work and a lot of applications, but lately it was more like borrowing the designs from the designers and I think they are better than me.	
31	Researcher	Yeah. So my question is, what are some sort of features that are really important for people with weak eyesight, worse hearing, do you have some sort of features that are accessible for people with that sort of issues?	
32	Respondent	Yeah. So for like, problems with eyesight, I mean, there's, you know that each phone has those settings for font, font size. When creating a mobile application, you can turn that off, which is easier for us developers that just turn it off. And you don't care about each letter on the site. Because sometimes the font can change and mess up your whole design. So you can create apps thinking about it, that the user will increase to the maximum number and see that everything is still there. So this will be helpful for people who don't see well. So that's one point also, you need to think about, since you have a bigger font, you will need to have bigger buttons. So that means that on one page, you wouldn't be able to, to add everything, all the buttons there. So it will be maybe one or two actions per page. And you'll think about it, okay, this device has a lot of text there, maybe I should divide it to more pages, which you can scroll with some button or whatever. So you need to think of it differently for eyesight specifically. But for hearing, I'm not really sure what you can do there. I mean, if hearing is bad, then maybe the vision is good. So you read something there, but you can just increase the volume. But maybe that doesn't help there. But as for the eyesight, you can just think about it as a developer that you need to create your design flexible enough for all those sizes of fonts.	TDA
33	Researcher	That is all, thank you so much for your time.	

Interview 6

Row	Person	Transcription	Code
1	Researcher	So, we'll start with the quick introduction, can you introduce yourself and describe your area of expertise and work.	
2	Respondent	Okay, so my name is [Respondent Name]. I'm now working at [Company Name]. But I mean, some of those projects are also related to healthcare. But why you contacted me is my previous experience writing my thesis at the University of Economics, where I was very interested in finding more information about the [Country Name] e-health environment climate.	
3	Researcher	Thank you. The next group of questions is about technology acceptance. How important is it for your application to be user friendly?	
4	Respondent	It's very important. Without the applications being user friendly, the users are never going to use them, they will either not be able to get the information they want or get the treatment they want. Or they would, just, I mean, skip using them because of the difficulty or because they are simply going to be confused.	TDA MHC
5	Researcher	Do you use Accessibility Guidelines or models for app development? Or Have you ever witnessed some sort of guidelines for such a development for an easier user interface or user-friendly applications?	
6	Respondent	Can you be more specific? What do you mean by this?	
7	Researcher	Is there like, when developing an application? Are there guidelines, specific guidelines or well-known guidelines for making applications that is user friendly?	
8	Respondent	Unfortunately, I'm not very knowledgeable about this one. But I might guess that some of those centers that are in the Czech Republic, for example, at universities, like their university centers, they have already developed their own guidelines, because of the specifics of the Czech context. But I am sure they also follow some international guidelines because the Czech Republic is not a pioneer in this sphere. So, in a lot of areas the Czech Republic follows the trends of low, more developed markets or more developed climates in the world, like America, Germany, for example. And so far.	TDA
9	Researcher	Yeah, thank you. So for the next one is, how much is the user's feedback important for developing an application or any sort of project?	

10	Respondent	In general, is super important, I think that are gradually to companies, to developers, and even potentially doctors, because, I mean, while ago we were discussing, but I can repeat, we were discussing that there is a center for energy efficient buildings here in [University Name] University, and they have a life lab where they directly collaborate with developers, I mean, the researchers collaborate directly with developers, so IT engineers, doctors and also patients at the same time, so they iterate the process the partial solutions, they discuss this with patients also. So, they get real time feedback and based upon that, they design the application, the banner, the processes, or the interface. So, and this is getting even more important nowadays, with the number of applications that are gradually becoming available.	TDF
11	Researcher	Thank you. Do your applications include some sort of guideline to assist people who find it harder to use them? Or have you ever witnessed or consulted a project with some sort of assisted user interface?	
12	Respondent	I mean, based on my experience or knowledge, usually I could find apps that includes some instructions either directly in the app, so like, introduction or technical settings or something, or there was also a website to directly search for specific in front information or a helpline to contact people from the company or from the center. Also, I think that in some cases when the doctors are more pro, pro eHealth, they can also help you navigate but this is rare, rather rare, especially in the [Country Name] context.	TDA
13	Researcher	So, the next one is elderly people included in a customer group you've worked on or consulted before? Do you put emphasis on elders' needs when developing or consulting applications or anything related to eHealth?	
14	Respondent	I mean, people that I've been working with included the elderly people, in the customers during the whole development, definitely.	IOE
15	Researcher	So, what challenges did you discover while integrating elder needs in developing applications or developing eHealth applications to be like more precise?	
16	Respondent	Unfortunately, I don't have all these details. But I would guess that the typical problems that we see in society that the elderly people don't know how to use modern technology, so they have to be assisted, a lot of things needs to be explained. And it depends on whether they have the information about the availability of an app, or if they have it available, how to navigate it better, like they can ask their family members because they are not so good in looking for information about modern technology and on the internet, I am sure of it. So they can either ask their relatives or the doctor, but it depends how knowledgeable and how helpful they are.	MHC
17	Researcher	So the next one is what benefits or challenges do you recognize that e-health can offer or put on elderly people?	

18	Respondent	Well, when it comes to benefits, definitely more continuous real time tracking of their physical condition, and of the progression of the illness or even prevention in some areas, it might be like, we were discussing while ago, we were talking about dementia. So maybe how this is evolving, and whether a doctor has to intervene beforehand, because some of those indicators, some of those markers are already pointing to something. So whether treatment and prevention and also the distances, for example, that an elderly person would have to cover if they wanted to visit doctors, sometimes it's not super necessary, and they can just stay at home and be monitored from distance. And only in case their health is deteriorated, they visit a doctor or the doctor visits them or vice versa. And when it comes to challenges, definitely the acceptance of the technology, the information about the fact that such a technology exists. Also, the possibility to buy it or to have it, first of all, to have a doctor to recommend a new technology, a new application for the elderly and then the fact that there is or there should be someone to pay for it. So for example, a health insurance company. So those are the challenges because sometimes they are not present.	MHB MHC
19	Researcher	Yes. And I think that's the last question. Do you think the current m-health applications in the world or specifically in your country, are well adapted to the elders needs or to the general customer?	
20	Respondent	I don't think so. I mean, general customer, that is something you said, in the end, maybe yes, but more towards younger people younger generations. But that doesn't mean that they are super adapted because younger generations are naturally more inclined towards using technology. So maybe it's just the fact that they are interested in new technology and are already well adapted to using it. So definitely, there is a huge need to adapt the technology that we use, including eHealth applications to the life and lifestyle of older people.	IOE
21	Researcher	Do you think is there like some sort of a way of thinking to give the elders so they can accept technologies more often, because I think for reading a lot of articles about e-health and the elderly, it always sum up the fact that they don't want or don't have the necessary knowledge to use such applications. Their way of thinking makes them not even bother using such applications in the first place.	
22	Respondent	I would say that, it's always important to have someone who they admire or look up to or respect as a professional. So potentially, the doctor might be the best place to start to explain to them the benefits, maybe even the challenges, but also in a way how to overcome them, so that they feel like they have all the information necessary to use it. And definitely someone like an assistance or something so that in case when they don't know what to do, or don't know how to turn an app on or switch the settings, change the settings, so that they can always contact someone, maybe on a phone or in person to help them. So definitely even patients from their relatives, doctors and other people, maybe	EAS IOE

		<p>some contact centers, client centers would be necessary. And you reminded me of a project I used to work on. In the past, it was about digital literacy of the elderly. So it wasn't directly connected to the topic. But there were some tips on how to help the elderly people be more digitally literate, and what changes were necessary. And there are things like you have to adapt a communication to the elderly people, because for example, if you talk about the benefits of an application for young people, it might be just speed, connection, sharing of information, being able to track your performance. This is all very cool. But it's not something that the elderly are interested in, unfortunately. So we have to change the context or the message to their needs. So there was an example that if you want them to use an email, then you have to talk about why they can use an email, talk about relatives who are not visiting, who do not visit them all the time. So you really need to talk about their lifestyle in specific. So I believe there could also be space to change the communication, so they really understand how it might facilitate their lives, not lives of the population in general. And to help them to train the use of the application in a sense, for example, by providing some workshops or individual consultations, or including their family members to directly supervise and help them.</p>	
23	Researcher	<p>I mean, elders have some sort of resistance toward technology, not m-health in particular, and they don't have much interest in using those applications. But we can help them to have such an interest. Most of us have parents and grandparents that are elders, so we can be that person who they look up to and help them in their journey to accept such technologies.</p>	
24	Respondent	<p>Yeah, and maybe also while thinking, my relative, an example from my environment, close environment, he's only 50. But we can already talk about an older generation. He never used a QR code scanner. And I knew that and I just showed him, do you know that you can just open the camera and just point it there and you can just open the menu or something. And he was so surprised how easy that is. And he was so grateful. Like, wow, this is really facilitating my life, thanks for showing me that, I really appreciate that. And he was so almost artificial, like, unnatural that he was so thankful for such an easy thing for young people.</p>	EAS
25	Researcher	<p>Yes. Also, like you mentioned, like some sort of family things. I had an aunt and grandmother and they used phones, which like the start of the android century where Android devices came with big screens and such. They always have that problem, I think that I've always tried to teach them, like swipe right to answer the phone, you do this here, you can read the name. But the problem is with my family, like most loved family members don't want to learn, like most of the time my grandmother or my aunt tells me I don't want to learn, I just want to do this. They will be like, yes, I want to answer the phone and just answer the phone, I don't want to send messages, I don't want to calculate anything, I don't want to take pictures. This problem with like, not</p>	

		wanting to learn. I'm from the Middle East. So there, the acceptance of technology is much worse, I think. But I don't know.	
26	Respondent	I come from a very very small town, So I know this feeling. And it's also very common in the town where I come from, for example, my grandma, it's the same like you were saying it's just the same. So it's not only the problem of the Middle East, but everywhere. And you brought me to an idea that even the application has to be I mean, has to have only the most basic functions for an elderly person, like you're saying they are not interested in taking photos, for example, they just want to have a call. So there's no need to have an icon or like picture anything, that functionality will just simply distract them. So having extra buttons and functionalities could be unnecessary for them.	TDA
27	Researcher	Yeah, I mean, there are like two things that are really important for them, guides for knowing what to do and having just like you said basic information. They don't want any fancy stuff, or high level tech things. They want something simple. Touch this to do this. And this will happen. And that's it. And we also should respect that. like most of them are over 60. So they learned too much in life. and for some of them what they learned so far is enough.	
28	Respondent	Their mindset is already like “ I don't want to learn anything because I've already learned everything I wanted and I need in life”, but they don't understand the change in the modern, modern world that they are gradually becoming really discriminated or, like Well, yeah, pushed from the society when they don't use some things, some technological devices or something.	EAS IOE
29	Researcher	And what is funny, I think entertaining to see is that for elders that use mobile devices and know how to use them, that they spend much more time than young people, because they find it really interesting and something that is really new to them. So they will be using applications like Facebook or Instagram and be more passionate than younger users.	
30	Respondent	it's possible but for other functions or different mindset or different needs. Like I couldn't imagine all the people stalking your family members who don't count for a visit very regularly.	
31	Researcher	Because just like we all know, technology is like we say in literature, English literature and Arabic literature. It's like a double-edged sword. it can be bad and it can be good. So we can choose which side today.	
32	Respondent	Yes, sure, sure. So that's why communication is very important, because you really need to help them understand how this can be useful, and why it is useful, why they are needed. I believe that when you explained this, and when you showed them that it also might be easy to use, they would be more inclined or more willing to use that. But you have to adapt all those details. Like we're saying, or also what comes to my mind, the screen on a phone has	EAS TDA

		to be larger, numbers have to be larger. Maybe it might need to be a bit lighter, so that they can carry it with themselves. Although, from my experience, my elder relative forgets about the phone all the time, but at least we can put in the effort.	
33	Researcher	Thank you for all these insights. It was like a really good amount of information and knowledge from you. Thanks.	
34	Respondent	Thank you. I mean, I found it very entertaining, to be honest. Very interesting. So thank you for contacting me and hopefully this is going to be useful for you. Good luck with your thesis	
35	Researcher	Thank you, Bye.	

Interview 7

Row	Person	Transcription	Code
	Researcher	Can you introduce yourself and describe your area of expertise and work?	
	Respondent	Hi, I'm [Respondent Name] and currently working at a large IT-consultant company in [Companies Location]. My area of expertise is e-health with specific focus on improving customer experience connected usage of electronic health journals. I studied cognitive science at the university of [University name] and brought that perspective with me to my professional life.	
1	Researcher	Do you think that being user-friendly is important for your applications?	
2	Respondent	That's a very leading question. Of course. Yes, I do.	TDA
3	Researcher	Do you use accessibility guidelines for your app development?	
4	Respondent	I personally haven't been involved in app development. But I have been involved in projects where we have an app that needs to conform to different standards. And one of them is EU standards specially made for accessibility for older people, for example, or people who don't see so well, and yeah, so when I work in those projects, I have come across these standards. And they are, I think they are the one that's coming along that you have to have reached this usability standard, high level of it to be able to sell the product, because this is a medical/technical product.	TDA
5	Researcher	Is the user's feedback important for developing your applications?	
6	Respondent	Yes, of course, especially in this day and age, if we don't gather feedback, then we won't know if what we're doing is good. And one of the main main steps in app development or other kinds of development nowadays is to have a final phase called the learning phase. That's when we gather the information, gather the feedback, and see how to know I'm sorry, before the learning phase we have the measuring phase, so that we measure. So before we send out the product also, we check for what variables we are going to measure. And from there, we then couple that with the feedback and improve for the next iteration.	TDF
7	Researcher	Thank you, Do your applications include some sort of guidelines/assist for people who find it harder to use them?	

8	Respondent	If this app is supposed to be used by, for example, people that are elderly, elderly people, if they are one of the targets, target users, then yes, we will consult them in some way, somehow during the process, but it can. It's not always. It's not a must. But that's how we usually do it. Yes.	IOE
9	Researcher	Are elderly people included in your current or previous customer group?	
10	Respondent	Yes, they are.	IOE
11	Researcher	Can you give me an example of a previous experience you have?	
12	Respondent	Absolutely. We have one app that helps with their telehealth. Telehealth, which is like health monitoring while the patient is at home, and, for example, the physician is at the hospital or the clinic. the physician will be able to monitor the patient's health even when they're not nearby. And most of those users are elderly people. Because those are the ones that need the most assistance with that.	MHB IOE
13	Researcher	So, for the next one, Do you put emphasis on elders' needs while developing applications?	
14	Respondent	A I'm not sure I understand the question but I think no, if they're not a target user, then we won't really focus on them. But like I said earlier, there is the standard that you have to fulfill to be able to sell the whole product, because there's a physical part to it also. And to sell that and be classified as a medically technical product, then it has to fulfill those standards, and one of them is to have it taken into consideration and make it readable for elderly people and usable for them also.	IOE
15	Researcher	So for the next, what challenges did you discover while integrating elder needs in product development?	
16	Respondent	And that's a bit hard for me to answer because I haven't worked with development directly. So I don't really know what challenges they have met, my colleagues worked on that part. Because I can't really answer that. Sorry.	
17	Researcher	Do you include elderly people while testing the applications?	
18	Respondent	Yes, I think they did. I'm pretty sure they did.	IOE
19	Researcher	What are the main aspects of your applications that are important to older people?	
20	Respondent	Readability, they must be able to read and understand. So we can, for example, have two fields that are similar in name and usage. If they're too similar, then it will be difficult for them to differentiate and understand what	TDA

		they're gonna register well. And also readability, usability. So, yeah, usability and readability. The font should be clear, the colors should be clear. Yeah, the elements, icons should be clear. Things like that.	
21	Researcher	What benefits do you recognize that m-health applications can offer to elderly people?	
22	Respondent	What benefits do I think there's one more time to repeat it?	
23	Researcher	What benefits do you recognize that mobile health can offer to elderly people?	
24	Respondent	Ah, yeah. Okay. Because you used the term M-health we use eHealth. Yeah, that's why I was confused. Yeah. A lot of benefits. How the society is moving right now, it's moving towards fewer doctors, fewer stations, fewer nurses, but larger and larger, older population. And that's an issue because then we can't offer good standardized health care for these elderly people that are increasing, and the workforce is decreasing. And that means that more, they will have a lot of pressure on their physicians and nurses and health care personnel. So the benefits are that the elderly people will be offered better health care for them by having these new solutions that are tailored S towards them, for example, telemental health, like one, one nurse can monitor several people at their own house so the elderly don't have to take the bus and get into the clinic just to get a blood pressure test. They can do that at home and save time and money and headache, for example.	MHB
25	Researcher	Okay, so for the last question, do you think that m-health applications are well adapted to elderly people?	
26	Respondent	No, I don't think so. I haven't seen so many but the ones I have seen are usually lacking in usability. Usually, elder people need a specific view or a specific presentation for them that is tailored to their shortcomings so to speak. They don't see so well, they don't hear so well, and sometimes they don't understand so well either. And the apps today, they're not really tailored for that target to be as much as I think they need. I think there's still a lot of progress that needs to be made. And one of those things that will enable this progress is this new EU standard and requirements for and but that is for health products. I'm not sure if that also applies to applications, but I think so. I think they do.	MHC TDA IOE
27	Researcher	Yeah, I mean, like, that's one problem we faced along the way for finding people that we want to interview. Is the lack of people that are specifically experienced in the elderly. That was one problem, a problem. And I think it was a limitation for us. There's like little amount of people that specialize in that area, especially in m-health and elderly.	

28	Respondent	Yeah, I can understand that little bit. There's a lot of money in elder healthcare, but it's not very popular. It's not a very cool area. And people who drive businesses and startups and investors would rather invest in something that will. Yeah, I think it's not really popular to work in that area. So people don't focus on that. But it's important and It's gonna get more important as the society changes going forward.	IOE
29	Researcher	I think that is all the questions I needed to ask you.	
30	Respondent	Okay, thank you.	

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