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Age-appropriate user experience in the digital transformation - technology acceptance of seniors and the UX implications for prescription digital health applications

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Abstract

This thesis explores the acceptance and user experience of prescription digital health applications (DiGA) among seniors, within the broader context of digital transformation in healthcare. With a rapidly aging population and the concurrent shortage of healthcare professionals, digital solutions like DiGA offer a promising alternative to traditional care methods. This study employs a mixed-methods approach integrating qualitative expert interviews, a quantitative survey of seniors, and an evaluation of existing DiGA applications to assess both the technological acceptance and the user experience among the elderly. Findings indicate that while there is a general openness among seniors towards using digital health technologies, significant barriers related to usability, privacy concerns, and the integration of these technologies into daily healthcare routines remain. The thesis concludes with recommendations for improving DiGA design and implementation, to enhance acceptance and effectiveness, thereby supporting seniors in managing their health independently and more effectively.

Keywords: Age-appropriate, user experience (UX), technology acceptance, senior citizens, digital health applications, DiGA, prescription apps, technological transformation, healthcare, acceptance factors, user-friendliness, user needs, age-specific requirements, influencing factors, usability, healthcare, senior health, healthcare technology

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List of Abbreviations

BfArM	German: Bundesinstitut für Arzneimittel und Medizinprodukte
BfDI	German: Bundesbeauftragte für den Datenschutz und die Informationsfreiheit
BSI	German: Bundesamt für Sicherheit in der Informationstechnik
DiGA	German: Digitale Gesundheitsanwendungen
DiGAV	German: Digitale Gesundheitsanwendungen-Verordnung
DVG	German: Digitale-Versorgung-Gesetz
EDI	Employee-Driven Innovation
EEA	European Economic Area
eGK	German: elektronische Gesundheitskarte (electronic health card)
ePA	German: elektronische Patientenakte (Electronic patient file)
EU	European Union
GDPR	General Data Protection Regulation (EU)
ISO	International Organization for Standardization
LCDP	Low-Code Development Platform
MINT	German: Mathematik, Informatik, Naturwissenschaften,Technik
SGB	German: Sozialgesetzbuch
UX	User Experience
CTA	Call-To-Action

1 Introduction

The healthcare industry is currently facing a significant challenge: a widening gap between the rising need for medical services, especially in societies with an aging population, and a decreasing number of healthcare professionals. Germany, with its sophisticated medical treatments and strong healthcare infrastructure, is no exception. This mismatch has become especially pronounced in nursing homes and other care facilities, where headlines often highlight the shortage of nursing staff. Compounded by a demographic shift characterized by an aging population and a declining birth rate, Germany faces a structural transformation that threatens the sustainability of its healthcare system. The increasing life expectancy, thanks to medical advancements, improved living conditions, and preventative healthcare measures, coupled with a falling birth rate, signals a looming crisis of insufficient workforce to meet the healthcare needs of the population. The issue of understaffed care facilities has sparked widespread concern, pointing to a deeper systemic problem that requires innovative solutions. Amidst this backdrop, the adoption of digital solutions emerges as a potential remedy. The recent authorization by the state allowing Digital Health Applications (German = digitale Gesundheitsanwendungen = DiGA) to be prescribed medically marks a pivotal step towards integrating digital innovation into healthcare delivery. This initiative raises critical questions about the readiness of the elderly population to embrace such digital interventions. Will seniors accept and utilize these digital solutions effectively? The exploration of this question forms the crux of this research, delving into the technological acceptance among seniors and its implications for the user experience (UX) in utilizing prescription-based digital health applications.

1.1 Problem definition

The challenge of aligning healthcare services with the needs and preferences of an aging population is multifaceted. The introduction of DiGAs represents a significant shift towards digitalization in healthcare, aiming to bridge the gap between the demand for care and the availability of healthcare professionals. However, this shift raises several critical questions: Are seniors ready to adopt these digital health solutions? How does the demographic shift impact the implementation and effectiveness of such digital interventions? The problem of inadequate staffing in care facilities is symptomatic of a larger structural issue within the healthcare system, exacerbated by demographic changes.

This research seeks to examine the viability of DiGAs as a solution to this problem, focusing on the acceptance and usability of these applications by the senior population. The study aims to investigate whether seniors possess the necessary digital literacy and openness to integrate these technologies into their healthcare routines. Furthermore, it explores the user experience of seniors with DiGAs, assessing the effectiveness of these applications in meeting their health needs and enhancing their quality of life. The overarching goal is to understand the potential of digital health solutions to mitigate the workforce shortage in care settings, thereby contributing to the resilience and sustainability of the healthcare system in the face of demographic challenges.

By examining the intersection of technology acceptance, user experience, and demographic trends, this research offers insights into the role of digital health applications in shaping the future of healthcare delivery for an aging population.

1.2 Delimitation

The review of existing literature quickly reveals that mHealth apps have been extensively tested, particularly in the domains of diabetes and diet. There is a wealth of studies evaluating the efficacy, usability, and acceptance of these apps across the general population. However, a gap in research emerges when considering the integration of digital solutions with a demographic that is stereotypically known for its skepticism or outright rejection of modern technologies: the elderly. While rapid trends and developments in digital health care continue to emerge, they are rarely tailored specifically to the needs and preferences of older individuals or tested on this demographic. Consequently, aspects of User Experience (UX) research, crucial for designing user-friendly and effective applications, often appear belatedly or insufficiently in app development for seniors.

This thesis distinguishes itself from existing research by linking digital solutions – specifically Digital Health Applications – with a demographic that has been limitedly focused on in mHealth research to date. By focusing on the technology acceptance and UX of DiGA apps among seniors, this work ventures into a relatively unexplored territory. It investigates how older individuals adopt and use digital health solutions, and what specific requirements and barriers exist regarding user experience. This interface research between technology acceptance, User Experience, and the specific user group of seniors does not currently exist in this form in the scientific discourse. By offering this specialized examination, the work contributes to enhancing digital inclusion of the elderly in health care and provides crucial insights for the development of future age-appropriate digital health applications.

1.3 Objective

The aim of this Master's thesis is to explore whether digital solutions, specifically mHealth apps, present a legitimate and practically usable means to bridge the structural transformation and the associated shortage of skilled professionals in the medical field, triggered by demographic shifts. Central to this examination are the specific User Experience requirements of older user groups, which are often inadequately addressed in the current development of health applications. Specifically, this thesis pursues the following objectives:

- Evaluation of Technology Acceptance: To investigate the willingness of older individuals to incorporate mHealth apps into their healthcare regimen, identifying motivational factors and potential barriers that could influence the acceptance and thus the usability of these digital solutions.
- Analysis of Seniors' User Experience: To explore the extent to which the design of mHealth apps meets the unique needs and requirements of older users. This involves identifying specific UX elements that could enhance the usability and thereby the effectiveness of the apps for this demographic.
- Assessment of the Potential of mHealth Apps: To evaluate how mHealth apps could contribute to bridging the gap in healthcare workforce by enabling older individuals to manage their health independently, potentially reducing the workload on medical personnel.
- Development of Design Recommendations: Based on the findings of the study, to derive practical recommendations for the development of mHealth apps that ensure higher acceptance and better user experience for seniors.

By focusing on the specific UX needs of older individuals, this thesis aims to contribute to the improvement of digital healthcare provision. It seeks to close the gap between technological advancements and the real-world requirements of this important, yet often overlooked, user group. By laying the groundwork

for a more inclusive and effective use of digital health solutions, this Master's thesis simultaneously addresses current challenges in the healthcare sector and opens avenues for future research in this field.

1.4 Structure

The structure of this thesis is designed to meticulously navigate through a comprehensive exploration of key domains such as structural demographic transformation, skilled labor shortage, seniors' needs, prescription apps, and user acceptance research. This groundwork paves the way for developing a unique research model tailored to address the intricacies of digital health application usage among seniors. Subsequently, the thesis employs three empirical methodologies to enrich the investigation.

Initially, a qualitative analysis of expert interviews with prescribing physicians provides deep insights into the practicalities and perceptions surrounding the prescription of digital health applications. This is followed by a quantitative survey aimed at seniors, designed to gauge their readiness, willingness, and potential barriers they perceive in adopting such digital health solutions. The third methodology undertakes a User Experience evaluation of mHealth apps, assessing how well these digital tools meet the specific usability needs of older adults.

The culmination of the thesis presents a discussion and implications of the work conducted, providing a critical retrospective examination of the findings and methodologies applied. This section not only synthesizes the key insights garnered through the empirical studies but also situates them within the broader context of digital health innovation, policy-making, and gerontologic acceptance. Through this structured approach, the thesis aims to contribute significantly to the discourse on enhancing healthcare delivery and digital inclusivity for the elderly demographic, amidst the challenges posed by structural shifts and workforce shortages in the medical field.

2 Semantic Exploration within the Context of the Topic

The present master's thesis is centered on the topic of developing age-appropriate applications within the digital transformation context. Specifically, it investigates the acceptance of technology by older individuals, hereafter referred to as seniors, and its impact on the user experience within prescription-based digital healthcare applications. The growing digitization and increased usage of healthcare applications constitute a significant development in the healthcare sector. However, the effective integration and utilization of these digital solutions by older demographic groups are crucial for maximizing health benefits and promoting an healthy lifestyle in later years. The current theoretical section aims to define the thematic framework of the master's thesis and emphasize the importance of the study. Subsequent sections will provide insight into the demographic context and various conceptual discussions. The technology acceptance of seniors will be examined within the context of digital healthcare applications, followed by an analysis of its effects on the user experience. Relevant theoretical approaches and recent research findings will be utilized to achieve a comprehensive understanding of this complex subject area.

2.1 Demographic Shift in Germany

The demographic transition characterizes changes in a country's population size and structure. This process is influenced by three key factors: life expectancy, birth rates, and migration patterns.[1, 2]

Life expectancy is defined by Mortality, also called the death rate, refers to the annual recorded deaths in a country, categorized by age and sex. Birth rates are determined by fertility. Fertility pertains to a nation's reproductive capacity, encompassing both the number of live births and the female population within childbearing age (15 to 45 years). Migration, also known as mobility, denotes the act of relocating one's primary residence from one location to another. This relocation may occur within a country's borders (internal migration) or span across national boundaries (international migration).[3, 4, 5]

In Germany, life expectancy has consistently increased due to medical advancements, improved hygiene standards, preventative measures, better working conditions, and reduced mortality across various age groups.[6, 7] Statistics from the Federal Statistical Office predict that the proportion of seniors in the population will increase in comparison to other age groups, and the average age in Germany will rise by ten years between 2010 and 2060.[8] The increase in life expectancy results in longer periods of

[1] cf. Göke/Heupel 2013, p. 2f

[2] cf. Bohk 2012, p. 43f

[3] cf. Saß 2015, p. 435ff

[4] cf. Scharein 2012, p. 23f

[5] cf. Bundeszentrale für politische Bildung 2021

[6] cf. Göke/Heupel 2013, p. 29

[7] cf. Buttler 2003, p. 94

[8] cf. Statistisches Bundesamt (Destatis) 2023

retirement, while an increasing number of retirees are supported by a diminishing workforce. Consequently, the pay-as-you-go statutory pension system is under substantial pressure to adapt.[9, 10] Another facet of demographic change in Germany is the decreasing birth rate, resulting from lifestyle-shifts like individualization and emancipation. The average birth rate has decreased from over 2 in 1920 to 1.46 in contemporary Germany.[11] Consequently, in recent years, the mortality rate has surpassed the birth rate. Even a slight increase in the birth rate to 1.6 children per woman in 2013 was insufficient to reverse this trend. In fact, the birth deficit reached its peak in 2013, with 212,000 more deaths than births, and it is projected to increase to 500,000 by 2050.[12, 13]

As a whole, the demographic change in Germany is already perceptible, with the population stagnating. Views from Pötsch/Rößger 2015 and Preißing 2014 suggest that neither immigration nor a moderately increased birth rate can offset this deficit.[14, 15] If the declining population trend continues or worsens, Germany could shrink from over 80 million to 67.6 million people (with lower immigration) or 73.1 million people (with higher immigration) by 2060.[16]

These estimates from the literature, however, are not infallible. In July 2023, there is a net migration surplus of approximately 41,000 individuals in Germany (July 2022: 66,000). This net migration, in particular, can be attributed to the arrivals of asylum seekers from Ukraine due to the ongoing Russian invasion since late February 2022. Without the unforeseen increase in net migration, the total population in Germany would shrink due to declining birth rates and increasing mortality rates. [17, 18]

This demographic transition has whatsoever significant impacts for various aspects of society, including healthcare.[19, 20]

2.2 Analysis and Implications of the Shortage of Skilled Workers in the Medical Healthcare Sector

The demographic evolution in Germany has substantial implications for the labor market. Specifically, the diminishing workforce pool tangibly influences businesses. The demographic shift results in an aging

[9] cf. Preißing 2014, p. 23f

[10] cf. Hackmann/Moog 2009, p. 85

[11] cf. Statistisches Bundesamt 2023a

[12] cf. Pötsch/Rößger 2015, p. 17

[13] cf. Pompe 2011, p. 15

[14] cf. Pötsch/Rößger 2015, p. 17

[15] cf. Preißing 2014, p. 23f

[16] cf. Statistisches Bundesamt (Destatis) 2023

[17] cf. Statistisches Bundesamt 2023b

[18] cf. tagesschau.de 2023

[19] cf. Pötsch/Rößger 2015, p. 6

[20] cf. Nagel-Jachmann/Schirmer 2016, p.14f

workforce, particularly prominent in the healthcare sector, thereby altering the composition of employees.[21, 22] Germany, as an export-oriented nation, relies on its strengths in technology and innovation. The rapid pace of technological advancement and ongoing structural changes continuously elevates qualification demands within the workplace.[23] Businesses depend on the innovative prowess of the technology sector, pharmaceutical industry, and medical technology to ensure Germany's competitiveness.[24] A scarcity of skilled professionals in these domains not only affects the competitiveness of German companies but also reverberates across healthcare and the broader economy. Notably, the demand for professionals in the MINT fields (Mathematics, Computer Science, Natural Sciences, and Engineering) is poised to experience significant growth, as they constitute the primary drivers of innovation in Germany.[25, 26] According to the Trend Report from IW Köln, there currently exists a shortage of 308,400 MINT professionals in the German labor market.[27] This shortage has adverse repercussions for companies, leading to production bottlenecks due to understaffing, incurring time and cost expenditures through product or service acquisition or outsourcing, impairing competitiveness, and expanding the competitive landscape. The scarcity of skills not only jeopardizes the growth of individual companies and the overall economy but also results in a loss of knowledge acquisition.[28]

The Prognos study 'Arbeitslandschaft 2035' anticipates an increase in labor demand by 2030, particularly in research, consulting, the service sector, healthcare, and social services.[29] The combination of rising life expectancy and medical advancements contributes to a surge in individuals requiring care. The most significant skills shortage is foreseen in healthcare, social services, and teaching professions. Consequently, a mismatch arises, creating an imbalance between labor demand and supply, indicating that, from an employer's perspective, the demand for skilled professionals is both quantitatively and qualitatively higher than the available or existing workforce potential in the labor market.[30]

Multiple McKinsey studies align with the Prognos study 'Work Landscape 2035' in forecasting a skills shortage of 700,000 professionals in Germany in the fields of healthcare and MINT for the year 2030.[31, 32]

The “Engpassanalyse der Bundesagentur für Arbeit” corroborates the foundational assumptions made. Despite increased workforce participation by women and older individuals, shortages are already

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[21] Cf. Gattnar 2020, p. 282f

[22] Cf. Pischke 2012, p. 45

[23] Cf. Preißing 2014, p. 22

[24] Cf. Nagel-Jachmann/Schirmer 2016, p. 9-26

[25] Cf. Anger/Betz/Plünnecke 2023, p. 63ff

[26] Cf. Schirmer 2016, p. 22

[27] Cf. Anger/Betz/Plünnecke 2023, p.64

[28] Cf. Prezewowsky 2007, p. 36

[29] Cf. Ehrentraut/Vereinigung der Bayerischen Wirtschaft e.V. 2019, p. 12f, 15f, 20, 38

[30] Cf. Hieronimus et al. 2023, p. 3-7

[31] Cf. Lund et al. 2021, p. 112

[32] Cf. Hieronimus et al. 2023, p. 6ff

emerging in certain professional groups, such as healthcare and elderly care.[33] The Bundesinstitut für Berufsbildung predicts an insufficient supply of skilled professionals in social service professions, encompassing technical-scientific academic occupations as well. The institute proposes more intensive training for employees as a potential solution.[34] [35]

Considering all these studies, including those by the Institut für Arbeitsmarkt- und Berufsforschung and the Bundesinstitut für Berufsbildung, along with the 'Arbeitslandschaft 2035' study, there is a clear consensus that a shortage of skilled professionals is already noticeable and will persist in the healthcare and social service sectors.[36, 37, 38, 39] Furthermore, these models predict that the retirement of the Baby Boomer generation will further increase the demand for skilled professionals.[40] This includes medical institutions, which, as entities in the future, are challenged to address the shortage of personnel in an aging workforce through appropriate frameworks or other measures to circumvent structural changes and ensure an adequate supply of qualified professionals.[41] Given that this structural shift affects the entire population, an increased number of older patients is also apparent due to a shortage of successors. To illustrate the existing example of demographic change and skill shortages in Germany, the situation of care-dependent individuals can be considered. Driven by the progressively aging population in Germany, the number of care-dependent individuals is rising, while the number of caregivers is decreasing.[42] This is attributed to the retirement of older caregivers and the shrinking younger demographic resulting from demographic trends. Moreover, significant reductions in nursing staff occurred between 1999 and 2006 due to the economization of hospitals.[43] This led to fewer nursing staff having to care for more patients. [44, 45]

To address the resulting imbalance in workload, new solutions must be introduced. Digital solutions could be considered as supportive tools to increase the efficiency of patient care and rectify the imbalance.

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[33] Cf. Kolodziej/Deutscher Bundestag 2011, p. 13-20

[34] Cf. Bundesinstitut für Berufsbildung/Maier 2023

[35] Cf. Schönfeld et al. 2023, p. 1

[36] Cf. Institut für Arbeitsmarkt- und Berufsforschung et al. 2022

[37] Cf. Bundesinstitut für Berufsbildung/Maier 2023

[38] Cf. Kolodziej/Deutscher Bundestag 2011

[39] Cf. Ehrentraut/Vereinigung der Bayerischen Wirtschaft e.V. 2019

[40] Cf. Gerhards/Ebbinghaus 2014, p. 3

[41] Cf. Suder/Killius 2011, p. 11

[42] Cf. Nowossadeck 2013, p. 1040f

[43] Cf. Haefker/Tielking 2017, p. 33f

[44] Cf. Gattnar 2020, p. 274

[45] Cf. Berberich 2022, p. 102

2.3 The Relationship Between Seniors and New Media

Digitization, robotics, and automation represent facets of technological change, each exerting multifaceted influences on the labor market and the very concept of work itself. The term 'work' or 'Industry 4.0' encapsulates the concept of the fourth industrial revolution, which has catalyzed a profound societal transformation. Over recent years, numerous aspects of daily life have become increasingly digital, spanning from personal communication, access to real-time information, administrative procedures, and appointment scheduling. This global trend has undergone further acceleration. The constraints imposed by the pandemic in the early 2020s expedited the digitalization of additional facets of life. Examples now abound, such as medical consultations conducted via video conferencing, vaccine certifications stored on smartphones, and the registration for events or even the simple act of patronizing a café—all of which frequently necessitate the possession of a smartphone or at the very least, access to an online platform. Furthermore, the most recent technological advancements in the field of artificial intelligence have taken center stage in the mass-media.

In comparison to other demographic groups, the elderly, particularly those in the age group of 70 and above, display a greater tendency away from innovative technologies and more towards the extensive utilization of traditional media forms, including television and printed newspapers. Their media consumption patterns are primarily guided by enduring routines, marked by a consistent commitment to established modes of media reception. In contrast, their interaction with digital mediums, such as computers, the internet, and smartphones, is notably limited. Hence, some literature suggests that the digital media transformation has not permeated the same extent within the elderly population as it has among younger groups.[46]

To explain this, research within the field of “elderly media usage” employs various theories.[47] Looking at it from an economic and structural perspective, the willingness to embrace new technologies hinges on a cost-benefit calculation, comparing the subjectively perceived utility with the degree of difficulty in acquisition.[48, 49]

In culturalist approaches, the "media generations" concept, which is based on Mannheim's ideas, suggests that fundamental processes of learning, appropriation, and action concerning media are shaped through socialization processes.[50] [51] [52] Acquired dispositions toward a specific "leading media technology" remain largely stable throughout one's life due to biographically acquired experiences and habits, encouraging "specific modes of perception and interaction" in terms of media consumption and utilization.[53] In instances where individuals used to analog media begin to adopt digital offerings, it can be

[46] Cf. Bundesministerium für Familie, Senioren, Frauen und Jugend 2010, p. 147

[47] Cf. Kolland/Wanka/Gallistl 2019, p. 1-19

[48] Cf. Davis/Venkatesh 1996, p.19-45

[49] Cf. Pelizäus 2013, p. 386

[50] Cf. Prommer 2016

[51] Cf. Mannheim 1964, p. 509–565

[52] Cf. Hartung-Griemberg/Schorb/Kuttner 2013, p. 41-64

[53] Cf. Hartung-Griemberg/Schorb/Kuttner 2013, p. 33, 37

presumed that the media-consuming subject adapts them "with an implied logic of action rooted in experiences with analog media".[54]

Another perspective falls under the rubric of Bourdieu's "media habitus".[55, 56, 57] Here, a lifelong process of psychogenesis is focused on, concerning the development of everyday behavioral patterns, forms of practice, and behavioral strategies. Despite their pronounced stability, these routine patterns of conduct are considered flexible when life contexts.[58] Consequently, there is room to question whether individuals genuinely acquire a relatively fixed routine of media behavioral logics throughout their biographies.[59] With alterations in life circumstances and situations, it is conceivable that the media behaviour undergoes transformations in old age.[60] Accordingly, attitudes toward specific media offerings and the willingness to use them may experience shifts.

A social science theory that models media consumption as highly individualized and differentially structured is the "Uses-and-Gratifications" approach originally conceived by Blumler and Katz.[61, 62] According to him, media actions result from purposeful and selective actions that are goal-oriented and emerge from personal daily life.[63, 64] Sociodemographic factors, such as age, gender, and education, serve as preliminary indicators that allow for the identification of a degree of IT affinity.[65, 66]

Nevertheless, these factors may offer an incomplete perspective and only address a portion of the underlying reasons. Alongside situational contexts, other personality-related aspects (e.g., values, beliefs, experiences, social networks) need to be considered. Needs, as a general sense of lack, and motives, as individual problem situations for which media usage can serve as a problem-solving strategy, follow this complex origin.[67] In the highly diverse field of Uses-and-Gratifications research, motives are defined more pragmatically as the starting point for perceived purposes of use and as everyday, meaningful incentives that can then lead to gratifications, which fulfill usage intentions and goals.[68] This thesis is based on this perspective.

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[54] Cf. Schäffer 2009, p. 42

[55] Cf. Biermann 2009, p. 51-59

[56] Cf. Fröhlich/Rehbein 2014

[57] Cf. Bremer/Lange-Vester/Vester 2014

[58] Cf. Schorb/Hartung/Reißmann 2009, p. 28-41

[59] Cf. Hartung-Griemberg/Schorb/Kuttner 2013, p. 54

[60] Cf. Biermann 2009, p. 58

[61] Cf. J. Blumler/E. Katz 1975

[62] Cf. K. Rosengren/L. Wenner/Philip C. Palmgreen 1985

[63] Cf. Schorb/Hartung/Reißmann 2009, p. 73-80

[64] Cf. Sommer 2019, p. 50

[65] Cf. Statistisches Bundesamt 2019

[66] Cf. Moritz Büchi/Natascha Just/Michael Latzer 2015, p. 8

[67] Cf. K. Rosengren/L. Wenner/Philip C. Palmgreen 1985

[68] Cf. Schorb/Hartung/Reißmann 2009, p. 73-80

In older age, it is presumed that motives for (non-)use of certain media interact with a dynamic interplay of developmental losses or gains and personal coping strategies and approaches to aging.[69, 70, 71] If older individuals associate meaningful and practical benefits with new media (e.g., expanded opportunities for participation), the perceived hurdle of acquisition is lower. [72, 73]

Beyond theoretical assumptions and quantitative studies on media use (e.g. Various studies [74, 75, 76, 77, 78 etc.]), empirical evidence exploring the significance of the medium in everyday life worlds is lacking.[79] Based on this exploration, it attempts to determine under what conditions individuals in their 70s and above turn to new media in later life and what specific characteristics this usage exhibits. In this context, occasions and motives in the process of media adoption need to be considered.[80] That said, Schmidt et al. list promoting factors at the environmental and personal level.[81] In addition to the importance of value-added communication, the consideration of individual wishes and needs is emphasized. Overall, great potential is therefore seen in self-efficacy, support structures and the efficient satisfaction of needs through the use of new technologies for seniors.

2.4 Conceptual Exploration of the Terms Telemedicine, Digital Health, eHealth, mHealth and Medical Apps

The previous sections have shown how technological progress can help address changes in structure. It's also clear that people might need to change how they use new media. In real life, many different strategies have been tried over the past few decades. The next section will break down the terminology used and explain what this study is focusing on. Over the years, there have been many terms related to information and communication technology (ICT) in healthcare. The boundaries between these terms are often blurry in academic discussions, which can make it difficult to define them clearly. Therefore, this section aims to give a basic overview of the main terms first, followed by more detailed explanations in later parts. We'll start by sorting them out using the framework proposed by Angerer, Bauer, and Adetunji, as shown in the diagram below.[82, 83]

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[69] Cf. Schorb/Hartung/Reißmann 2009, p. 76

[70] Cf. Mares/Woodard 2006, p. 598

[71] Cf. Heyl 2015, p. 214f

[72] Cf. Bundesministerium für Familie, Senioren, Frauen und Jugend 2020

[73] Cf. Kubicek/Lippa 2017, p. 186f

[74] Cf. Kubicek/Lippa 2017

[75] Cf. Bundesministerium für Familie, Senioren, Frauen und Jugend 2020

[76] Cf. Hartung-Griemberg/Schorb/Kuttner 2013

[77] Cf. Schäffer 2009

[78] Cf. Pelizäus 2013

[79] Cf. Hartung-Griemberg/Schorb/Kuttner 2013, p. 41

[80] Cf. Doh et al. 2016, p. 49f

[81] Cf. Doh et al. 2016, p. 19-36

[82] Cf. Angerer et al. 2017, p. 8

[83] Cf. Bauer 2018, p. 8

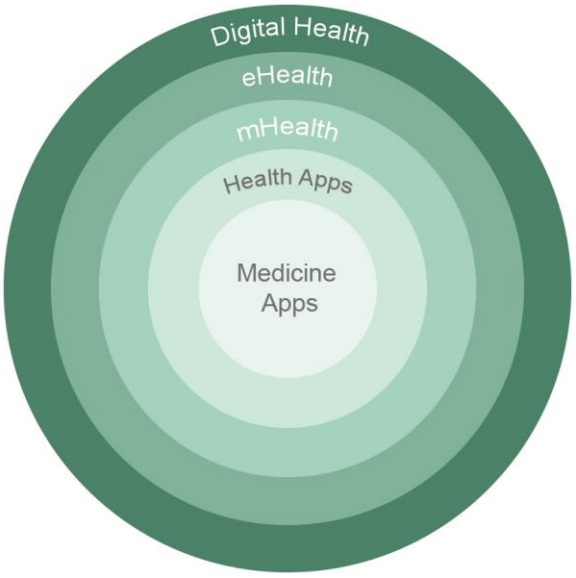

Figure 1 Terminological definition of apps. Own representation based on Angerer and Bauer (see Angerer et al. 2017, p. 8; see Bauer et al. 2016, p. 8).

The concept of health telematics involves utilizing information and communication technology to connect various information systems within the healthcare sector. One aspect of this field is telemedicine, which includes specialties like teleradiology, telecardiology, teleneurology, among others.[84] Another area is telehealth, which focuses more on health-related services rather than medical ones. As the World Wide Web developed, e-health emerged, emphasizing data management and electronic processes within healthcare systems. According to Fischer and Krämer, "Health telematics emphasizes the use of ICT to overcome spatial and temporal distances, while e-health encompasses various digital applications in healthcare." [85] The rise of smartphones has added a mobile dimension to e-health, leading to the term mHealth for mobile processes within e-health. With the rapid digitization of healthcare, terms like digital health, smart health, connected health, intelligent health, health 2.0, and medicine 4.0 have surfaced. Among these, digital health encompasses all digital innovations and advancements in healthcare and is the most widely used term.[86]

According to Istepanian and Woodward, the four main areas of ICT in the healthcare industry are Telemedicine, Telehealth, E-Health, and mHealth.[87] Angerer, Schmidt et al., on the other hand, group all these terms under Digital Health.[88] The World Health Organization (WHO) also consolidates the terms

[84] Cf. Adetunji et al. 2022, p. 158f

[85] Cf. Fischer/Krämer 2016, p. 6

[86] Cf. Bauer 2018, p. 9ff

[87] Cf. Istepanian/Woodward 2017, p. 3f

[88] Cf. Angerer et al. 2017, p. 8

E-Health and mHealth under Digital Health, along with free ICT.[89] Therefore, literature reveals the absence of uniform definitions for the above-mentioned terms.[90] Consequently, comparability is hindered, which is why the terminology in this work is only presented and not extensively elaborated.

The following figure attempts to illustrate the chronological development of the before mentioned terms and their importance to this paper visualized with the diameter of the circles.

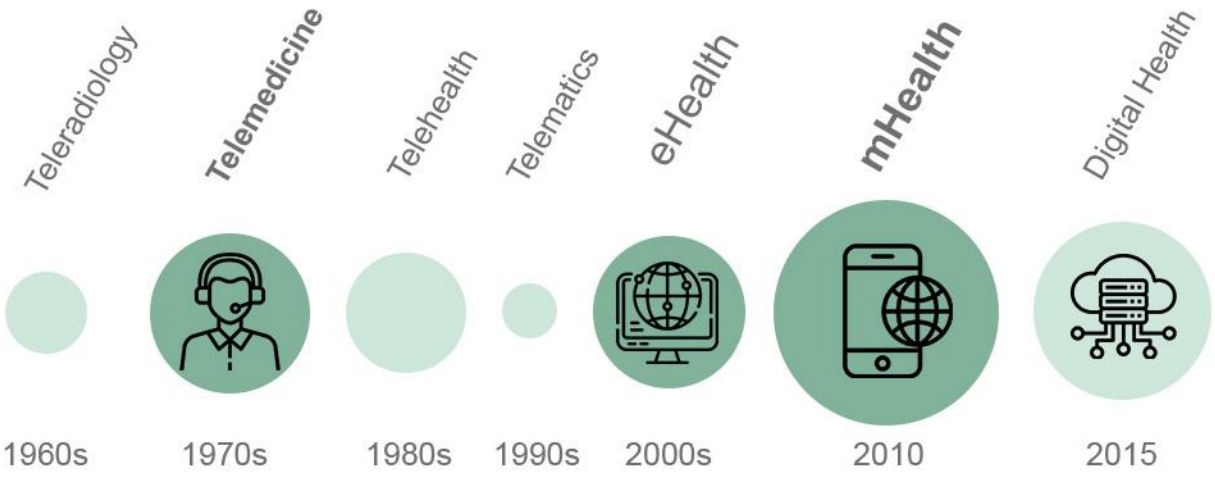

Figure 2 Development of ICT in medicine over time. Own illustration based on Angerer et al (2017) and Kramer/Vollmar (2017).

In the early days, telephone calls were the initial means of communication used in radiology to share medical findings. The 1970s saw the emergence of Telemedicine, enabling medical care to be extended over larger distances. Regions with scarce medical resources or expertise gaps could now access assistance from other institutions. As the internet became more widespread and e-business gained popularity, a surge in E-Health applications was noted around the turn of the millennium. Presently, digital health services are rapidly advancing, offering cutting-edge solutions for healthcare delivery.[91]

According to Scheermesser/Meidert et al.(2018), the concept of "health" can vary, acknowledging that perceptions of health and well-being are subjective and may vary from one individual to another based on factors like gender-related variations in cold tolerance, pain sensitivity, and immune system resilience. This study synthesizes various definitions to conceptualize health as encompassing total physical, mental, and social well-being, along with optimal functionality in the absence of illness or abnormalities.[92]

In this work, several definitions (see Appendix A) have been synthesized to conceptualize health as the state of complete physical, mental, and social well-being, along with optimal performance of an individual, in the absence of any illness or other pathological changes. In contrast, health can be viewed as an ongoing process, where an absolute state of health does not exist. Health can also be seen as an

[89] Cf. World Health Organization 2023

[90] Cf. Kramer/Vollmar 2017

[91] Cf. Istepanian/Woodward 2017, p. 5f

[92] Cf. Scheermesser et al. 2018, p. 57f

ongoing process without a fixed state of health. A more detailed examination of the development and maintenance of health is provided by salutogenesis, which was developed by Antonovsky (1996).[93, 94]

Health Telematics involves utilizing information and communication technology (ICT) and connecting information systems within healthcare. While Telemedicine predates E-Health and Health Telematics, these terms are sometimes used interchangeably. However, Telemedicine and Telehealth are subfields of Health Telematics. Telemedicine involves the exchange of medical information for diagnosis, treatment, prevention, research, and education across distances, facilitating communication between healthcare professionals and patients. On the other hand, Telehealth includes technologies and services aimed at promoting health and well-being, emphasizing spatial and temporal independence and targeting non-ill individuals. This differentiation is crucial in distinguishing between Health Apps, which address health topics, and Medical Apps, used for treating medical conditions.[95, 96]

Telehealth encompasses a wide range of health-related activities, including patient and provider education, management, and care delivery. It involves the provision of health services and treatments through telecommunication technology such as video conferences, SMS, and email. This includes online counseling and therapy, which can be conducted synchronously (e.g., real-time video conference) or asynchronously (e.g., email/SMS).[97, 98] Mobile technologies, driven by smartphones and global mobile networks, facilitate continuous health data collection and analysis, reducing dependence on fixed networks and expanding the applicability and reach of Telemedicine and Telehealth. This shift emphasizes personalized patient-centered care, urging designers, manufacturers, and service providers to tailor products and services to patients' specific needs.[99]

In 2005, a systematic study identified 51 independent definitions of E-Health. To this day, there is no unified definition for E-Health. One reason for this lack of consensus may be the continuous transformations within the E-Health domain. The scope of E-Health constantly expands and changes with technological innovation and development.[100, 101] With the emergence of the Internet economy and E-Business, traditional sectors underwent a transformation into interconnected, digitized, and computer-based systems. Consequently, fields like E-Learning in education and E-Commerce in general business operations emerged. Evers-Wölk, Oertel et al. (2018) and Fischer & Krämer (2016) also view E-Health as the migration of healthcare services to the electronic marketplace within the healthcare sector, mirroring the trends of the New Economy.[102, 103] E-Health is often defined broadly as Information and Communication Technology (ICT), leading to its interchangeable use with terms like Telemedicine and Health

[93] Cf. Antonovsky 1996, p. 13f

[94] Cf. Beise/Schwarz/Heimes 2014, p. 28f

[95] Cf. Celi et al. 2017, p. 326f

[96] Cf. Hailey 2021, p. 4947f

[97] Cf. Celi et al. 2017, p. 327

[98] Cf. Chandan/Starcevic 2019, p. 170

[99] Cf. Fisk 2020, p. 1-6

[100] Cf. Fischer/Krämer 2016, p. 7

[101] Cf. Lux 2016, p. 5

[102] Cf. Evers-Wölk/Oertel/Sonk 2018, p. 29

[103] Cf. Fischer/Krämer 2016, p. 4

Telematics.[104] While E-Health utilizes ICT, it also encompasses services, quality enhancements, and proposals for streamlining related to the digitalization of data management and communication processes. Consequently, Health Telematics can be seen as a subset of E-Health. E-Health should be understood as a foundational approach aimed at improving healthcare through the global networking and collaboration of all stakeholders in the healthcare system.[105, 106] Lux and Shaw, along with McGregor et al., further delineated the key characteristics of E-Health, as depicted in Figure 3. Shaw and McGregor constructed a model based on a study involving numerous experts to offer a comprehensive perspective on E-Health. The combined viewpoints of the authors are illustrated in Figure 3, where each aspect interacts with the others. Lux emphasizes Integration, Interoperability, and Networking as distinct yet overlapping domains, whereas Shaw, McGregor, and others describe personalized health, data management, and health interaction. Personalized health signifies the shift toward patient-centered care and self-managed individual health, leveraging mobile technologies, social networks, and the internet. Additionally, considerations such as security and quality, data privacy and access, as well as research and education, are pertinent across all domains.[107, 108]

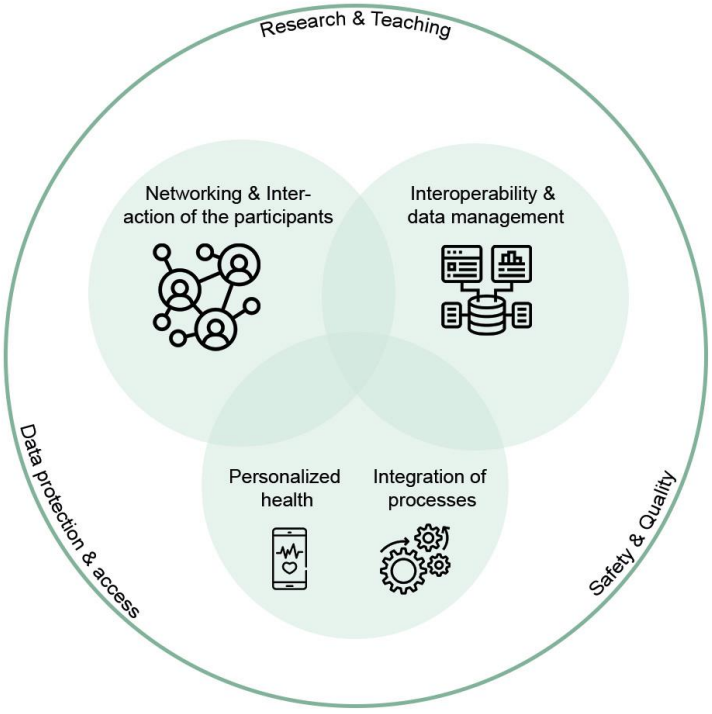

Figure 3 E-Health model. Own depiction based on Lux & Shaw (2017) and McGreagor et al. (2017)

Mobile Health, or mHealth, is considered the mobile manifestation of E-Health and has, due to its complexity, gained recognition as a distinct concept. Since its initial mention in 2003, the term has continued to evolve, gaining new perspectives with the proliferation of smartphones and apps. It is noteworthy that,

[104] Cf. Haring 2019, p. 2f

[105] Cf. Fischer/Krämer 2016, p. 5ff

[106] Cf. Evers-Wölk/Oertel/Sonk 2018, p. 29f

[107] Cf. Shaw et al. 2017, p. 5-9

[108] Cf. Lux 2016, p. 20f

like E-Health, there is no uniform definition for mHealth. An overview of some definitions is listed in Appendix B. In general, these definitions encompass all activities and services in the healthcare domain where at least one mobile device is used, including traditional mobile phones, smartphones, tablets, phablets, wearables, and various electronic patient monitoring devices. Wearables encompass not only smartwatches and fitness bands but also smart clothes, smart lenses, and other wearable technologies.[109] However, smartphones and wearables are the most influential drivers of mHealth, as observed by Bierbaum and Bierbaum.[110] However, mHealth goes beyond simply using mobile technologies in healthcare; it promotes a responsible approach to personal health and fosters the development of health literacy through readily available information. Additionally, mHealth involves direct patient engagement.[111] By integrating mobile devices into everyday life, mHealth allows for interactive participation in medical care and healthcare management. Consequently, telemedical and other E-Health approaches can be utilized interactively and in real-time.[112] mHealth transforms the applicability of previous telemedical and E-Health solutions and offers the chance to harness previous potentials more effectively, with patients playing an active role in their treatment. Rather than relying solely on the availability of physicians or hospitals in specific locations, mHealth services can be accessed by users wherever they are in their daily lives. Physicians' roles are not intended to be replaced but rather supplemented, with patients assuming partial responsibility through patient empowerment initiatives.[113, 114, 115] The healthcare system is witnessing a shift towards patient-centered care, encouraging users to take greater initiative and engage more deeply in their health. Alongside medical applications like diagnostics and therapy, mHealth encompasses concepts for health promotion and disease prevention, including fitness, nutrition, and natural remedies, aimed at improving physical and mental health as well as overall quality of life globally.[116, 117, 118]

Moreover, mHealth "brings together academic researchers, medical professionals, and business experts worldwide to develop innovative solutions for healthcare that leverage advances in these technologies".[119] Mobile Health pursues the improvement of global health through higher quality, safety, availability, and efficiency of healthcare services and research. Through continuous health monitoring, symptoms can be detected early, and emergency situations can be prevented.[120, 121]

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[109] Cf. Albrecht 2016, p. 50

[110] Cf. Bierbaum/Bierbaum 2017, p. 252

[111] Cf. Kraus-Füreder 2018, p. 20f

[112] Cf. Albrecht 2016, p. 51

[113] Cf. Bartmann et al. 2018, p. 62f

[114] Cf. Matusiewicz/Pittelkau/Elmer 2018, p. 5f

[115] Cf. Albrecht 2016, p. 50f

[116] Cf. Istepanian/Woodward 2017, p. 3f

[117] Cf. Evers-Wölk/Oertel/Sonk 2018, p. 30f

[118] Cf. Albrecht 2018, p. 1

[119] Cf. Istepanian/Woodward 2017, p. 8

[120] Cf. Song/Yu 2020, p. 1

[121] Cf. Istepanian/Woodward 2017, p. 8

Apps, in particular, represent a highly current and attractive segment of mHealth. Subsequent sections will delve into the categorization and applications of these apps. Apps are application software designed for mobile devices such as smartphones, tablets, and wearables, as well as for desktop computers and laptops running operating systems from Windows 8 and MacOS 10.6.6 onwards. Apps can be categorized into three types: Native Apps, Web-Apps, and Hybrid-Apps (a combination of both). Native Apps are specifically designed for a particular operating system, such as Android, and are intended for use on a single device. These apps are downloaded and installed through an app store, which serves as the marketplace for distributing apps. In contrast, Web-Apps can be used across different devices with a web browser, eliminating the need for installation since the web app is loaded and accessed via a website. Native Apps, thanks to their unrestricted access to a device's built-in sensors, offer greater potential for active mHealth applications. As a result, this work primarily focuses on Native Apps, known for their fast installation via app stores and intuitive user interfaces. Additionally, most apps are available for free, with alternative financing models like advertising and in-app purchases. Apps for Android devices are obtained from the Google Play Store, while those for Apple devices are available through the Apple App Store. Windows devices have the Microsoft Store as their source.[122, 123] Modern smartphones, with their powerful processing capabilities and extensive sensor arrays, can support comprehensive health and medical apps. These apps, known as Health Apps, positively impact health.[124] However, the lack of a standardized definition complicates their classification. Some literature distinguishes between Health Apps and Medical Apps, while others group all apps together. Categorizing them as Medical and Health Apps is more common and aids in a unified understanding. Health Apps focus on preserving, preventing, promoting, controlling, and monitoring health, targeting healthy individuals with preventive and promotional measures in areas like fitness, lifestyle, wellness, and nutrition.[125] In contrast, Medical Apps address tasks related to diagnosis, therapy, disease management, and health restoration. They are used by healthcare professionals, chronically ill individuals, and patients. When apps serve a medical purpose, they are considered medical devices and fall under regulations like the Medical Device Regulation (MDR) and the Digital Supply Act (Digitales-Versorgungs-Gesetz, or DVG).[126]

Subsequently, Figure 4 provides a comprehensive overview of these terms due to their many overlaps and partial confusion in terminology.

[122] Cf. Albrecht 2016, p. 53

[123] Cf. Kraus-Füreder 2018, p. 21f

[124] Cf. Albrecht 2016, p. 136f

[125] Cf. Bierbaum/Bierbaum 2017, p. 176ff

[126] Cf. Kraus-Füreder 2018, p. 21ff

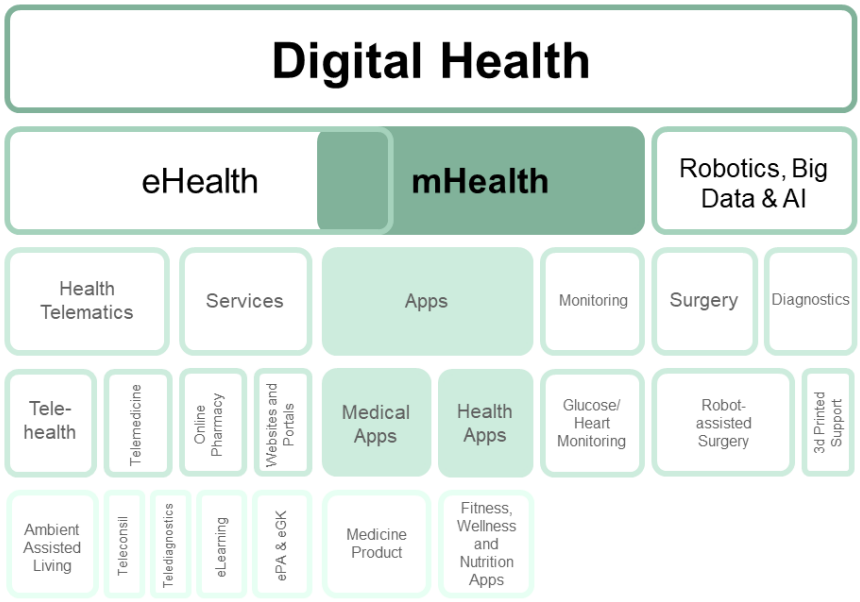

Figure 4 Summarized overview of terms. Own representation with color coding to indicate the focus of this work

2.5 Prescription Apps

The growing demand for healthcare services due to demographic changes, physician shortages, and evolving political dynamics has piqued the interest of both providers and consumers in digital healthcare solutions. Mobile health apps (mHealth apps), in particular, have emerged as promising solutions.[127]

The potential of health-related mobile applications is widely recognized. This term encompasses a variety of mobile applications addressing health-related topics, including medical apps, wellness applications, and those pertaining to lifestyle. The Apple and Android app stores offer an extensive selection of over 300,000 health and wellness apps, with hundreds of new additions daily. A substantial portion of these apps is focused on fitness and lifestyle. The overall revenue in this sector has approximately doubled between 2017 and 2020, with expectations of continued growth in the coming years. Approximately 80% of these apps are available for free and often include premium features offered on a paid basis. This situation results in users being less inclined to pay for apps, posing a long-term economic challenge for app developers. The prevailing market expansion and insufficient monetization hinder both content and technical advancements. New regulatory frameworks aim to address this issue.[128]

Noteworthy health apps include “Happify Health” for addressing mental health conditions, “mySugr” for diabetic management, and “Kaia” for back pain. Some of these apps are already supported through selective contracts between health insurance providers and manufacturers.[129] It is worth noting that nearly half of smartphone users now utilize health apps. These health apps are characterized by their accessibility, real-world relevance, and patient empowerment. The most commonly observed positive effects are health-promoting behavior, early recognition of health risks, and more effective doctor-patient

[127] Cf. Betts et al. 2019, p. 14f

[128] Cf. Hedwig et al. 2020, p. 4f

[129] Cf. Hedwig et al. 2020, p. 7f

relationships. Risks primarily revolve around data privacy and potential vulnerabilities. In surveys, approximately 25-45% of physicians reported discussing health apps with their patients. Reluctance can be attributed to uncertainty about reliability, safety, and integration into daily life. Physicians in urban and suburban areas, as well as those of younger age, tend to view health apps more favorably. While 52% perceive the benefit as modest yet possible, 37% anticipate a greater benefit. The expected benefits vary across application areas, with considerable potential seen in medication management and self-monitoring of risk factors. Physicians emphasize the importance of more binding data protection and quality standards, along with legal clarity.[130] In a November 2020 survey of various healthcare practitioners in Germany, approximately 24% expressed their intent to prescribe digital health applications in the future.[131] Mobile apps have the capacity to collect data through sensors, such as those for acceleration and location, establish connections to external devices via Bluetooth, and obtain information through camera functionalities.[132]

Results from studies on the effectiveness of apps exhibit significant variations, but these applications seem to positively influence a wide range of health-related behaviors. A meta-analysis of mHealth interventions for smoking cessation, for instance, demonstrated that advice delivered via mobile phones approximately doubled the abstinence rate six months after quitting, yielding similar results to nicotine patches. Another meta-analysis evaluating the effectiveness of mHealth applications on nutrition revealed a positively effective impact.[133]

2.5.1 German Legal and Regulatory Framework

In Germany, there are evaluation procedures and quality seals for apps. For instance, DiaDigital, an initiative by the German Diabetes Society, assesses diabetes apps and provides assistance to users. Another example is AppQ, a set of quality criteria for app evaluation. However, a challenge arises from the fact that the interests of users and researchers do not necessarily align, and the sheer volume of apps complicates the assessment.[134]

The National Institute for Health and Care Excellence (NICE) and the National Health Service (NHS) in the United Kingdom have developed an approach to categorize apps based on their functionality. Four categories are established: diagnostic apps, behavior change apps, digital therapists, and educational or knowledge-sharing apps. Diagnostic applications include tools like symptom checkers, which can be particularly valuable in regions with limited healthcare infrastructure. Behavior change apps can, for instance, calculate BMI or HbA1c values and support medication adherence and therapy compliance for chronic conditions.[135] Moreover, within the realm of Disease Management Apps, the greatest potential for enhancing healthcare delivery is identified.[136]

The vast array of available apps and their recognized potential necessitate regulation. Currently, any developer can add an app to the app store without independent assessment of functionality and safety.

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[130] Cf. Wangler/Jansky 2021, p. 3ff

[131] Cf. Rohleder 2020, p. 11

[132] Cf. Rossmann/Brew-Sam 2016, p. 443

[133] Cf. Jahnel/Schüz 2020, p. 2

[134] Cf. Jahnel/Schüz 2020, p. 2f

[135] Cf. Rowland et al. 2020, p. 2f

[136] Cf. Agnihothri et al. 2018, p. 3

Given that health apps are often employed in disease management, it is imperative to ensure their utility and quality to mitigate risks. For example, if the algorithm for insulin calculation is erroneous, it can lead to severe comorbidities, posing harm to disease management. Apps that provide information about a patient's therapy must be classified as medical devices and bear a CE marking in Europe. This process typically takes 1-2 years and often incurs a cost exceeding 500,000 euros, presenting a substantial barrier for most manufacturers.[137] The E-Health Act has clarified some legal matters regarding digital communication in healthcare, but it does not assess compliance with these regulations in the context of apps.[138]

However, changes in the app market can be anticipated, as on December 19, 2019, the "Law for Better Supply through Digitalization and Innovation," also known as the "Digital Supply Act" (Digitales-Versorgungs-Gesetz or DVG), came into effect, forming the legal framework for mHealth in Germany. This law integrates health apps into regular healthcare services, offering numerous prospects for stakeholders. The DVG encompasses various aspects, including the regulation of the deployment and reimbursement of health apps, promotion of telemedicine, expansion of the telematics infrastructure, innovation incentives from health insurance companies, continuation of an innovation fund for fostering digital innovations, facilitation of digital health literacy, and promotion of process digitalization within the German healthcare system.[139] However, the majority of currently available apps pertain to fitness and lifestyle and are unaffected by the DVG, as they lack a medical context.[140] Through this law, patients can have apps prescribed as reimbursable standard benefits by statutory health insurance companies, but not every app qualifies. The category of "Digital Health Applications" (DiGAs) was established (§ 33 SGB V). DiGAs are defined as medical devices falling into risk classes I or IIa, primarily relying on digital technologies, and not merely serving for device data reading and control. DiGAs support the “detection, monitoring, treatment, or alleviation of diseases, injuries, or disabilities”, but do not serve primary prevention.[141] Furthermore, DiGAs are not practice equipment but must be utilized jointly by the patient and the healthcare provider.[142]

The law enhances legal and procedural security by adhering to a standardized approval process and enabling prescription by physicians or psychotherapists. It simplifies monetization since compensation is regulated and facilitated by health insurance companies. Thus, the lack of user willingness to pay no longer hinders app development. Selective contracts, which previously benefited only a small proportion of patients, are now replaced. The "Fast-Track Approval Process" expedites monetization. The medical focus is strengthened as the DVG does not encompass lifestyle and fitness offerings. Furthermore, health insurance companies can influence the development of the offering through targeted promotion according to §68a SGB V, under the conditions of a limitation to 10 years, applicability within the EU or EEA, and the absence of default risk. The DVG process begins with the development of an app, which is then reviewed for approval by the Federal Institute for Drugs and Medical Devices (BfArM). The

[137] Cf. Kaltheuner/Drossel/Heinemann 2019, p. 2f

[138] Cf. Rossmann/Brew-Sam 2016, p. 453

[139] Cf. Bundesministerium für Gesundheit 2020

[140] Cf. Hedwig et al. 2020, p. 6

[141] Cf. Bundesamt für Soziale Sicherung 2023

[142] Cf. Heinemann/Drossel/Kaltheuner 2021, p. 280

BfArM's review process takes three months. Subsequently, the app is included in the DiGA directory according to §139e SGB V.[143, 144]

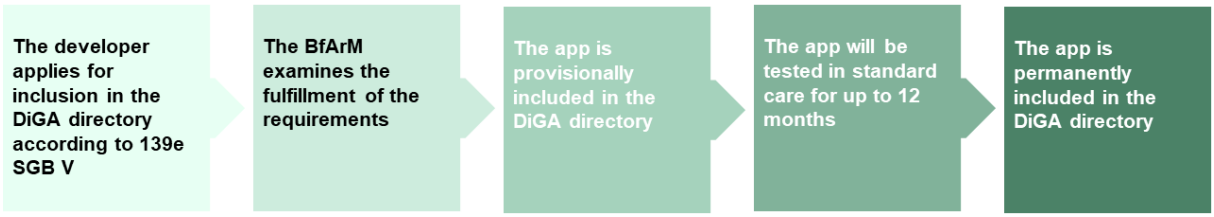

Figure 5 The fast-track approval process. Own illustration based on Hedwig et al. (2020)

For inclusion in the DiGA directory, it must be demonstrated that the app is designed to be interoperable. Users must have the ability to receive or transmit, for their own use or distribution, therapy-relevant extracts of the data collected in a legible and printable form. Furthermore, users must be allowed to receive the collected data in a machine-readable, interoperable format, enabling further processing through other digital applications.[145] A connection to the electronic patient record should be offered in the future. If other medical devices or wearables are used for data measurement and transmission, an interface must be established.[146] The exact details and requirements for physicians are explained in the "Digital Health Applications Ordinance" (DiGAV).[147]

In the case of Fast-Track Approval, proof of a positive supply effect can be provided up to twelve months later, but only with a plausible justification of expectations. Prerequisites for approval include classification as a medical device in risk classes I or IIa, compliance with safety, functionality, and quality standards, and evidence of medical benefit for the patient.[148] Data security and data protection under the General Data Protection Regulation (GDPR) are critical aspects of the review. These considerations encompass access to personal and account information, as well as connected data and potential use by third parties.[149] There are no limitations regarding the field of application; however, apps for prevention are unlikely to be approved based on the evidence of a supply effect. Following approval, the price is set according to pharmaceutical pricing, with the provider determining the price in the first year. From the second year onward, the price is negotiated between the provider and the health insurance company. Once the price is established, the physician must prescribe the app as a standard service and explain its benefits and usage to the patient. The final step in the process is the application by the patient. Problematic aspects within the approval process include the short product cycles in software development and the frequent updates that must be performed. The Fast-Track procedure also carries a risk, as apps that do not produce any effects could receive temporary promotion. For startups and small businesses, the requirements are often too high, creating a barrier. It remains unclear whether

[143] Cf. Bundesinstitut für Arzneimittel und Medizinprodukte 2023

[144] Cf. Hedwig et al. 2020, p. 11f

[145] Cf. Bundesinstitut für Arzneimittel und Medizinprodukte 2023

[146] Cf. Heinemann/Drossel/Kaltheuner 2021, p. 279

[147] Cf. Bundesministerium der Justiz 2020

[148] Cf. Hedwig et al. 2020, p. 11f

[149] Cf. Kaltheuner/Drossel/Heinemann 2019, p. 279

physicians should prescribe a specific app or provide a performance profile. Determining how a particular app is selected for use and whether health insurance companies will have a means of control, such as through discount agreements, is also an issue to be addressed. Additionally, it is uncertain whether patients will download apps from a private app store, a government alternative, or directly from the manufacturer, which is currently favored. Further discussion is needed on the method of instruction, which could be conducted by the physician, through service offerings by the manufacturer or health insurance companies. According to the Medical Devices Act (§ 29 MPG), app providers would be obliged to train consultants to inform and instruct physicians. Additional explanations regarding the proof of a positive supply effect are also required. Specifications for billing and price negotiations need to be clarified, and the handling of subsequent updates must be regulated.[150]

2.5.2 SWOT Analysis of Apps

To conduct an in-depth examination of prescription apps, the following section will entail the creation of a SWOT analysis. This analysis will first elucidate the strengths and opportunities, followed by an exploration of weaknesses and risks.

Strengths and Opportunities of Apps

The advantages of mHealth applications vary based on their categories and functionalities. These applications offer extended access to healthcare services, cost-effective treatment paths, improved communication between patients and healthcare providers, and sustainable healthcare delivery.[151, 152]

Diagnostic apps, for instance, have shown promise in detecting recurrent lung cancer and offering early intervention recommendations, particularly valuable in regions with limited access to expert healthcare services, as emphasized by the World Health Organization.[153]

Mobile Health applications targeting behavior adaptation utilize features such as personalized goal-setting, medication reminders, and gamification techniques to enhance motivation and engagement. They have demonstrated effectiveness in promoting weight loss, controlling blood sugar levels among diabetic patients, and improving nutrition and exercise habits, especially when used consistently over an extended period.[154]

Moreover, apps focusing on medication adherence for chronic conditions have been positively received by patients, with features like tailored medication plans and reminders being particularly appreciated.[155]

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[150] Cf. Hedwig et al. 2020, p. 12-14

[151] Cf. Rowland et al. 2020, p. 4f

[152] Cf. Agnihothri et al. 2018, p. 186f

[153] Cf. World Health Organization 2023

[154] Cf. Mühlen 2022

[155] Cf. Rowland et al. 2020, p. 2f

Mobile applications also facilitate communication between patients and medical personnel, improving patient understanding of their conditions and supporting shared decision-making. They have significant potential in remote or underserved areas and preventive care settings.[156]

Furthermore, mHealth apps serve educational purposes, offering easily accessible disease- and treatment-related information. While evidence supporting app effectiveness is still emerging, benefits include enhanced patient self-management and improved healthcare outcomes.[157]

Despite the perceived advantages, the evidence supporting cost-effectiveness is limited, and more research is needed to ascertain long-term benefits and cost savings associated with mHealth applications.[158]

Overall, mHealth applications offer advantages such as high accessibility, personalized engagement, and the potential to improve health outcomes, particularly among chronically ill patients. They complement traditional healthcare approaches and have the potential to modernize therapy approaches and improve self-management practices. However, it's crucial to view them as therapeutic aids rather than substitutes for professional medical guidance. Continuous monitoring by healthcare professionals is essential for optimal outcomes.[159]

Sensor technology plays a crucial role in enabling the collection of extensive datasets, offering real-time health monitoring and reducing the need for frequent clinic visits. Wearable devices, such as blood sugar monitors, significantly enhance daily life for patients by providing accurate and convenient health data.[160, 161]

Surveys indicate that health apps positively impact users' daily lives, particularly among younger demographics. They provide a sense of security through continuous health data monitoring, allowing for early interventions and improved overall well-being.[162]

Weaknesses and Threats of Apps

In the exploration of mHealth interventions, it is crucial to contextualize research findings considering factors such as language, cultural nuances, health status, disease progression, and app usage frequency. Long-term outcomes, particularly concerning chronic diseases, warrant comprehensive examination for meaningful insights. However, the existing literature predominantly comprises short-term studies, potentially introducing bias as participants self-select apps and exhibit higher motivation levels than the general population.

Moreover, many apps lack evaluations, posing challenges in staying abreast of software updates. Healthcare providers should elucidate app usage and benefits to patients, with patient involvement in

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[156] Cf. Collado-Borrell et al. 2020, p. 2f

[157] Cf. Belakovskiy/Jones 2022, p. 576f

[158] Cf. Iribarren et al. 2017, p. 6ff

[159] Cf. Devi et al. 2015, p. 4f

[160] Cf. Cvrkel 2018, p. 516f

[161] Cf. Agnihothri et al. 2018, p. 2f

[162] Cf. Continentale 2019, p. 17f

app design ensuring alignment with treatment objectives and user preferences. A comprehensive evaluation of mHealth apps should encompass efficacy evidence, data privacy, developer information, installation and regulatory standards, technical aspects, design, and interoperability, addressing both patient and physician perspectives.[163]

Challenges persist in healthcare practitioners guidance on mHealth apps, as physicians often lack the necessary knowledge to counsel patients on associated risks and integration into treatment plans. To mitigate these challenges, ongoing education and training initiatives for healthcare professionals are essential. Additionally, collaboration between healthcare providers, app developers, and patients can enhance the efficacy and usability of mHealth interventions, ultimately improving patient outcomes and healthcare delivery.[164]

The lack of knowledge carries the risk of patients gaining access to raw data that they may not comprehend. In such a scenario, patients may resort to internet search engines or self-medication without guidance, both of which can introduce risks of incorrect treatment decisions and potentially evoke unnecessary anxiety or concern. A substantial challenge stems from the vast and overwhelming array of available apps. This plethora can make it arduous for patients to identify a suitable app that meets quality standards.[165] The absence of an official or standardized evaluation of apps further complicates the selection process. App popularity in app stores does not necessarily reflect quality, thus potentially misleading users.[166] The mHealth app landscape undergoes rapid and constant changes, rendering the quality of apps challenging to assess due to inaccurate, misleading, or erroneous descriptions.[167] Few apps mention certifications or provider quality endorsements. Users may be misled into assuming that an app measures specific health metrics, only to find out that the app generates arbitrary data, resulting in misjudgments of their health behavior.[168, 169]

A study involving 23 diagnostic symptom-checker apps in the United States revealed that only approximately 34% of cases were accurately diagnosed, frequently leading to incorrect recommendations for actions.[170] Such inaccuracies can lead to frequent and, at times, unnecessary visits to primary care physicians. Experts emphasize that these apps should not substitute clinical consultation. Various instruments have been introduced to assess the quality of apps, such as the Mobile App Rating Scale (MARS). Measuring the average quality score and a subjective quality score with the MARS tool is a somewhat elaborate process.[171]

Technical challenges, misleading app navigation, dosage plans, and inflexible reminder settings have also received negative feedback. Occurrences where different software components interfere with each

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[163] Cf. Rowland et al. 2020

[164] Cf. Agnihothri et al. 2018

[165] Cf. Mühlen 2022

[166] Cf. Rowland et al. 2020

[167] Cf. Rossmann/Brew-Sam 2016

[168] Cf. Cvrkel 2018

[169] Cf. Agnihothri et al. 2018

[170] Cf. Rowland et al. 2020

[171] Cf. Rossmann/Brew-Sam 2016

other or updates result in issues have been noted.[172] Additionally, firewalls, which are crucial for security, can obstruct the transfer of health data, especially for users with limited technical proficiency, potentially leading to security vulnerabilities or lack of understanding. The transition to mHealth in medical practices necessitates more than just procuring the required hardware and software; the approach to processes is crucial. Proper reimbursement by healthcare payers is crucial, as failure to do so discourages many from adopting mHealth.[173] The traditional model of billing for consultations or physician visits can no longer be applied as doctors now must continuously monitor values digitally and communicate via email, phone, or video chats.[174]

Effective support from app developers should be ensured, and the legal responsibility for difficulties needs to be clarified. It is also necessary to analyze whether all patient groups derive equal benefits or if specific barriers exist for particular patient populations. Limited accessibility can pose a barrier, particularly for individuals who do not consistently use mobile devices or possess varying levels of technological infrastructure.[175] Some apps are exclusively available in one of the app stores. Varied costs can also present an obstacle for some individuals. Additionally, it remains inconclusive whether the use of mobile phones might entail health problems, such as electromagnetic radiation or constant accessibility. Data privacy is frequently opaque and fraught with dangers, as the security of data is contingent on the device used. For individuals with conditions like mental health issues or substance addiction, disclosing health information can pose a genuine risk, potentially leading to stigmatization, discrimination, or legal repercussions.[176] Results from a 2019 study in Germany examining the impact of health apps indicated that 31% of respondents expressed concerns about being frequently reminded of their illness through the app. Notably, individuals over the age of 60 demonstrated less conviction. Regarding the sense of security arising from the constant monitoring of health data, approximately 43% of respondents reported experiencing unnecessary anxiety and fear due to the continuous availability of data.[177]

2.5.3 Standards and Quality of Apps

In the previous chapter, the legal framework surrounding mHealth apps was delved into, and a comprehensive SWOT analysis of these applications was conducted. Having established an understanding of the regulatory environment and the strengths, weaknesses, opportunities, and threats associated with mHealth apps, it is now imperative to shift the focus towards the pivotal aspect of app quality. The quality of mHealth apps is a multifaceted and critical consideration that encompasses various elements such as functionality, usability, security, and adherence to medical standards. In this chapter, the intricacies of mHealth app quality will be explored, examining its significance, key determinants, and the impact it has on the user and their healthcare outcomes.

The guidelines provided by the Federal Institute for Drugs and Medical Devices (BfArM) establish specific requirements for the quality of DiGA apps, complementing the framework outlined in section 2.5.1. Developers of DiGA are required to demonstrate safety and functionality during the application process, typically through the acquisition of a conformity certificate or EC certificate.

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[172] Cf. Rowland et al. 2020

[173] Cf. Heinemann/Drossel/Kaltheuner 2021

[174] Cf. Agnihothri et al. 2018

[175] Cf. Rossmann/Brew-Sam 2016

[176] Cf. Cvrkel 2018

[177] Cf. Continentale 2019, p. 17f

Crucially, data protection is fundamental in DiGA. The BfArM, along with the BfDI and BSI, define data protection criteria, expanding on GDPR requirements for both manufacturers and DiGA. Compliance entails implementing technical and organizational measures to safeguard data confidentiality, integrity, and availability. In summary, while the SGB V establishes baseline requirements, the guidelines provided by the BfArM, BfDI, and BSI prioritize data protection, ensuring the quality and reliability of DiGA apps within the digital health landscape. Regarding prescription apps, data security is of paramount importance. This entails various measures, notably in IT security, including passing penetration tests and adhering to ISO-27000 standards. Data collection from devices like medical instruments and wearables demands rigorous security standards to maintain data confidentiality, integrity, and availability. Hence, prescription apps must adhere to stringent quality and security standards.[178]

The focus of this work does not lie within the realm of IT security, as delving into this topic would exceed the scope of the study and may not be feasible with the available resources. Therefore, IT security aspects will not be further explored or discussed in the following text.

To assess the quality of DiGA in this study, it is first necessary to thoroughly discuss the concept of quality. According to the standards DIN EN ISO 9000:2015-11 and IEC 2371, quality can be defined as "the capability of the inherent characteristics of a product, system, or process to meet the requirements of customers and other stakeholders". Moreover, quality is understood as "the congruence between the identified characteristics and the predefined requirements of an entity under consideration".[179]

The perspective from which quality is viewed plays a crucial role. According to Garvin's classification, five dimensions of quality can be differentiated:

- Transcendent quality, which refers to high performance standards of a product.
- Product-oriented quality, which is based on the specific characteristics of a product.
- Process-oriented quality, concerning the adherence to specifications and standards during product development and manufacturing.
- User-oriented quality, determined by the utility for the user after use.
- Value-oriented quality, assessing the product's price-performance ratio.[180]

The importance of the concept of quality also extends to Quality Management Systems (QMS) according to DIN EN ISO 9001, which sets the basic requirements for a QMS.[181] Additionally, the implementation of a QMS for quality assurance in the medical sector is regulated by §135a Abs.2 (2) SGB V to make medical services more transparent and safer. Institutions such as the Institute for Quality and Efficiency in Health Care (IQWIG), the Institute for Quality Assurance and Transparency in Health Care (IQTIG), and the Medical Center for Quality in Medicine are dedicated to quality assurance. With the updates of the Medical Device Regulation (MDR), manufacturers of mHealth apps, depending on their risk class, are required to implement a QMS.[182] The standards ISO/IEC 25000 and IEC 62304 set requirements for the quality and development of software, though the direct application of these norms to apps due to

[178] Cf. Bundesinstitut für Arzneimittel und Medizinprodukte 2023, p. 39-61

[179] Cf. Deutsches Institut für Normung e. V. 2015a

[180] Cf. Garvin 1988, p. 40f

[181] Cf. Deutsches Institut für Normung e. V. 2015b

[182] Cf. Wojcieszak 2016

their specific form of software presents challenges.[183] This complicates adherence to the norms by manufacturers and results in a wide range of products of varying quality being available to the user. Moreover, health apps are subject to fewer requirements than medical apps, which further limits transparency. For a more transparent overview, users have access to databases listing reputable apps, such as the DiGA database digimedia, alongside independent institutions' test reports.[184] This database compiles certifications and quality seals and additionally offers checklists and guidance, such as the checklist from the Peter L. Reichertz Institute for trustworthy apps. There are also checklists for verifying whether an app qualifies as a medical product. Quality assessment procedures for mHealth, web-based, and e-health applications are documented in the literature and include methods like ENLIGHT and MARS. The MARS method, developed by Stoyanov et al., allows for the evaluation of apps based on six main criteria: classification, aesthetics, user experience, functionality, information, and subjective quality.[185]

2.6 App-Specific Requirements of Seniors

Specifically, by the age of 50, nearly half of the population is afflicted with at least one health condition, and the prevalence of multimorbidity significantly increases by the age of 65.[186, 187] The ensuing discussion delves into sensory impairments commonly associated with aging, underscoring the necessity for adaptive digital technology development to accommodate these changes.

Hearing impairments manifest progressively with age, beginning around the 60th year, with an average decline in hearing sensitivity of about 1 dB per year.[188, 189] The World Health Organization reports varying degrees of hearing loss among different age groups, noting a significant increase in prevalence with advancing age.[190]

Visual impairments also exhibit an upward trend with age, with the prevalence rates for visual impairment and blindness reflecting a significant increase among those aged 65 and above.[191] Age-related macular degeneration (AMD) and glaucoma are identified as the leading causes of blindness in this demographic.[192]

Furthermore, the tactile system undergoes degenerative changes, impacting tactile and haptic sensory performances. From the 20th year onwards, the perceptual quality for tactile stimuli decreases annually by approximately 1%, attributed to both the reduction in receptor numbers and neuronal degeneration.[193]

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[183] Cf. International Organization for Standardization 2014

[184] Cf. Bundesinstitut für Arzneimittel und Medizinprodukte 2023

[185] Cf. Stoyanov et al. 2016

[186] Cf. Bundesministerium für Bildung und Forschung 2023, p. 2f

[187] Cf. Robert Koch-Institut 2015, p. 409ff

[188] Cf. Seger/Gaertner 2020

[189] Cf. Völter et al. 2021

[190] Cf. Gablenz/Holube 2015, p. 195-214

[191] Cf. Wolfram/Pfeiffer 2012

[192] Cf. Finger et al. 2012, p. 27f

[193] Cf. Libouton et al. 2010, p. 473-478

These sensory impairments directly influence the elderly's interaction with technology. The design of digital technologies, therefore, must be intrinsically informed by an understanding of these age-related changes to ensure accessibility and usability. This is particularly crucial as the prevalence of conditions such as Alzheimer's disease increases with age, affecting over 90% of individuals over 90 years old and presenting significant challenges in learning and utilizing new technologies.[194] The aging brain's slower information processing capabilities necessitate the avoidance of sensory overload and the simplification of technological interfaces to enhance intuitiveness.[195]

Research indicates that older individuals prefer shallower menu hierarchies and fewer functions in top menu entries when using mobile phones, suggesting a need for tailored interface designs to mitigate discomfort and facilitate ease of use.[196] These findings emphasize the importance of developing digital technologies that respect the heterogeneity of the elderly population, taking into account their unique sensory, cognitive, and functional requirements.[197]

In conclusion, the intersection of gerontology and technology development presents a multifaceted challenge that necessitates a synergistic approach from various scientific disciplines, aligned with corporate strategies and market trends.[198] Recognizing and addressing the diverse needs and preferences of the elderly in technology design is paramount, thereby ensuring that digital innovations are both accessible and beneficial for this demographic.

In the conversation around aging and digital innovations, Quinn and his team suggest that improving access to educational tools and training on tech for older adults and their support systems could markedly boost their interaction and use.[199] An approach to increase elderly engagement with mobile health (mHealth) applications involves tailoring and embedding their specific requirements into the app functionalities, supporting their navigation of digital healthcare.[200] Furthermore, the pandemic has highlighted the pivotal role of mHealth for the elderly. Research by Abbaspur-Behbahani and his team into mHealth's role during this period revealed its multifaceted utility for older adults, including informational provision, therapeutic guidance, health tracking, and emotional support. Notably, certain mHealth tools were specifically crafted to aid in pandemic-related challenges like contact tracing and symptom checking, despite older users facing obstacles primarily due to unfamiliarity with the apps' operations.[201, 202, 203]

Recognizing the growing importance of mHealth tools and the obstacles faced by the elderly in utilizing them, embedding elder-centric functionalities into mHealth apps is essential for their well-being. Chao highlights that traditional usability engineering might not ensure the persuasive quality of mHealth apps.

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[194] Cf. Schmidt 2016

[195] Cf. Biermann/Weißmantel 1998

[196] Cf. HARA/KASHIMURA 2010, p. 216–226

[197] Cf. Nelson/Dannefer 1992, p. 17-23

[198] Cf. Bundesministerium für Familie, Senioren, Frauen und Jugend 2020

[199] Cf. Quinn et al. 2019

[200] Cf. Vo/Auroy/Sarradon-Eck 2019

[201] Cf. Abbaspur-Behbahani et al. 2022

[202] Cf. Alharbi et al.2020, p 5-9

[203] Cf. Birnholtz et al. 2021

A pilot study focusing on a diet management mHealth app, crafted with User-Centered Design principles, showed significant acceptance among older populations.[204] Morey's evaluation of apps geared towards medication and congestive heart failure management identified design shortcomings that hinder usability for the elderly, prompting the creation of design guidelines aimed at fulfilling the elderly's diverse needs.[205]

Additional research by Kim et al. and McKay and Martin provides insightful design considerations.[206, 207] These insights are crucial for tailoring applications that cater specifically to the needs of the elderly, emphasizing the importance of intuitive design to foster greater acceptance and usage:

- Minimizing complexity through straightforward menu structures.
- Ensuring icons and text are displayed in a sufficient size with adequate contrast and color saturation to enhance readability.
- Avoiding the use of potentially unfamiliar terminology in user navigation, such as technical jargon

These design principles underscore the necessity of developing mHealth applications that are not only functional but also accessible to the senior population. By incorporating these guidelines into the development process, designers can create more inclusive technologies that accommodate the diverse abilities and preferences of older users. This approach not only improves the user experience for seniors but also supports their independence and engagement in managing their health digitally. In summary, the integration of these research findings into mHealth app development represents a critical step towards achieving a more age-inclusive digital health landscape.

Advancing the conversation on crafting mHealth apps for the elderly, Salman and colleagues' pivotal research in usability challenges for aging users and smartphone interfaces is crucial. Through SMASH, a detailed framework with 12 usability heuristics for evaluating smartphone apps, they embarked on uncovering common usability issues. With the help of five experts, these challenges were corroborated by tests with seniors, highlighting consistent problems encountered by 79% of participants. They pinpointed critical areas like design, language, dialogue, and information display, proposing targeted improvements and guidelines for elder-friendly smartphone usage. Their findings, while emphasizing general smartphone usability, offer valuable insights for mHealth app development.[208]

This leads into the examination conducted by Salman et al. underscores the overarching theme of this discussion: the imperative to meticulously design digital health technologies that resonate with the elderly's user experience preferences. By integrating these research findings, alongside those from Kim et al. and McKay and Martin, into the design process, developers can forge mHealth applications that not only address the practical health management needs of seniors but also navigate the nuanced usability challenges they face. In essence, the fusion of these scholarly insights paves the way for creating digital health solutions that are both efficacious and elderly-friendly, marking a significant stride towards an inclusive digital health ecosystem.

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[204] Cf. Chao 2020

[205] Cf. Morey et al. 2019

[206] Cf. McKay/Martin 2015, p. 391-410

[207] Cf. Kim et al. 2014, p. 381-388

[208] Cf. Salman/Wan Ahmad/Sulaiman 2018

Following the analysis on the significance of intuitively designing mHealth applications for the elderly, it is imperative to consider additional psychological principles that digital apps should embody, aligning with human perception. These principles provide a psychological foundation for creating user-friendly interfaces that are especially conducive to the cognitive and perceptual capabilities of older users.

The "Miller's Number" – 7 plus/minus 2 principle, posits that humans can hold 5 to 9 information units, or chunks, in short-term memory simultaneously. The capacity of short-term memory is genetically determined and cannot be increased through training.[209] An interface cluttered with chunks beyond this capacity complicates perception and processing, posing a significant challenge for first-time users who cannot draw on long-term memory. Thus, the Miller's Number serves as a useful guideline for the number of menu entries in an app, although research indicates the actual number of chunks one can remember short-term varies based on the type of information and context.[210]

The Hick-Hyman Law, discovered by William Edmund Hick and Ray Hyman, articulates that "the time required to make a decision increases with the number of alternatives, following a logarithmic pattern".[211] This suggests that, despite a preference for many options, only as many choices as are truly necessary should be offered in user interface design.[212]

Furthermore, the phenomenon of "banner blindness" reveals that many users do not perceive advertisements on websites, quickly learning to ignore elements situated in typical ad locations, such as the top right of a screen or the bottom in apps. This effect persists even in the absence of actual advertisements, as users may mistake non-ad elements for ads due to their shape, color, or position.[213]

Fitts's Law, introduced in 1954 by psychologist Paul Fitts, notes that the time to reach a target with a cursor or finger increases as the target becomes smaller or further away.[214]

The Gutenberg Diagram illustrates the path of human gaze when viewing web pages, applicable primarily to individuals who read from left to right. The area of highest attention is the top left, with the gaze moving to the top right, then down to the bottom left, and finally to the bottom right in a Z-pattern. Therefore, calls to action and critical elements should be positioned in the top left or bottom right.[215]

Jacob Nielsen's concept of the F-pattern in eye-tracking studies shows that our gaze traverses web pages in the shape of the letter F.[216] Users therefore typically read the headline, the first few words of the first paragraph, then the subheadings and the initial sentences that follow. This insight aids in understanding and visualizing how people perceive web pages and apps.

Contrast, or color visibility, is defined by algorithms proposed by the Web Content Accessibility Guidelines. Two colors are considered visibly distinct if they meet specific threshold values. When selecting contrasts in the early design phase, it is crucial to account for individuals with low contrast sensitivity, a

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[209] Cf. Kösterke 2018

[210] Cf. Jacobsen/Meyer 2024, p. 43

[211] Cf. Sánchez 2023

[212] Cf. Jacobsen/Meyer 2024, p. 44

[213] Cf. Jacobsen/Meyer 2024, p. 48

[214] Cf. Jacobsen/Meyer 2024, p. 49

[215] Cf. Jacobsen/Meyer 2024, p. 50

[216] Cf. Jacobsen/Meyer 2024, p. 50

condition more common in older age, and those sensitive to brightness, who should be able to adjust color schemes and contrasts.[217] A study demonstrated that reading performance on displays is enhanced with dark text on a light background, noting that finer lines require higher contrast against the background.[218]

The detailed examination emphasizes the essential understanding of the unique needs of older adults for creating mHealth applications designed specifically for them. Due to the limited research on the elderly's user requirements for mobile applications, there's a noticeable gap in solid evidence backing their needs. However, as seniors become more accustomed to using smartphones and tablets amidst technological progress, this research seeks to bridge this gap by delving into seniors' specific needs for mHealth applications, applying psychological and perceptual design principles to make digital health solutions both impactful and accessible to them.

2.7 User Acceptance Research

For digital health applications to succeed in Germany, user acceptance of these technologies is paramount. Therefore, gaining a deeper understanding and fostering the acceptance of mHealth apps within the healthcare sector is critical for their effectiveness and seamless integration. Historically, the value derived from health apps transcends their functional capabilities, heavily relying on patients' willingness to integrate these technologies into their everyday lives. Research into acceptance reveals a broad spectrum of factors that influence users' willingness to embrace digital health solutions, including technological attributes and demographic and psychosocial factors.[219] The intricate nature of acceptance demands sophisticated approaches, with several models of user acceptance demonstrating that the intent to use technology can predict actual usage patterns and illuminate underlying barriers.[220, 221] The exploration and comprehension of these acceptance factors are vital for enhancing the dissemination and effectiveness of DiGA applications in healthcare, thereby making a substantial contribution to improving patient care.

In the scholarly field and within Human-Computer Interaction (HCI) studies, a wide range of models for evaluating technology acceptance has been introduced. To guarantee the pertinence and judicious choice of a model for this investigation, the following section will conduct a historical review of acceptance models in social research. This review is intended to traverse the extensive array of theoretical frameworks developed to decipher the subtleties of how individuals accept and integrate new technologies. By examining the historical development of these models, the discourse aims to situate their relevance and efficacy in addressing the complex dynamics of technology acceptance. Such a retrospective analysis is essential for anchoring the study’s methodological framework in a robust academic tradition, thereby bolstering the rigor and scholarly significance of the research findings. This structured approach lays a solid foundation for the introduction of multiple acceptance models, setting the stage for an in-depth exploration of their theoretical underpinnings and practical implications in the context of digital health.

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[217] Cf. Web Accessibility Initiative 2023

[218] Cf. Buchner/Baumgartner 2007, p. 1036–1063

[219] Cf. Püchel/Wellbrock/Buschow 2020, p. 77-85

[220] Cf. Torbjørnsen et al. 2019

[221] Cf. Petersen/Jacobs/Pather 2020

2.7.1 Acceptance Models

A multitude of models exists within the academic discourse, which have often been expanded upon and integrated with other theoretical frameworks. The literature frequently cites the Attitude model known as the Theory of Reasoned Action (TRA) and its subsequent extension, the Theory of Planned Behavior (TPB), developed by Fishbein and Ajzen.[222, 223, 224] This paper aims to introduce and discuss the principal models and their extensions that attempt to articulate technology acceptance. These models serve as foundational pillars in understanding the factors influencing individuals' intentions and behaviors regarding technology use. By exploring these models, it can be delved into the intricate mechanisms that underpin the acceptance and utilization of technology, highlighting the evolution of theoretical constructs that have significantly contributed to the field of technology acceptance research.

The Theory of Reasoned Action (TRA) posits that various factors can influence the behavior of individuals. According to this theory, an attitude is formed after considering all available information. Alongside attitude (Attitude Toward Behavior), subjective norms (Subjective Norm) influence the intention to use (Behavioral Intention), which serves as the immediate precursor to actual behavior (Actual Behavior).[225, 226] In simpler terms, an individual's attitude represents their personal opinion about a matter, while subjective norms are shaped by the opinions of others, should the individual act in one way or another. The TRA distinguishes between the intention to use and actual behavior, illustrating a positive correlation between the two components. A schematic overview of the model is provided in the following illustration. This framework articulates a nuanced understanding of how behavioral intentions are formulated, emphasizing the role of cognitive processes in evaluating the outcomes of actions and the social pressures that might affect these decisions. By dissecting the interplay between personal attitudes and the perceived expectations of others, the TRA sheds light on the underlying dynamics that propel individuals towards certain behaviors, offering a critical lens through which the adoption of technology, among other behaviors, can be examined.

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[222] Cf. Gellman/Turner 2013

[223] Cf. Heller et al. 2013

[224] Cf. Ajzen/Fishbein 1980

[225] Cf. Ajzen/Fishbein 1980

[226] Cf. Ajzen/Fishbein 1988

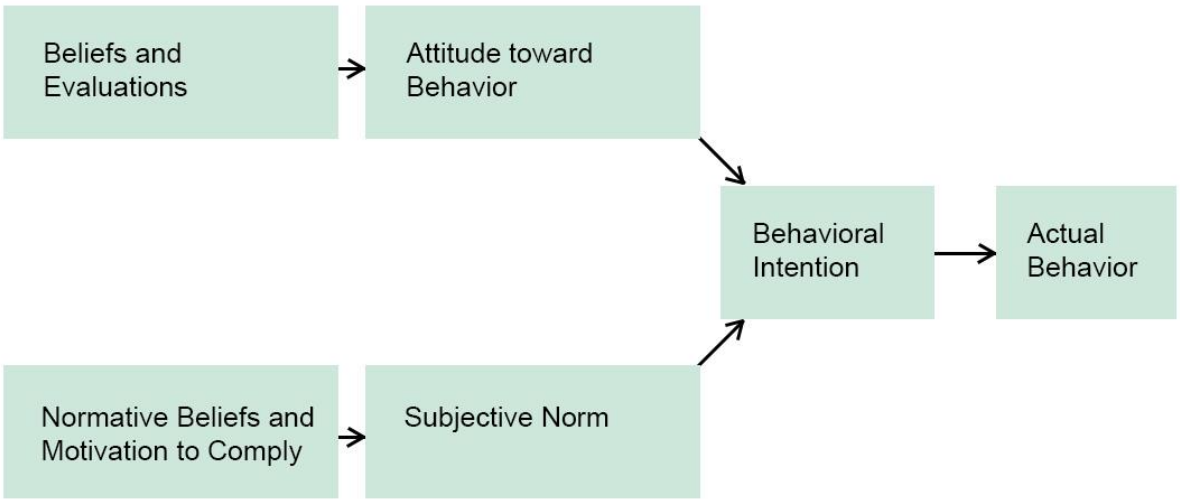

Figure 6 Theory of Reasoned Action (TRA) based on Ajzen and Fishbein, 1980, p. 100

The Theory of Planned Behavior (TPB), illustrated in the following figure, can be understood as "an extension of the Theory of Reasoned Action (TRA)". Its foundational structure, with determinants of behavior mirroring those of the TRA, is augmented "by the addition of perceived behavioral control (Perceived Behavioral Control) as a determinant of behavioral intention." This theory describes individual behavior as being rationale-based, meaning that individuals consider the potential consequences of engaging in or abstaining from a behavior. Hence, this added factor embodies assumptions regarding conditions "that may facilitate or impede the actual enactment of the behavior".[227]

The augmentation of this theory is particularly relevant for behaviors over which individuals perceive they have limited control. To illustrate this point more clearly, consider the example of overweight individuals with intentions to lose weight. Such individuals, assuming they are intent on losing weight, hold a positive attitude (Attitude toward Behavior) towards the behavior. Additionally, expected reactions from their social environment are deemed positive (Subjective Norm). However, many overweight individuals do not progress to actual behavior (Behavior), as they lack or have limited control (Perceived Behavioral Control) over themselves when faced with sweets, ultimately succumbing to the temptation.[228]

This addition to the theory highlights the significance of perceived behavioral control over the behavioral intentions and actual behaviors, especially in scenarios where personal control is perceived to be low. By accounting for this dimension, the TPB offers a more comprehensive framework for understanding how individual perceptions of control, alongside attitudes and subjective norms, influence the likelihood of engaging in specific behaviors.

[227] Cf. Ajzen 1991, p. 182-198

[228] Cf. Schwarzer 2004, p. 54f

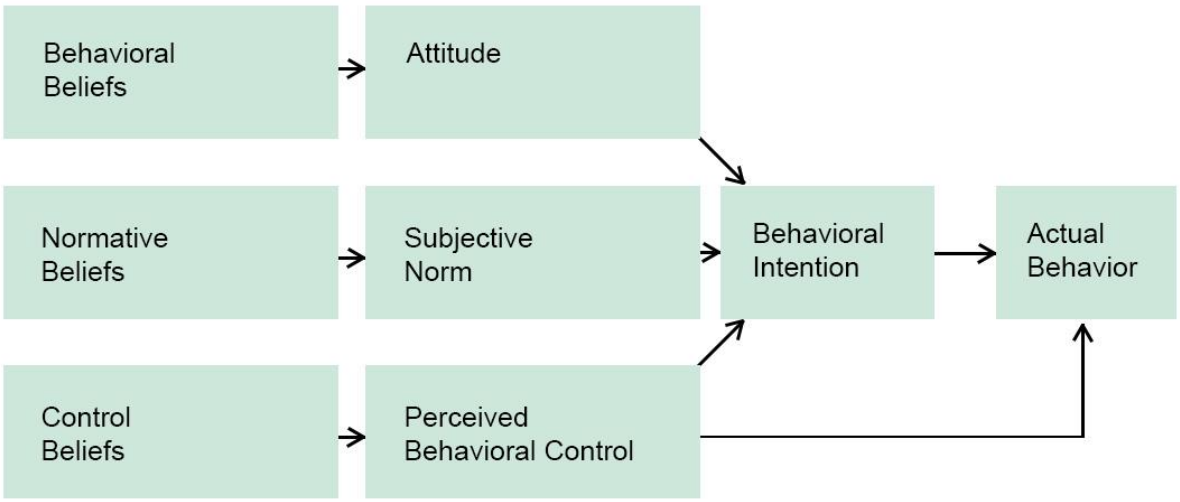

Figure 7 Theory of Planned Behavior (TPR) based on Ajzen, 1991, p. 182

Introduced by Davis in 1989, the Technology Acceptance Model (TAM) has been foundational in understanding "how individuals come to accept and use technology".[229] Central to TAM are two primary determinants: "Perceived Usefulness, the belief that a system enhances job performance, and Perceived Ease of Use, the belief that a system operates without much effort".[230] These aspects shape attitudes towards technology use, which, influenced by external factors like demographics and personality, predict the actual usage behavior. TAM's broad applicability aims to generalize user behavior across diverse computing technologies.[231]

However, the original model has been critiqued by several researchers for its selected determinants being insufficient to explain a complex phenomenon.[232] The model is illustrated in the following figure.

[229] Cf. Davis/Bagozzi/Warshaw 1989, p. 985

[230] Cf. Davis/Bagozzi/Warshaw 1989, p. 320

[231] Cf. Davis/Bagozzi/Warshaw 1989, p. 985

[232] Cf. Adams/Nelson/Todd 1992

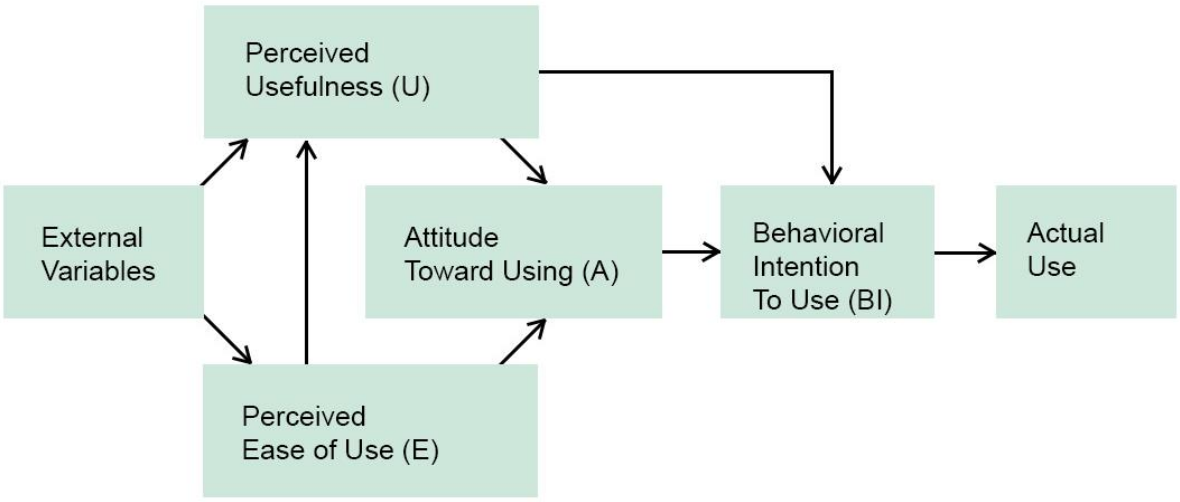

Figure 8 Technology Acceptance Model (TAM) based on Davis et al., 1989, p. 984

The explanation of TAM highlights its crucial role in delineating the factors behind technology adoption, with perceived usefulness and ease of use as key drivers. Despite criticisms of its simplicity, TAM's sustained relevance underscores its fundamental contribution to technology acceptance studies, laying groundwork for more sophisticated analyses. TAM is a recognized model foundational to numerous investigations confirming its efficacy in explaining technology use Yet, its scope and precision faced scrutiny, prompting Davis and Venkatesh to enhance it into TAM 2, incorporating additional variables that consider social influences and cognitive processes affecting technology utilization.[233] This extension enriches the model by elaborating on external factors that influence perceived usefulness and directly affect usage intentions.[234]

On one side there are social process variables. “Subjective Norms (Subjective Norm) are direct determinants of behavior. If there is a discrepancy with personal norms, actions are reluctantly taken.” Additionally, the image positively affects perceived usefulness if the technology use enhances the individual's social status.[235] Davis and Venkatesh articulate this as follows: "People may choose to perform a behavior, even if they are not themselves favorable toward the behavior or its consequences, if they believe one or more important referents think they should, and they are sufficiently motivated to comply with the referents".[236] The underlying principle is that individuals are influenced by the ideas and attitudes of others, leading them to act in a certain way motivated by others. This aligns with the assertions made by Fishbein and Ajzen. Moreover, the “voluntariness of use moderates the relationship between subjective norm and intention to act, measuring the strength of the influence of an independent variable (social norm) on another variable (intention to act)”.[237]

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[233] Cf. Venkatesh/Davis 2000, p. 186-204

[234] Cf. Venkatesh/Davis 2000, p. 194f

[235] Cf. Venkatesh/Davis 2000

[236] Cf. Venkatesh/Davis 2000, p. 187

[237] Cf. Ajzen/Fishbein 1980

On the other spectrum there are cognitive-instrumental process variables. “The relevance of usage outcomes to job results (Job Relevance), output quality (Output Quality), and the demonstrability of the result (Result Demonstrability) constitute the cognitive-instrumental process variables. These variables influence the perceived usefulness of the system (Perceived Ease of Use)”.[238] The participant's interaction (UX) serves as an intermediary factor for societal expectations, significantly affecting the PU and the “intention to use”.

Research findings indicate that variables related to social processes have a significant impact on the perceived utility, particularly in the initial stages; however, this effect lessens as the user gains more experience. This relationship is depicted in the following diagram, which highlights the dynamics among these variables and their influence on the acceptance of technology.

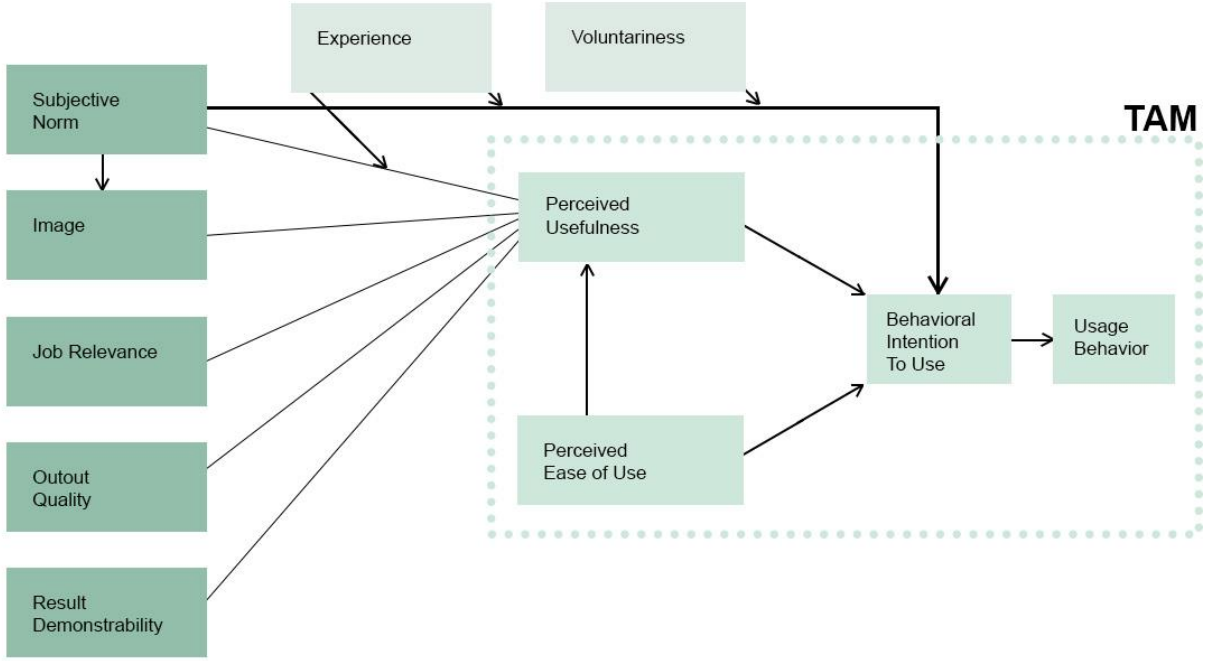

Figure 9 Extension of the TAM with specific external variables based on Vankatesh/Davis 2000

The Unified Theory of Acceptance and Use of Technology (UTAUT) emerged from an literature review by Venkatesh et al. as a summary of “the eight most prominent models of technology acceptance”.[239] The authors aimed to develop a unified model that is free from redundancies and empirically validated, integrating the key insights from these eight theories. This model, illustrated in the following table, seeks to explain and predict individual user behavior.[240] Four key determinants are identified as significant factors for intention to use and actual use: “Performance Expectancy, Effort Expectancy, Social Influence, and Facilitating Conditions are identified as key determinants influencing user acceptance and interaction with technology. The influence exerted by these factors is further nuanced by moderating variables such as Gender, Age, Experience, and Voluntariness of Use. These moderators adjust the intensity of the relationship between determinants and outcomes. For instance, an individual's experience with technology and their age can significantly alter how facilitating conditions affect the actual usage of the technology. It has been observed that the intention to use technology is predominantly

[238] Cf. Venkatesh/Davis 2000

[239] Cf. Venkatesh/Morris/Davis 2003

[240] Cf. Venkatesh/Morris/Davis 2003, p. 425ff

shaped by Performance Expectancy, Effort Expectancy, and Social Influence. Venkatesh and colleagues have demonstrated that Facilitating Conditions and the intention to use are crucial predictors of actual usage behavior." [241]

Acceptance model	*Source*
Theory of Reasoned Action (TRA)	(Ajzen and Fishbein, 1980)
Theory of Planned Behavior (TPB)	(Ajzen, 1985, 1991)
Technology Acceptance Model (TAM)	(Davis et al., 1989; Davis, 1989; Venkatesh & Davis, 2000)
Motivation Model (MM)	(Davis, Bagozzi, & Warshaw, 1992)
Combined TAM and TPB (C-TAM-TPB)	(Taylor & Todd, 1995)
Model of PC Utilization (MPCU)	(Thompson, Higgins, & Howell, 1991)
Innovation Diffusion Theory (IDT)	(Moore & Benbasat, 1991)
Social Cognitive Theory (SCT)	(Compeau, Huff, & Sid, 1999; Compeau & Higgins, 1995)

table 1 Models and Theories of Individual Acceptance according to Venkatesh/Morris/Davis 2003, p. 428-432

"Social influence refers to an individual's perception of how significant others in their environment view their use or non-use of the system. This influence diminishes with increasing experience with the technology and is only significant in cases of mandated use. If the use is voluntary, the effect is negligible".[242]

The perceived benefit from using a technology represents the performance expectancy regarding the use of the information system. Venkatesh et al. attribute the strongest influence on intention to use to this factor, with gender and age determining the strength of influence.[243]

Effort expectancy, defined as the expected effort required from an individual to use the system, depends on the novelty of the technology. The influence of this factor is anticipated shortly before the commencement and in the initial phase of actual use of the technology. As usage progresses, this effect diminishes.[244]

"Facilitating conditions describe the extent to which an individual perceives the organization's existing infrastructure as supportive. Regarding intention to use, this variable can be considered insignificant. However, Venkatesh et al. observe a direct impact of this variable on actual use, with age and experience moderating the facilitating conditions. With increasing experience, the effect of this variable grows as users can mobilize support".[245] Older individuals also have a greater need for support with complex systems; thus, besides experience, age also influences the facilitating conditions variable.[246, 247]

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[241] Cf. Venkatesh/Morris/Davis 2003, p. 427-431

[242] Cf. Venkatesh/Morris/Davis 2003

[243] Cf. Venkatesh/Morris/Davis 2003

[244] Cf. Venkatesh/Morris/Davis 2003

[245] Cf. Bergeron/Rivard/Serre 1990, p. 247-259

[246] Cf. Audretsch/Lehmann 2005

[247] Cf. Morris/Venkatesh 2000

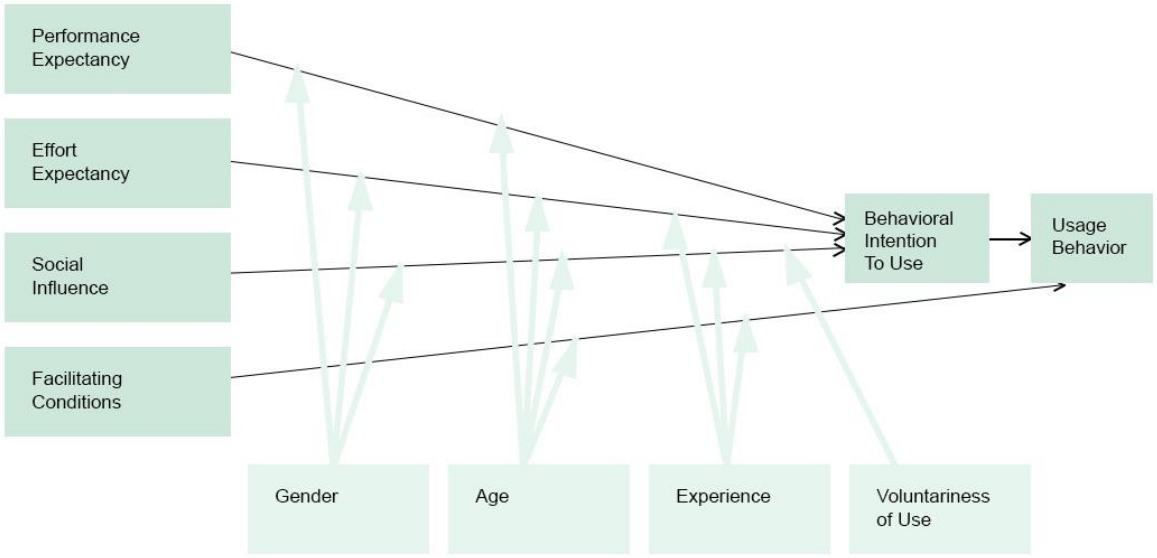

Figure 10 Unified Theory of Acceptance and Use of Technology (UTAUT) based on Venkatesh/Davis 2003, p. 447

2.7.2 Factors Influencing Acceptance

Numerous studies have delved into the determinants influencing the acceptance of mHealth applications, employing various diseases and methodologies for their investigations. Often, the focus is on specific applications, with a keen interest in their acceptance across diverse locations. It has been observed that demographic and socioeconomic factors, such as age and income, significantly impact the acceptance of mHealth apps. Particularly, individuals over the age of 65 and those with lower educational attainment and income exhibit less willingness to use these applications.[248, 249, 250, 251] Differences between urban and rural dwellers have also been noted, with urban residents showing higher acceptance rates. Furthermore, social influence plays a crucial role: recommendations or usage by close associates increase the willingness to engage with mHealth apps.[252]

The Unified Theory of Acceptance and Use of Technology (UTAUT) has elucidated that "performance expectancy, effort expectancy, social influence, and facilitating conditions influence the intention to use such technologies. Particularly for older individuals, effort expectancy is a key factor in determining behavioral intention."[253] Age also acts as a significant moderator affecting all facets of technology acceptance.

Perceived utility and technological self-efficacy are pivotal in determining acceptance. Motivation to use increases when users discern a clear benefit. However, barriers such as a lack of IT proficiency or lower

[248] Cf. Petersen/Jacobs/Pather 2020

[249] Cf. Ernsting et al. 2017

[250] Cf. Zhang et al. 2019

[251] Cf. Junker et al. 2020

[252] Cf. Macdonald/Perrin/Kingsley 2018

[253] Cf. Petersen/Jacobs/Pather 2020

socioeconomic status can diminish the willingness to use.[254] Personality traits also influence self-management capabilities and the acceptance of health applications, with younger and less extroverted individuals showing greater willingness.[255]

Finally, the expectation of an app's performance significantly dictates the willingness to adopt. If patients perceive no additional benefit or deem the functionality inadequate, acceptance decreases. Social influence, moderated by performance expectancy, and facilitating conditions exert both, "direct and indirect effects on the intention to use". Studies have also highlighted the "positive impact of perceived disease threat on acceptance and the variable effects of privacy risk concerns", underscoring the complexity of factors influencing the acceptance of mHealth.[256]

2.8 User Experience

It can be inferred that user acceptance is significantly influenced by perceived benefits, individual predispositions, and attitudes towards technological innovations. The entirety of experiences gained from using a product can be defined as User Experience (UX). The focus of User Experience is not primarily on technology, design, or the interface, but rather on the experience elicited by the product. Hassenzahl characterizes these experiences as "an episode, a stretch of time one has lived through, including seen and heard things, feelings and thoughts, motivations and actions, that are closely interlinked, stored in memory, named, relived, and communicated to others. An experience is a story that emerges from the dialogue of a person with their world through action".[257] Although User Experience is often associated with the entertainment industry, the interaction with any product elicits a specific experience. According to Hassenzahl, the aim of Experience Design is to create an experience that serves as the foundation for the design of a product.[258] For instance, the experience associated with different objects fulfilling the same function can vary depending on the design, thereby evoking different emotions.

In ISO 9241-11, User Experience is defined as "the perceptions and responses of a user resulting from the use and/or anticipated use of a system, product, or service. […] The perceptions and responses of users include their emotions, beliefs, preferences, perceptions, physical comfort, behaviors, and achievements that occur before, during, and after use. […] User Experience is a consequence of brand image, presentation, functionality, system performance, interactive behavior, and the supportive capabilities of a system, product, or service. It also results from the internal and physical state of the user, shaped by previous experiences, attitudes, skills, abilities, and personality; and from the context of use."[259]

Expanding on this: "A user-centered design can only shape those aspects of the User Experience that result from the designed elements of the interactive system." Adikari, McDonald, and Campbell define the objective of User Experience as understanding the interactive experiences of users with products or

[254] Cf. Macdonald/Perrin/Kingsley 2018

[255] Cf. Su et al. 2022

[256] Cf. Zhang et al. 2019

[257] Cf. Hassenzahl 2014

[258] Cf. Hassenzahl 2014

[259] Cf. International Organization for Standardization 2018

systems, centered around core concepts such as joy, fun, aesthetics, and hedonistic qualities.[260] According to Norman, User Experience encompasses all aspects of a user's interaction with a product. In the context of User Experience, usability does not necessarily equate to a positive User Experience.[261]

According to Adikari, McDonald, and Campbell, “there is no universal definition of User Experience”; rather, there exist various perspectives on it.[262] In ISO FDIS 9241-210, User Experience is defined as "the perceptions and responses of a person resulting from the use or anticipated use of a product, system, or service, with two main aspects highlighted: use and anticipated use."[263] This definition also takes into account “emotions, beliefs, perceptions, physical and psychological reactions, behavior, and performance of users that occur before, during, and after use.”[264] Usability is utilized as a criterion for evaluating various aspects of User Experience.

In the process of design development, to achieve a positive User Experience, three central questions should be posed: Why? What? How?

The questions "What?" and "How?" address the functionalities of the product and the manner in which interaction with the product occurs, where the context of use is of central importance. "Why?", on the other hand, focuses on the purpose for which users intend to use the product.[265]

The discernible intersections observed between the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) substantiate the premise that these theoretical frameworks implicitly recognize the paramount importance of user experience and the subjective interpretations of individuals in the process of technology acceptance. This implicit acknowledgment underscores a critical dimension in the discourse on technology adoption, suggesting that the determinants of technological acceptance extend beyond the conventional bounds of usability and functionality to encompass the nuanced and subjective experiences of users.

3 Research Model Development

Throughout the preceding chapters of this Master's thesis, a comprehensive analysis of the topic "Age-Appropriate User Experience and Technology Acceptance among Elderly Users for Prescription Digital Health Applications" has been conducted. The insights gained underscore the imperative to develop a research model that takes into account the specific requirements of older user groups as well as identifies the factors influencing their acceptance and engagement with digital health solutions. This introduction to the chapter leads into the section on the development of the research model, which aims to systematically capture and analyze the complex interactions between technological features, user experience, and acceptance factors. The research model is grounded in the solid theoretical foundations of technology acceptance and user experience, integrating these with the specific needs of older individuals derived from literature and empirical studies. The focus is particularly on exploring how digital

[260] Cf. Adikari/McDonald/Campbell 2011, p. 25

[261] Cf. Norman/Nielson 1998

[262] Cf. Adikari/McDonald/Campbell 2011, p. 26

[263] Cf. International Organization for Standardization 2018

[264] Cf. International Organization for Standardization 2018

[265] Cf. Adikari/McDonald/Campbell 2011, p. 26

health applications must be designed to achieve high user acceptance and positive user experience among the senior demographic. Through detailed development and subsequent empirical validation of the model, valuable insights are intended to be gleaned for the design of age-appropriate digital health solutions, thereby contributing to the enhancement of digital healthcare provision for the elderly.

3.1 Technology Acceptance Model in combination with User Experience

Upon reviewing the preceding chapters that delve into technology acceptance models and aspects of User Experience, the selection of the Technology Acceptance Model as a foundation for integrating these focal points appears wise. TAM concentrates on Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) as the primary determinants of technology acceptance, pivotal for comprehending how individuals accept and utilize new technologies.

Augmenting TAM with UX components could facilitate a more profound comprehension of how emotional and aesthetic experiences influence technology acceptance and usage. This is particularly pertinent as modern technologies, notably in the realm of mHealth Apps, increasingly aim to cultivate a positive user experience to boost their acceptance and ultimate utilization.

Although the Unified Theory of Acceptance and Use of Technology (UTAUT) seemingly offers a more comprehensive framework by incorporating additional factors such as social influence and facilitating conditions, the specificity of TAM concerning PU and PEOU might be more suitable for this study's focus on UX in mHealth applications. TAM provides a solid starting point for examining the foundational assumptions about technology acceptance, which can then be expanded to include UX dimensions for a more complete understanding of acceptance and usage.

The evolution of the TAM since its introduction by Davis in the late 1980s has been notable with over 86.000 citations on JSTOR, shaping the understanding of how individuals come to accept and use new technologies. The TAM posits that perceived ease of use (PEOU) and perceived usefulness (PU) are key to an individual's technology acceptance. While invaluable, this model has predominantly focused on the technology's functionalities and the user's attitudes, potentially sidelining the broader context of technology implementation.

The socio-technical systems framework, introduced by Trist and Bamforth in 1951, offers a holistic perspective, stressing the interplay between technology, individuals, and organizational structures. This approach underscores that technology acceptance hinges not just on the technology's features or user perceptions but also on its integration into the existing socio-technical milieu. Recent works have reignited interest in this integrated approach, advocating for the exploration of technological determinants in technology acceptance studies.[266, 267, 268]

Against this backdrop, this study seeks to refine TAM by embedding User Experience aspects into the model. UX encompasses the broad spectrum of a user's reactions to “using a product, system, or ser-

[266] Cf. Davies/Coole/Smith 2017

[267] Cf. Maier/Engels/Steffen 2020

[268] Cf. Paulsen et al. 2020

vice, including emotions, beliefs, preferences, perceptions, physical and psychological responses, behaviors, and achievements".[269] This study aims to devise a more nuanced framework that not only assesses technological functionalities but also considers the experiential factors crucial for user acceptance and satisfaction. Given the swift advancements in mHealth apps and their potential in enhancing healthcare delivery for seniors, this study specifically examines how UX factors could influence the acceptance of mHealth apps among this demographic. Seniors form a distinct user group whose acceptance of technology might be swayed by usability challenges, health-related needs, and attitudes towards technology. Incorporating UX into TAM could thus offer deeper insights into designing mHealth apps that are both functional and conducive to a positive user experience for seniors.

Hornbæk et al. identified a significant void in technology acceptance discourse, emphasizing the limitations of existing models in offering actionable insights for technology selection and adaptation. They proposed the integration of other aspects such as User Experience as an extension to TAM, advocating for an empirical investigation of TAM and other areas' converging constructs.[270] This work is trying a TAM's extension through the lens of UX, especially concerning mHealth app acceptance among seniors, bridges the gap between traditional technology acceptance models and the broader socio-technical systems perspective. It aims to foster the development of user-centric mHealth applications tailored to the senior population's preferences, ultimately encouraging their adoption and use for health and well-being.

In UX, a domain within human-computer interaction, the goal is to elevate technology from mere functionality to offering experiential qualities that resonate with users. This involves distinguishing between pragmatic and hedonic attributes, thereby allowing a detailed exploration of how different UX facets affect user perceptions and intentions toward technology use. In the theoretical works of Hassenzahl et al. the UX can be based on the following 3 categories: Hedonic quality, functionality and usability. Hedonic quality pertains to the characteristics of a user interface that cater to pleasure and the avoidance of boredom and discomfort. Hedonic quality encompasses elements that are enjoyable, original, interesting, appealing, and new. Functionality as a core aspect of UX, emphasizing designs that reliably meet user goals across various products. It focuses on usability and effectiveness. Key considerations include the relevance and operational reliability of the product to fulfill user expectations. Usability, in UX research, is defined as "the effectiveness, efficiency, and satisfaction with which specific users can achieve goals using a product in a specific context."[271] It covers ease of use, task completion speed, error minimization, user satisfaction, and the intuitiveness and learnability of the interface.[272, 273, 274]

This model suggests that PU might be associated with technological functionality aspects, while PEOU might align with usability aspects. Furthermore, hedonic qualities of technology could directly impact users' behavioral intentions, but also according to Vankatesh/Davis 2000, the PU, highlighting the motivational and originality appeal of the new technology.

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[269] Cf. International Organization for Standardization 2018

[270] Cf. Hornbæk/Hertzum 2017

[271] Cf. Hassenzahl/Tractinsky 2006, p. 91

[272] Cf. Hassenzahl/Tractinsky 2006, p. 91-97

[273] Cf. Brandenburg/Vogel/Drewitz 2013, p. 450f

[274] Cf. Mahlke/Thüring 2007

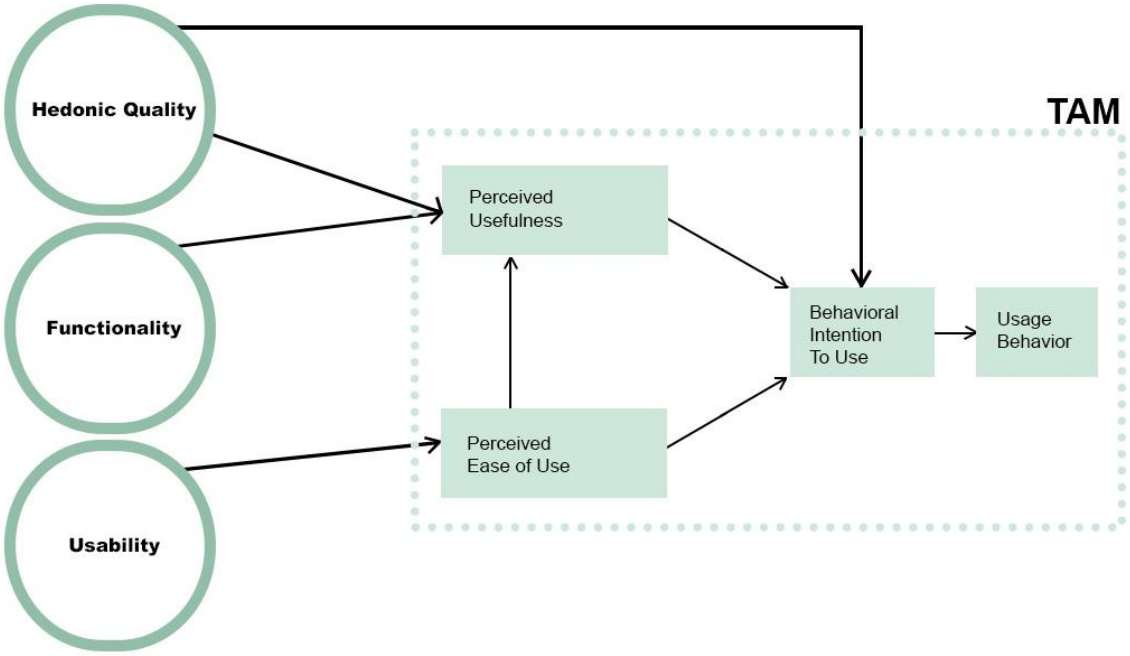

Figure 11 Extension of the TAM with concrete UX variables based on Davis 1989 and the literature analysis

This revised approach, encapsulated within a new TAM, presents a comprehensive framework for examining technology acceptance. It emphasizes the necessity of integrating UX considerations into the design and evaluation of technological systems, ensuring these systems are not only functional but also align with user preferences and needs. Through this perspective, technology acceptance can be seen not merely as a product of utility and ease but as a result of a deeper engagement with the user's comprehensive interaction with technology.

3.2 Research Model

This paper is focused on the development of a comprehensive research model that intersects the fields of technology acceptance, User Experience, and the specific needs of elderly individuals. At the center of this study lies the inquiry into how digital health applications must be designed to achieve high acceptance and a positive user experience among senior citizens. Esteemed acceptance models such as the Technology Acceptance Model and the Unified Theory of Acceptance and Use of Technology are employed and expanded upon with aspects of User Experience and age-specific requirements. An extensive literature review, which includes both classical acceptance models and contemporary insights into User Experience and the specific demands of older individuals regarding technology, has been conducted to develop an integrative research model. It is postulated that technology acceptance among seniors is not determined solely by perceived usefulness and ease of use but also by age-specific factors such as sensory and cognitive abilities, technology experience and apprehensions, and the need for social support.

The core components of the conceptual framework are composed of derivations from user acceptance research and user experience research. Independent variables such as technological capabilities and accessibility, age-specific requirements, social support, and health consciousness. These are found to impact the dependent variables of technology acceptance and User Experience, the main focus of this study.

In detailing the independent variables, the necessity for digital health applications to be accessible and to possess the technological capabilities that cater specifically to the elderly, taking into consideration their unique requirements and limitations, is emphasized.

Moderating variables are recognized for their role in shaping the individual experiences of senior users with digital health applications. These factors contribute to the complexity of the user experience, necessitating a nuanced approach to application design and implementation. The inclusion of social support mechanisms within the independent variables is highlighted as a crucial factor in promoting technology acceptance and enhancing the overall user experience for senior users. Furthermore, health consciousness is identified as a significant characteristic of the target user group, influencing their engagement and interaction with digital health technologies.

The dependent variables, technology acceptance, and User Experience, are explored within the context of the aging population's interaction with digital health applications. A direct positive effect of perceived usefulness and user-friendliness on acceptance and the significant influence of social surroundings and facilitating conditions on the readiness to use digital health applications are hypothesized.[275]

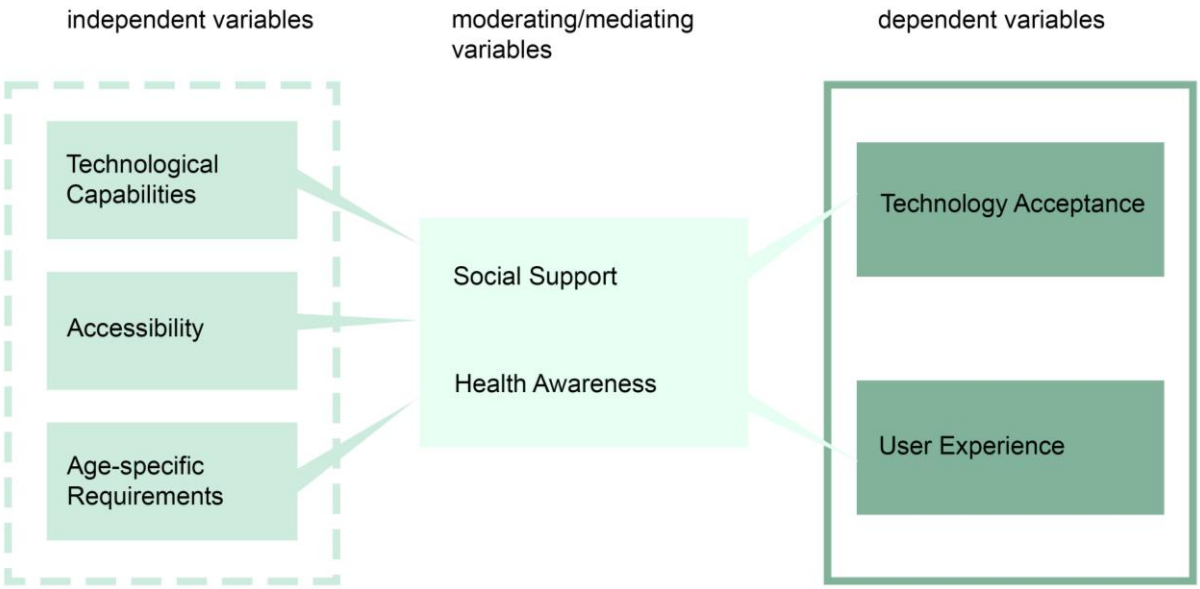

Figure 12 Visualization of the conceptual framework as a research model for this study. Own representation based on the theory by Latif (2022)

This approach allows for a systematic capture of the complexity of the research subject and provides a solid foundation for the empirical investigation of the research question:

"Are technology acceptance and User Experience among seniors influenced by age-specific requirements, accessibility and capabilities when using prescription digital health applications?"

This question aims to capture the central aspects of the investigation and sheds light on how the specific needs and capabilities of older people shape their attitudes towards and experiences with digital health technologies. It enables the exploration of not only the direct influences of the identified variables but also the moderating effects, such as social support and health consciousness, on technology acceptance and User Experience. For the empirical validation of the model, the variables are precisely defined, and the methodology for their measurement is detailed. This approach presents a sound research model that forms the basis for the empirical investigation of technology acceptance and User

[275] Cf. Latif 2022

Experience among seniors in the use of digital health applications. By integrating an adapted acceptance model in harmony with User Experience and the specific requirements of older individuals, an innovative contribution to research in this area is offered.

3.3 Formulating Hypotheses: Bridging Technology Acceptance and User Experience in Elderly Digital Health Usage

Following the detailed exposition of the comprehensive research model, a pivotal aspect of empirical investigation is transitioned into: the formulation of hypotheses. These hypotheses are derived from the interplay between the established theoretical framework and the nuanced insights garnered from an extensive literature review. They aim to systematically test the relationships posited between technological capabilities, age-specific requirements, social support, health consciousness, and their collective impact on technology acceptance and user experience among seniors. As this section is delved into, each hypothesis is articulated with clarity, grounded in the conceptual underpinnings of our model and preparing the groundwork for empirical validation. Through this process, the dynamics of seniors' engagement with digital health applications are not only elucidated but also contribute to the broader discourse on enhancing digital inclusivity and efficacy in healthcare. In addition to outlining the theoretical underpinnings and objectives of the formulated hypotheses, an accompanying table is provided. This table meticulously categorizes each hypothesis into either the domain of Technology Acceptance or User Experience, offering a clear delineation of the primary focus of each hypothesis. Furthermore, it enumerates the main variables impacted by each hypothesis, enhancing the comprehension of the intricate relationships explored within our research model by the reader. This structured presentation facilitates a deeper understanding of the proposed hypotheses and their foundational role in navigating the empirical investigation that follows.

	Hypothesis	***Category***	***Focused variable***
H1	High expectations of effectiveness positively influence seniors' intentions to use prescription digital health applications. This aligns with the study's emphasis on the importance of perceived utility in technology acceptance among seniors.	Technology Acceptance	Independent Variable: Health Consciousness (effectiveness expectations) Dependent Variable: Technology Acceptance
H2	Seniors' willingness to try prescription digital health applications increases when perceived benefits align with their expectations and when supported by their social environment. This reflects the study's discussion on the role of social influence and perceived usefulness in technology acceptance.	Technology Acceptance	Independent Variables: Technological Capabilities and Accessibility (perceived value), Social Support (social environment) Dependent Variable: Technology Acceptance
H3	Doctor recommendations significantly influence seniors' acceptance of new digital treatment methods, underlining the study's insight into the trust and authority figures' impact on technology acceptance.	Technology Acceptance	Independent Variable: Social Support (doctor's recommendation) Dependent Variable: Technology Acceptance

H4	The skepticism of seniors towards digital treatment methods requires targeted and comprehensive training to facilitate acceptance, highlighting the need for clear communication and education on digital health tools as discussed in the document.	UX	Moderating Variables: Technological Experience and Anxiety, Cognitive and Physical Abilities (skeptical attitude and training needs) Dependent Variables: Technology Acceptance, User Experience
H5	The younger the age within the senior demographic, the higher the tendency to consider using a prescription medical app, suggesting a gradient of technology openness within the age group.	Technology Acceptance	Independent Variable: Age-specific Requirements (younger age within the senior demographic) Dependent Variable: Technology Acceptance
H6	The efficiency and quality of the results produced by new technology are directly correlated with its perceived usefulness, reflecting the study's focus on the importance of tangible benefits for technology acceptance.	Technology Acceptance	Independent Variable: Technological Capabilities and Accessibility (efficiency and quality) Dependent Variable: Technology Acceptance (perceived usefulness)
H7	The comprehensibility and reliability of new technology are directly correlated to its perceived user-friendliness, echoing the study's emphasis on ease of use as a critical factor for senior users.	UX	Independent Variable: Technological Capabilities and Accessibility (comprehensibility and reliability) Dependent Variable: User Experience (perceived user-friendliness)
H8	The excitement and innovativeness of new technology are directly correlated with the user's intention to use new technology, which may be explored further in the context of seniors' openness to innovation.	UX	Independent Variable: Technological Capabilities and Accessibility (innovativeness) Dependent Variable: Technology Acceptance
H9	A better user experience of the app significantly increases the willingness to use prescription apps, aligning with the study's discussion on the importance of UX in technology acceptance.	UX / Technology Acceptance	Independent Variable: User Experience Dependent Variable: Technology Acceptance (willingness to use prescription apps)
H10	Prescription apps that have undergone the DiGA fast-track process are perceived to have better user experience, emphasizing the role of regulatory approval in shaping user perceptions of app quality.	UX	Independent Variable: Technological Capabilities and Accessibility (DiGA process testing) Dependent Variable: User Experience
H11	Social support mechanisms embedded within prescription digital health applications enhance seniors' usage intentions, drawing on the study's focus on social influence as a factor in technology acceptance.	Technology Acceptance	Independent Variable: Social Support (embedded social support mechanisms within digital health applications) Dependent Variable: Technology Acceptance (seniors' usage intentions)

H12	Accessibility features and age-specific design considerations in digital health applications positively affect seniors' acceptance and user experience, reflecting the study's emphasis on age-specific requirements and capabilities.	Technology Acceptance	Independent Variable: Technological Capabilities and Accessibility (accessibility features and age-specific design considerations) Dependent Variables: Technology Acceptance, User Experience (seniors' acceptance and user experience)

table 2 Overview of the Hypotheses

4 Research Methodology

The advancement of digital health technologies presents a pivotal opportunity to enhance the quality of life for seniors, a demographic increasingly engaging with digital solutions for health management. This thesis adopts a multifaceted research methodology to dissect the layers of technology acceptance and user experience among this group, scrutinizing the interface where human behavior meets digital innovation. By navigating through qualitative expert interviews with physicians, quantitative surveys with seniors, and a thorough evaluation of existing DiGAs, this research endeavors to construct a comprehensive panorama of the current landscape and future directions of prescription digital health applications.

Empiric method I - Qualitative Expert Interviews with Physicians: Delving into qualitative interviews with healthcare professionals offers an essential vantage point, uncovering the subjective nuances that influence physicians' recommendations of DiGAs. This approach grants a voice to the medical experts at the frontline of digital health application deployment, whose perspectives are crucial for understanding the ecosystem's dynamics. It illuminates the criteria physicians consider when prescribing these applications, the challenges they face in integrating technology into care plans, and their perceptions of patient receptivity and engagement.

Empiric method II - Quantitative Surveys Targeting Seniors: The deployment of quantitative surveys elucidates the statistical underpinnings of seniors' interactions with digital health technologies. By reaching a broad spectrum of the elderly population, this method captures diverse experiences and attitudes, providing a robust dataset from which to draw generalizable insights. It allows for the empirical testing of hypotheses derived from the literature review and expert interviews, offering a quantified perspective on technology acceptance and UX among seniors.

Empiric method III - Evaluation of Existing DiGA: The critical analysis of DiGAs through a structured evaluation matrix not only benchmarks the current offerings against identified needs but also integrates insights from the qualitative and quantitative research phases. This triadic methodological structure ensures a holistic view, aligning theoretical frameworks with practical application and user feedback. By identifying gaps and aligning with seniors' specific requirements, this phase underscores the practical implications of research findings, steering the future development of more accessible, user-friendly, and effective digital health solutions.

This methodological trifecta is meticulously chosen to address the complex nature of technology adoption and utilization among seniors, providing a balanced and comprehensive understanding of the factors that drive or hinder the effective use of prescription digital health applications. The synthesis of qualitative depth, quantitative breadth, and practical evaluation in this research model not only addresses the nuances of seniors' experiences with DiGAs but also offers a critical contribution to the academic and practical discourse on enhancing healthcare delivery through digital innovations. In the forthcoming Chapter 4, empirical data will be collected and compiled. Thereafter, in Chapter 5, these data will be discussed collectively to address the hypotheses and the primary research question. The results will be evaluated, limitations of the research will be highlighted, and conclusions will be drawn.

4.1 Methodology I: Qualitative Expert Interviews

The decisive element in choosing the suitable empirical approach hinges on the specific research interest. Fundamentally, “the decision falls on quantitative or qualitative data collection methods, or a combination of both methods.” [276] Quantitative social research is characterized by “the aggregation of data, including by standardized questionnaires, an analysis of them, and the abstraction into numerical forms. The aim is to explain social phenomena, societal developments, and the culturally and socially shaped reality.” [277] The approach of qualitative social research, on the other hand, aims to "describe life worlds 'from the inside out' from the perspective of the acting individuals by making visible individual values, attitudes, interpretive patterns, and processes.” [278] These interviews particularly are suited as a “method of collection to gain access to these subjective perspectives since they provide respondents with the opportunity to articulate and narrate their own experiences and knowledge base. The expert interview established itself, even though it is often disparaged as a mere informational interview due to its typically semi-structured interview methodology and was long considered secondary from a methodological (debate) perspective.” [279, 280] Nevertheless, within the scope of this work, the expert interview offers several advantages over other forms of qualitative interviews, such as open and flexible or more closed and structured interviews. It can be characterized as follows:

"It concerns investigations in which [...] situations or processes are to be reconstructed in order to find a social science explanation. (...) In these investigations, expert interviews serve the purpose of making the specific knowledge of people involved in the situations and processes accessible to the researcher." [281]

“Expert interviews distinctively emphasize the contextual relevance of content, sidelining the detailed exploration of individual or collective life stages typically featured in biographical research through narrative interviews. Instead of presenting a holistic view of a person's life, these interviews delve into the organizational or institutional facets that represent specific segments of an individual's experiences, manifested through their expert knowledge. This approach underscores the intrinsic connection between

[276] Cf. Wolf/Priebe 2003

[277] Cf. Raithel 2006, p. 65f

[278] Cf. Flick/Kardorff/Steinke 2022, p. 14

[279] Cf. Lamnek 2008, p. 334

[280] Cf. Liebold/Trinczek 2009, p. 35

[281] Cf. Gläser/Laudel 2010, p. 13

expert knowledge and the roles or actions within the professional realm from a sociological perspective on knowledge, thereby lending a practical dimension to the concept." [282] Consequently, experts can be defined as "individuals who, based on specific practical or experiential knowledge related to a clearly defined problem niche, creating the opportunity to structure the concrete field of action meaningfully and action-guiding for others".[283]

By examining the context of expert interviews, the "primary focus shifts from the experts' specific knowledge to the practical effects of their expertise and their capacity for action-oriented problem-solving. The designation of someone as an expert does not stem from personal attributes but rather from external recognition. This recognition begins with the researcher's initial invitation to participate and is further emphasized during the interview process, where respondents are prompted to demonstrate their expertise." [284]

At the beginning, it's highlighted that "experts are engaged for their insights, detailed issue accounts, and actions closely related to their practice, facilitated through a semi-structured interview format. Unlike standardized questionnaires that constrain responses with predetermined options, semi-structured interviews afford interviewees the latitude to express open, reflective, and narrative responses. The approach relies on a flexible set of questions tailored to the themes and challenges under investigation, offering a framework rather than a rigid script. The interview guide acts as a cognitive prompt, ensuring vital topics are covered while allowing for adjustments in the conversation's direction as needed. This format grants both parties—the interviewer and the interviewee—the flexibility to navigate the interview dynamically, adjusting question sequences and delving deeper into topics as required. This capacity to tailor the dialogue to the unfolding interview scenario presents a distinct advantage over more rigid data collection methods, enhancing the depth and relevance of the information gathered." [285]

Considering the research interest of this work, which is grounded in the research question, the structured expert interview will be utilized for the following reasons:

(1) The expert interview emphasizes specialized information and underlying practice-close insider knowledge. Pertaining to the investigation of prescribing practices and direct patient contact, the expert interview methodology facilitates analysis and firsthand insights, as prescriptions for Digital Health Applications are likely initiated by the treating physician at the point of first contact.

(2) The individuals selected for interviews possess specific expert knowledge by virtue of their function or role in the professional sphere, rendering them apt conversational partners for the research aim at hand.

(3) The structured method of data collection—owing to its emphasis on an structured communication culture but also the ability to flexibly adapt to the interview situation—affords the respondent ample scope for explanations while simultaneously providing the interviewer with evaluatable and structuring frame.

(4) Given that prescriptions for Digital Health Applications have only recently been legislated, the literature lacks longitudinal studies. Expert interviews can thus offer initial qualitative insights into how the

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[282] Cf. Meuser/Nagel 2002, p. 71

[283] Cf. Bogner/Littig/Menz 2002, p. 13

[284] Cf. Bogner 2014, p. 14

[285] Cf. Riesmeyer 2011, p. 224

technology is being received and the perception concerning the adaptation chances of the senior user demographic.

4.1.1 Expert Selection

A key element in the expert interview process is the purposeful and justified selection of experts. Moreover, "research-practical factors such as the accessibility and willingness of interview partners also play a pivotal role in the selection process".[286] Based on the outlined criteria for expert designation, four individuals were selected for interviews, identified through their roles and affiliations as practicing physicians. This professional status firmly establishes them as experts in the field. Froschauer et al. emphasize that these individuals bring to the research a deep, field-specific operational knowledge, which is a direct outcome of their active professional involvement with the subject matter of the study.[287]

When considering expert interviews from a statistical perspective, achieving representativeness can not be possible—hence, the qualitative social research speaks of content representativeness. "This concept is based on the notion that respondents are not perceived as individual persons but as representatives of a group that encompasses all the characteristics and aspects under investigation within the sample".[288] To adhere to this principle, the selection focused on experts from different specialties and medical institutions. There was also an opportunity to interview a representative from DiGA Info Vertrieb Bayern. DiGA Info is an information society providing medical professional information on the new care sector of Digital Health Applications. However, it was decided to maintain a more homogeneous group of prescribing physicians among the interviewed experts, and therefore, the interview was excluded from the analysis.

Nonetheless, the diversity of the sample can be emphasized, as it ranges from young specialists in hospitals to long-standing general practitioners. The relevant information about the experts, particularly their position and institutional affiliation, is organized in a table as follows:

id	*Expert*	*specialist*	*medical institution*	*hierarchical role*
I1	[redacted]	Transfusion Medicine and Emergency Medicine	[redacted]	Specialist
I2	[redacted]	Internal Medicine and Geriatrics	[redacted]	Senior Physician
I3	[redacted]	Internal Medicine and Geriatrics	[redacted]	Senior Physician
I4	[redacted]	General Practice	[redacted]	Practice Owner

table 3 Overview of the experts, their specialty, medical institution and hierarchical role

[286] Cf. Gläser/Laudel 2010

[287] Cf. Froschauer/Lueger 2003

[288] Cf. Mayring 2010

4.1.2 Categorization according to Mayring

A qualitative content analysis is intended to be utilized in this work since it not only possesses a methodological advantage but also pursues an aim that aligns with the research focus of this elaboration, which is primarily directed towards information acquisition. “The qualitative content analysis is capable of systematically extracting research-relevant information from the typically extensive interview material. This approach is only feasible when the spoken word is not itself the subject of investigation, as is the case with biographical constructions or contextual meanings. The essence of qualitative content analysis lies in the development of a category system that serves as the fundamental evaluation tool. This category system is used to search and analyze the material according to specific structures and criteria. Depending on the objective, various techniques can be employed in the search grid:” [289]

“(1) Summary: The material is minimized to a manageable extent through abstraction and reduction, thus producing a clear representation of the raw material.

(2) Explication: Focus is directed towards individual ambiguous text passages, which are to be questioned and explained with the help of additional material.

(3) Structuring: The aim of the analysis is to filter out certain aspects from the material, to lay a cross-section through the material under previously determined ordering criteria, or to assess the material based on certain criteria".[290]

Within the scope of this study, a structuring approach is adopted, with a focus on the substantive elements of the interview data. To organize this content, two categorization methods are available: inductive and deductive. The inductive approach involves generating categories directly from the data itself, ensuring that the categorization emerges organically based on the material's specifics. Conversely, the deductive method of category creation is guided by theoretical considerations, with categories predefined prior to the analysis of the data, thereby framing the analysis within established conceptual boundaries.[291] In the discussion, the deductive approach is utilized, identifying key opportunities for technology acceptance and user experience from scholarly sources, as detailed in chapters 2 and 3. Throughout the qualitative content analysis, the established category system serves both as a framework for exploration and a means for systematic organization, structuring the material across multiple reviews.

The flexibility inherent to this evaluation methodology is highlighted by the potential for iterative refinement and expansion of the category scheme throughout the analytical process. This adaptability is crucial when, during the expert interviews, new topics emerge that do not neatly fit into existing categories, allowing for the category system to be accordingly broadened to encompass these elements. The methodology for qualitative content analysis is characterized by its systematic and structured nature, delineated into distinct phases. This organization ensures a clear, step-by-step progression through the analysis, enhancing both the depth and rigor of the examination. A procedural framework for conducting

[289] Cf. Mayring 2016

[290] Cf. Mayring 2016, p. 115

[291] Cf. Mayring 2010

structured qualitative content analysis can thus be outlined, ensuring a comprehensive and flexible approach to analyzing qualitative data:

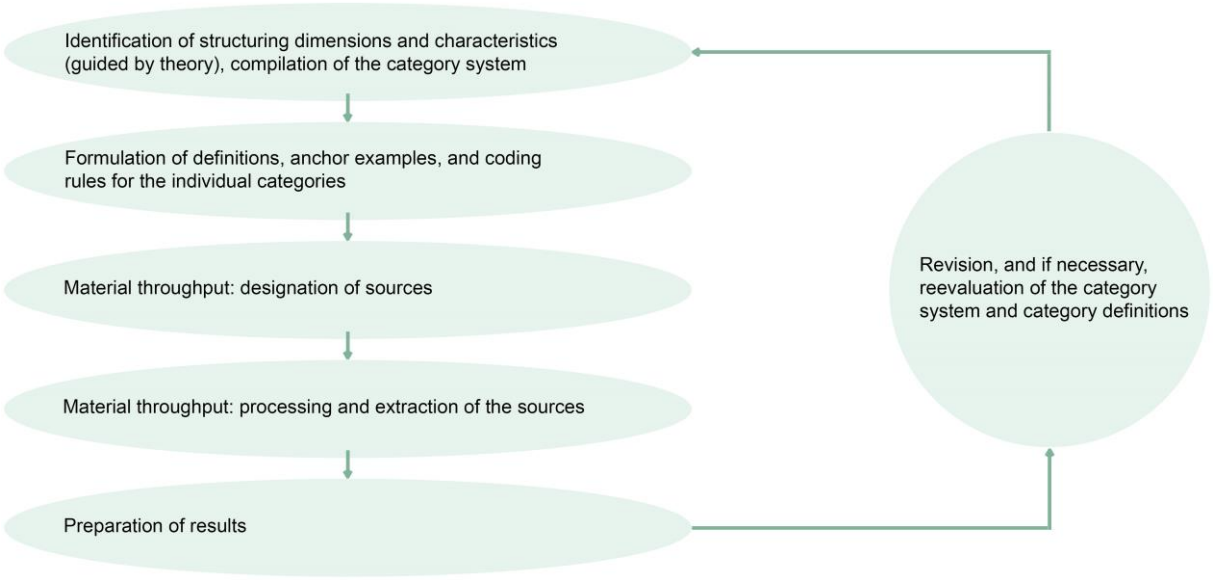

Figure 13 Flowchart of the structured qualitative content analysis. Own illustration based on Mayring, 2010

"The foundational approach to the construction of the deductive category system entails three key steps:

- Definition of Categories: It is determined which text elements belong to the respective category.
- Anchor Examples: Clear text passages from the interview are provided as exemplary instances for each category.
- Coding Rules: To avoid demarcation difficulties between categories, rules are defined to create unambiguous assignments." [292]

The structure of the category schema is guided by the theoretical expositions of Chapter two and the research model in chapter three and by the hypothesis of this elaboration. Consequently, the following search and evaluation grid emerges.

category	***definition***	***Coding rule***
RQ1 Assessment of DiGA	Examines how healthcare professionals evaluate the effectiveness, usability, and suitability of Digital Health Applications within their practice. This includes opinions on the benefits and limitations of DiGAs, potential impact on patient care, and their integration into current healthcare processes.	Deductive summery: Encompasses statements, assessments, and discussions by healthcare professionals about the effectiveness, usability, and suitability of Digital Health Applications in their clinical practice.

[292] Cf. Mayring 2010

RQ2 Technology acceptance	Focuses on capturing statements and insights related to the experiences and assessments of seniors regarding the acceptance of mHealth technologies. It encompasses seniors' willingness to adopt and use mHealth solutions, including factors that influence their acceptance, such as perceived usefulness, ease of use, trust, and personal attitudes towards technology.	Deductive summery: Code any expressions or accounts detailing the elderly population's engagement with, attitudes towards, and acceptance of mHealth applications. Include references to specific factors that contribute to or hinder their willingness to incorporate these technologies into their healthcare management, such as usability concerns, perceived benefits in health monitoring, apprehensions about data security, or the influence of social norms and support.
RQ3 User Experience	Seeks to identify statements that provide insights into the user experience of the apps from the perspective of both seniors and healthcare professionals. It encompasses evaluations of app design, navigation, accessibility, functionality, and overall satisfaction with using the app. User experience here is understood in a broad sense, including usability, engagement, and the emotional response elicited by apps.	Deductive summery: comments, feedback, or observations that relate to the user experience of the apps, including both positive and negative aspects. This may cover ease of use, intuitiveness of the interface, visual appeal, responsiveness, and any features that particularly enhance or detract from the user's interaction with the app. Also include remarks on how the app meets the specific needs of seniors, such as font size, button size, simplicity of the navigation, and the clarity of instructions.
RQ4 Social Support	Encompasses comments about the necessity of support to enable seniors to correctly use the apps. It includes the importance of external assistance from family members, healthcare professionals, or peer networks in facilitating the effective use and adoption of mHealth apps among the elderly. The focus is on understanding the role of social support in overcoming barriers to technology use, enhancing learning, and ensuring the apps' benefits are fully realized.	Deductive summery: Statements that highlight the need for, or the impact of, social support on the successful utilization of mHealth apps by seniors. This may include references to training provided by healthcare professionals, guidance from family members, or support from peers who are also users of the technology. Include mentions of the types of support deemed most beneficial, such as step-by-step tutorials, regular check-ins, or the availability of a helpdesk, and how these support mechanisms contribute to a positive user experience and acceptance of the apps.

RQ5 Health Awareness	Addresses whether the added value of the apps is clear to seniors and how much time and effort medical professionals invest in educating, enlightening, and familiarizing seniors with new technology. It encompasses the understanding and awareness among the elderly regarding how mHealth apps can enhance their healthcare management, improve health outcomes, and empower them in their health journey. Additionally, it considers the commitment of healthcare providers to facilitate this understanding through training and education.	Deductive summery: discussions or observations that reflect on seniors' recognition of the benefits provided by mHealth apps, and the extent of involvement by medical staff in promoting these technologies among the elderly. This includes the clarity with which the advantages of app usage are communicated to seniors, the educational strategies employed by healthcare professionals to ensure seniors are well-informed and comfortable with the technology, and the overall effort made to integrate these digital tools into seniors' healthcare routines. Highlight mentions of educational sessions, informational materials provided, and any personalized assistance or encouragement given to seniors to explore and use mHealth apps effectively.
RQ6 Technological Capabilities	Investigates the actual practical proficiency of seniors in utilizing mHealth apps, based on observed behaviors and self-reported abilities. It includes assessments of seniors' skills in navigating app interfaces, understanding app functionalities, executing required actions within the app, and their overall comfort and confidence in using digital health technologies. The focus is on identifying both the strengths and limitations in seniors' technological capabilities in the context of mHealth utilization.	Deductive summery: Descriptions, anecdotes, or direct observations related to seniors' ability to use mHealth apps effectively. This should include detailed accounts of their interactions with the apps, such as ease of navigation, understanding of features, ability to follow instructions, and any challenges or successes experienced. Also, incorporate observations on any learning curves observed among seniors, strategies they employ to overcome difficulties, and any external help they require or seek out to use the apps proficiently.
RQ7 Accessibility	Challenges faced by seniors in accessing and being recommended mHealth apps. It explores barriers to obtaining these digital health tools, including issues related to the digital divide, such as limited internet access or lack of digital literacy, as well as systemic hurdles like insufficient guidance from healthcare providers on which apps to use. Additionally, it considers the extent to which mHealth apps are made available and approachable to seniors through user-friendly design, clear instructions, and support for users with various physical or cognitive impairments.	Deductive summery: insights that shed light on difficulties seniors encounter in accessing mHealth apps or receiving recommendations for their use. This includes comments on technological, informational, or logistical barriers that prevent seniors from effectively engaging with these tools. Highlight mentions of the lack of personalized recommendations from medical professionals, difficulties in navigating app stores, challenges in understanding how to install or set up apps, and any accessibility issues within the apps themselves that hinder ease of use for seniors. Also, include observations on the availability of resources or support systems designed to aid seniors in overcoming these barriers.

RQ8 Age-specific Requirements	Challenges in usage that were either anticipated or emerged during training, specifically related to the age-specific needs of seniors using mHealth apps. It encompasses initial expectations and actual observations regarding the usability issues faced by older adults, including but not limited to, difficulties with small text sizes, complex navigation, the need for simplified interfaces, and the necessity for more intuitive interaction designs. This focus aims to highlight the unique requirements of seniors that must be addressed to ensure mHealth apps are genuinely age-appropriate and accessible.	Deductive summery: Mentions or descriptions of challenges encountered by seniors in using mHealth apps, as predicted before training sessions or as identified during the course of training. This includes direct feedback from seniors about their experiences, trainers' observations on areas where seniors struggle, and any modifications or accommodations that were necessary to facilitate better understanding and use. Emphasize specific design and functionality aspects that were not initially suited to seniors' capabilities and any adjustments or educational efforts made to address these issues. Also, include insights on how these challenges impact seniors' overall engagement with and attitudes towards mHealth technologies.

table 4 Overview of the coding categories

4.1.3 Interview framework

In crafting the interview guide, it's wise to use the theoretically identified categories as a structural basis, from which specific, content-oriented, and functional questions are derived. This guide is designed to function primarily as a tool for data collection, providing a mnemonic support for the interviewer while ensuring that interviewees have the maximum possible freedom in articulating their responses. Adhering to this approach, the guide is organized around the identified categories and their respective facets, ensuring a comprehensive coverage of the research themes while facilitating a fluid and open-ended dialogue. This organization allows for a thorough exploration of the subject matter, guided by the framework yet flexible enough to accommodate the depth and breadth of interviewees' insights.

Interview Guide: Expert Interviews on DiGA

1. **Introduction**
2. **Individual Knowledge on DiGA**
    a. How and when did you first become aware of these prescribable medical health apps?
    b. Did you initially have a positive or skeptical attitude towards DiGA? What reasons contributed to this attitude, and have any factors changed your opinion?
    c. Do you prescribe apps yourself? If so, in what context?
    d. How do you assess the reliability of digital health applications approved by the Federal Institute for Drugs and Medical Devices (BfArM)? Do you consider them trustworthy enough for medical professionals to recommend and prescribe without reservations?
    e. In your view, what role can DiGA play in patient health care and recovery, assuming correct usage?
    f. In which areas of application do you find DiGA particularly useful and effective in improving patients' health status?

g. What advantages and potential disadvantages or risks do you see in the use of DiGA within clinical practice?

3. Usage Estimation Questions

a. In your estimation, what percentage of patients have already used a digital application in some form?
b. Can you define the patient group that, in your opinion, would be most willing to use DiGA?
c. How do you view older patients' willingness to try new treatment methods?
d. How influential is a medical recommendation in this context? Do older patients heed the advice of their doctors?
e. What criteria must a DiGA meet for you to recommend or prescribe it to patients? What are your top priorities in this regard?
f. How do you rate your knowledge and capabilities in navigating the range of available DiGA and advising patients on their use?
g. It has been suggested that many general practitioners and family doctors have been somewhat hesitant to prescribe DiGA. What do you believe are the reasons for this reluctance?
h. How do you assess the potential of DiGA to address the shortage of skilled professionals in healthcare?

4. Opinions on Statements

a. "The use of DiGA is too complex for many older patients, leading to incorrect health data and, in the worst case, therapy errors."
b. "DiGA improve patient adherence to treatment plans, particularly in disease management and prevention."
c. "DiGA can make communication between practices and patients more efficient."
d. "Patients respond to my advice and trust physicians, even when new treatment methods are suggested."
e. "DiGA enable more efficient treatment of older patients through additional new channels."

The original used guide in german is also in the appendix. A guide in general is “framed by general information about the interview”.[293] Before the start, the interviewee is informed about the possibility of using confidentiality clauses, permission for transcribtion, and anonymity. “After the official part of the interview, the interviewees are informed about the opportunity to review the transcription to clarify any uncertainties and are offered the chance to receive the results.” [294] However, the primary focus of this interview component is the personal thanks for the interest shown and the willingness to converse.[295, 296]

[293] Cf. Bogner 2014

[294] Cf. Gläser/Laudel 2010

[295] Cf. Bogner 2014

[296] Cf. Gläser/Laudel 2010

In the context of this work, the investigation period extended from December 4, 2023, to January 18, 2024. The first interview was conducted with [redacted], who focuses on emergency medicine. This was followed by [redacted], who specialize in the treatment of geriatric multimorbid patients. [redacted]. The fourth and final interview involved [redacted]

Ultimately, four experts from diverse medical backgrounds were interviewed. The contact request highlighted a detailed description of the research subject to prepare the interviewees for the topic of digital apps. The duration of the interviews ranged from 34 to 55 minutes. All interviews were conducted onsite, and with the participants' permission, all conversations were transcribed using the automatic speech-to-text transcription tool via the Google Cloud and the Google Pixel 7 device. The previously outlined guide was employed as a guided structure and conceptual framework. Following the automatic transcription, filler words were manually removed, and recording errors were corrected. The 4 transcribed interview documents are attached to the appendix.

The process of data evaluation employed the online resource qcamap.org, a platform designed to support categorization and coding aligned with the principles established by Mayring. Drawing upon categories delineated in an earlier table, the textual material was meticulously analyzed, adhering to the procedural guidance depicted in Mayring's flowchart model. This entailed a thorough examination of the interview text, during which specific segments deemed relevant were systematically highlighted and subsequently archived. A detailed compilation of the coded data is accessible in the appendix for comprehensive review. The ensuing sections are dedicated to a concise summary of each category, accompanied by a presentation of the principal outcomes derived from this analytical endeavor.

4.1.4 Summery of the interview answers

To construct a detailed and academically grounded summary of the experts' opinions from the interviews, each question is first considered and summarized based on the provided information. The complete transcripts of the 4 interviews can be found in the appendix.

Individual Knowledge About DiGA

The experts were made aware of DiGA through various channels such as training sessions, professional literature, and conferences. These initial touchpoints led to an interest in utilizing digital health applications within a medical context. The initial reactions ranged from fascination through mixed feelings to skepticism, highlighting the complexity of perceptions towards this technology. The heterogeneity of the initial attitudes reflects the individual experiences and the respective level of information of the respondents regarding the potential and challenges of DiGA.

While some experts were initially positive about DiGA, motivated by the prospect of innovative treatment possibilities, others had reservations, particularly regarding data protection and practical implementation in clinical practice. Opinions changed in part through direct experiences with DiGA, which allowed for a better assessment of their usefulness and reliability. The state examination and approval of DiGA by the Federal Institute for Drugs and Medical Devices contributed to trust building, although concerns regarding the approval process and clinical validation continued to exist.

Questions on Usage Assessment

The assessments of the proportion of patients who have already used digital applications varied. The experts reported a growing acceptance and use of digital technologies, including among older patients,

indicating an increasing penetration of digital health care. The acceptance and willingness to try DiGA seem to depend particularly on how they are introduced and explained by the doctor.

The medical recommendation by doctors plays a crucial role in the acceptance of DiGA by patients. A trusting doctor-patient relationship and clear, comprehensible communication about the benefits and handling of DiGA can significantly increase the willingness to use them. Compliance, i.e., the willingness of patients to follow the instructions and recommendations of doctors, improves significantly when the proposed DiGA are perceived as sensible and helpful.

General Opinion on DiGA

The interviewed experts recognize a significant potential of DiGA in improving health care and patient management. Especially in the continuous monitoring and management of chronic diseases, they see advantages. DiGA provide better insight into the daily routines and habits of patients, allowing for more personalized and effective treatment. Despite the recognized potential, the experts point out challenges, such as the need for comprehensive education and ensuring data protection.

Challenges and Recommendations

Integrating DiGA into clinical practice presents challenges for doctors and patients, particularly regarding data protection, digital competencies, and ensuring clinical effectiveness. The experts recommend a stronger focus on education and training in the field of digital health technologies for medical personnel, as well as the development of user-friendly, intuitive DiGA that are specifically tailored to the needs of older patients.

In summary, the experts recognize the benefits and potential of DiGA for medical practice but also call for a critical examination of the challenges and risks. The importance of informed consultation and care of patients in the introduction of DiGA is considered crucial for the successful deployment of these technologies in health care.

4.1.5 Answering the categories from coded responses according to Mayring

After creating a sound summary of the experts' opinions as expressed in the interviews, the next step in the academic analysis of the collected data material follows. The aim here is to prepare the insights gained in a structured and methodologically comprehensible manner. Qualitative content analysis according to Mayring offers an established framework for this, which makes it possible to systematically analyse and categorize the extensive interview material. The list of the complete coded text passages can be found in the appendix and is only given with the category name as the source at the end of a paragraph to make it easier to read.

RQ1 Assessment of DiGA

Within the medical community, the effectiveness, user-friendliness and suitability of digital health applications in everyday practice are evaluated in different ways. Healthcare professionals confirm increased medication compliance and improved patient self-management through the use of DiGA. The continuous recording of health data enables precise monitoring of disease progression and strengthens patients' self-responsibility. The advantages of DiGA range from the control of chronic illnesses to the support of rehabilitative measures. Nevertheless, user-friendliness and data protection are identified as significant challenges, especially for older patient groups. However, trust in DiGA remains, especially with careful testing before approval and ensuring safety and reliability (RQ1-1).

The usability of DiGA is perceived as complex and challenging, mainly due to the novelty of these technologies. Nevertheless, they promote the rapid recognition of changes in the patient's condition and enable more detailed health management. Healthcare professionals consider the provision of reliable sources of information and support from health insurance companies to be supportive. However, they warn against transferring too much responsibility to patients, which can lead to treatment errors. DiGAs transform patients into informed stakeholders in their health and help them to enjoy using their health data. Nevertheless, there are risks of misuse and a user-friendly design is required to avoid incorrect entries. DiGAs must be designed in such a way that they are easy and intuitive to use, even for patients who do not regularly use digital technologies (RQ1-2).

The implementation of DiGA in the healthcare sector is seen as largely feasible, provided that clear information and training strategies are in place to increase the acceptance and efficiency of these technologies. There is a need for standardized interfaces that enable easy integration into existing IT systems, as well as a centralized advisory office to maintain an overview and avoid overload. There is a demand for clear communication of the benefits to skeptical patients, with the aim of achieving a more effective organization of doctor contacts. Despite the additional burden that the introduction of DiGA may entail, the potential of these technologies for expanding the spectrum of healthcare and strengthening patient autonomy is recognized. Digitalization offers opportunities for patient-centered medicine. The importance of involving relatives and carefully testing digital solutions is emphasized to ensure a successful implementation of DiGA. Unfortunately, the solution to overcoming structural challenges in the healthcare system is not seen in DiGA, as the effort of teaching, introducing, understanding and maintaining the apps for patients is associated with additional work (RQ1-3).

In summary, DiGAs have the potential to significantly improve and individualize healthcare. Careful risk-benefit assessment, user-centered development and comprehensive training measures are essential in order to successfully integrate DiGAs into everyday medical practice and fully exploit their benefits. Maintaining the personal doctor-patient relationship is just as important as the technical and content-related design of the applications themselves.

RQ2 Technology acceptance

The experts' experiences and observations regarding technology acceptance among seniors show that the willingness to use digital health applications increases when traditional therapy approaches reach their limits. The support provided by mHealth technologies for medication compliance and self-management emphasizes the importance of older patients' personal responsibility. Initial skepticism often gives way to acceptance as soon as the personal benefits are clearly communicated, with the continuous monitoring of health data in particular meeting with a positive response. The integration of the family in the management of health apps promotes their continuous use and acceptance, which emphasizes the need for training adapted to the needs of seniors (RQ2-1).

Digital health applications are perceived as useful by seniors, especially due to the improvement in medication adherence and the strengthening of health awareness. Such technologies enable improved doctor-patient communication and give seniors back a degree of autonomy, which is beneficial both in terms of preventive care and adherence to treatment. The challenge is to design the applications in such a way that they can also be used by less tech-savvy seniors (RQ2-2).

User-friendliness plays a central role in the acceptance of mHealth solutions by seniors. Intuitive and appealing user interfaces that allow easy visualization of health data can increase the preference for mHealth over traditional paper documents. It is important that mHealth applications are developed in such a way that they are easy to use even by seniors who rarely use smartphones (RQ2-3).

Trust between doctor and patient is crucial for the acceptance of mHealth among seniors. Doctors who communicate new treatment methods confidently and convincingly can gain the trust of their patients. This promotes the willingness to embrace new technologies. The experts emphasize the need for clear and understandable communication and participatory decision-making in order to strengthen the trust of seniors and increase their willingness to accept mHealth (RQ2-4).

The emotional attitude of seniors towards mHealth is crucial. When seniors see technology as a way to improve their care and increase their health awareness, they are more likely to adopt mHealth. The emotional reaction to learning about illness as a loss of control can be transformed into a sense of empowerment through the use of mHealth applications. However, physicians need to address privacy concerns and skepticism about technology to promote a positive attitude toward mHealth (RQ2-5).

RQ3 User Experience

The integration of DiGA into the medical care of older patients depends crucially on their user-friendliness. Experts emphasize the importance of DiGAs being intuitive and easily accessible to ensure effective use. Benefits such as promoting medication compliance and confident self-management through continuous monitoring are significant, albeit with the challenge of adequately introducing seniors to the technology. A carefully designed user interface can reduce excessive demands and ensure continuous use (RQ3-1).

In terms of engagement, it has been shown that the continuous use of DiGA strengthens the empowerment of seniors and their health awareness. Seniors who are initially skeptical about the new technology open up to its benefits once they are clearly communicated. A personalized approach that takes into account the individual needs and knowledge of seniors is therefore essential to promote their engagement and sustained use of DiGA (RQ3-2).

The emotional reaction to DiGA ranges from initial skepticism to increased autonomy. Seniors who are open to technological innovations are positive about DiGA and enjoy the feeling of increased self-determination in dealing with their health. Privacy concerns do exist, but are often outweighed by the recognizable benefits of the technology. Emotional acceptance is strengthened or weakened by the simplicity of operation and the perceived trust in the recommending authority. Thus, adequate education and design of the DiGA becomes a key component for its successful adoption by older patients (RQ3-3).

RQ4 Social Support

In the context of social support and overcoming technology barriers, the experiences of doctors show that the social environment plays a decisive role in the acceptance and effective use of digital health applications by seniors. The joy of some seniors to monitor their health values on their smartphone contrasts with the skepticism of others who perceive such technologies as alien. Here, support from relatives is often a turning point that facilitates and encourages the adoption and use of DiGA. Medical therapy suggestions, accompanied by clear communication and support in using the applications, are particularly appreciated and often positively received. Doctors who take the time to explain options and assist with set-up help significantly to reduce barriers and support smooth coordination with health insurance companies. The willingness of seniors to use DiGA depends significantly on their attitude to technology, their state of health and, above all, the quality of their social network. Clear instructions from doctors that convey trust and respect, as well as support from family and friends, are often decisive factors that contribute to the acceptance of DiGA. A participatory decision-making process in which patients are actively involved not only strengthens their sense of trust, but also their commitment and willingness to actively participate in their own healthcare (RQ4-1).

Interaction between doctors and seniors plays a central role in the learning process in the context of social support. Learning how to use digital health applications (Di-GA) is a dynamic process that usually unfolds in dialog. The continuous use of the apps not only as a reminder tool, but also as a means to communicate medical information directly, allows patients to effectively communicate their progress and challenges to doctors. Developing a deeper awareness of their health conditions and learning to self-monitor through the use of apps increases patients' understanding of their condition. Education plays a vital role in empowering patients to use the apps correctly and to know how to respond to incorrect entries. A proactive approach to patient education shows that with the right support and a patient-centered teaching approach, seniors can adopt new health technologies and integrate them into their daily lives (RQ4-2).

In the context of social support, the realization of benefits through DiGA plays an essential role for seniors. The experts report that an increased level of adherence to therapy and medication compliance is achieved as patients are continuously and actively involved in their treatment through DiGA. These tools not only offer support in coping with illness, but also give patients a degree of autonomy and reduce the distance to medical staff, which strengthens the doctor-patient relationship. The benefits of DiGA, such as the avoidance of invasive measurement procedures and improved data collection, extend health management beyond the clinic and into the home environment. Patient education is essential to ensure the correct use of the technology and to understand how to deal with data errors. Experience shows that DiGAs can lead to significant improvements in patient care, especially for chronic diseases such as diabetes, and by making it easier to record and communicate health data, DiGAs facilitate interaction with the healthcare system and promote patient independence. Technical challenges and the usability of apps are key issues that can be mitigated by social support. Family and friends, as well as medical staff, play a crucial role in communicating the benefits and practical application of the technology. DiGA can therefore not only improve communication between doctors, patients and the patient's social environment, but also increase the quality of life for those affected by contributing to independence and social integration (RQ4-3).

RQ5 Health Awareness

The use of digital health applications significantly promotes health awareness among seniors by enabling continuous reminders and monitoring, which not only improves the accuracy of health data, but also reduces mismeasurements. Seniors gain an active role in their healthcare through DiGA by taking disease management into their own hands, supported by a tool that gives them autonomy and control over their condition. Patients learn to better understand their condition and become experts in their own wellbeing, which not only creates enjoyment in self-managing their health data, but also leads to better adherence to treatment and enables them to independently identify problems early on. The integration of DiGA into everyday life offers a deeper insight into patients' daily lives, far beyond the snapshots that can be obtained during short visits to the doctor. This strengthens patients' trust in the healthcare system and enables doctors to optimize treatment based on data that provides a more comprehensive picture of the patient's condition. However, to maximize these benefits, it is necessary to establish clear guidelines and inform patients about the benefits and limitations of the technology through sound training and transparent communication. Personalized reminders and the ability to monitor and share health data reduce organizational burden and increase autonomy, which is particularly beneficial for those who need to independently manage chronic conditions or in the rehabilitation phase (RQ5-1).

With regard to the involvement of medical staff, it is clear that the integration of DiGA into everyday medical practice requires careful supervision and a deep understanding of patients' needs. Doctors and

nursing staff play a key role in bridging the gap between technological possibilities and practical application. They are responsible for the sensitive handling of health data and for ensuring that the use of DiGA strengthens the relationship between doctor and patient rather than distancing them. The medical staff must assess the evaluations of the apps, adequately train the patients and ensure clarity in the use of the application. Although this requires additional effort, the benefits, such as better insights into patient behavior outside the practice and more precise therapy design, justify it. The role of clinicians is also crucial in prescribing DiGA - assessing the suitability of the technology for each individual case and ensuring that it is used in the best interests of the patient. The success of DiGA and confidence in these technologies builds on the positive experiences facilitated by competent staff support (RQ5-2).

RQ6 Technological Capabilities

The technical skills of seniors are a decisive factor for the successful adoption and use of digital health applications. Doctors observe that ongoing reminders and the proactive use of apps lead to a reduction in problems such as incorrect measurements and give patients an increased level of autonomy. They allow patients to take a more active role in their own healthcare, giving them a sense of control and self-efficacy. Nevertheless, there are challenges, especially when it comes to the intuitiveness of the user interface. Some seniors who are less familiar with modern technology may feel overwhelmed by the complexity, highlighting the need for intuitive and user-friendly design solutions. At the same time, the apps should be designed in such a way that they do not cause additional health anxiety, for example by avoiding misinterpretation of health data. The use of DiGA strengthens seniors' health awareness as it enables them to better understand and monitor their health conditions. This not only promotes confidence in treatment methods, but can also improve quality of life by supporting independence. However, individualized support is often necessary to take into account the technical capabilities of older people. Data protection concerns and worries about the loss of personal contact must not be neglected. The solution lies in well-designed applications that are easy to use, even for technology novices, and that complement but do not replace the human component of medical care (RQ6-1).

RQ7 Accessibility

The accessibility of digital health applications is a challenge for seniors that is clearly recognized by healthcare professionals. The digital divide is a recurring theme: not all older patients are equally able or willing to engage with modern technologies, which can result in unequal care. Even as technologies such as smartwatches become more common among the older generation, there is a need to make apps user-friendly and easily accessible. Patient training seems essential to ensure the correct use of DiGA and that patients know how to react to errors and how to use the apps in general. Readability is crucial here, because if the presentation of the data is not clear, this can lead to rejection. Some older patients may view such apps as too modern or unnecessary, but adoption by relatives can often provide a solution and encourage use. Despite technical hurdles and the need to be familiar with digital devices, patient feedback on DiGA is often positive, with reports of improved quality of life and an increased sense of empowerment. This feedback underlines the potential benefits of DiGA and the importance of family and professional support to increase acceptance and confidence in these technologies. It is therefore the responsibility of doctors to provide comprehensive information and guide patients through the process, especially with more technically complex apps (RQ7-1).

RQ8 Age-specific Requirements

When designing DiGA for older people, it is important to consider specific age-related requirements. Readability is a crucial aspect, as a clear and easily readable interface promotes acceptance. Seniors

often welcome apps that enable them to autonomously monitor their health data, allowing them to reduce regular doctor visits. Despite some skepticism towards new technologies, interest and trust in DiGA can be increased with patience and understandable explanations. A key factor for acceptance among older patients is trust in medical recommendations. They tend to follow the expertise and authority of doctors, which enhances the effectiveness of medical app recommendations. To overcome challenges in dealing with the complexity of modern technologies, focusing on ease of use and clear instructions is critical. Support from family and friends can also increase the willingness to use DiGA. Developing apps that minimize error-prone operations while not replacing personal interaction is central. For older people, who may not be accustomed to digital devices, user-friendly and simply designed applications are crucial. It is essential to carefully monitor and support older patients in using DiGA to ensure they can derive the maximum benefit from these technologies without being overwhelmed (RQ8-1).

4.1.6 Interpretation of expert insights with theory

In the interpretation of the expert interviews conducted for this dissertation, it has become evident that Digital Health Applications hold remarkable potential in enhancing the healthcare experiences and outcomes for seniors. This aligns closely with the theoretical discussions presented earlier in this work, suggesting that DiGAs could serve as a vital tool in bridging the structural transformation within the healthcare system.

The empirical evidence from the expert interviews substantiates the theory that seniors are likely to accept and use new technologies if they perceive tangible benefits and receive adequate support, both socially and in terms of user experience. This is consistent with the extended Technology Acceptance Model from the research model, which posits that perceived ease of use, perceived usefulness and ux are primary predictors of technology adoption. The experts observed that DiGAs could empower seniors to manage their health more proactively, reflecting the theoretical proposition that technology can alleviate some pressure off the healthcare system.

However, the interviews also illuminated a significant concern: while DiGAs offer extensive possibilities, they also impose an additional burden on healthcare professionals. The theory had anticipated that technology could simplify and streamline healthcare delivery, yet the practical insights suggest that there's an increased workload for medical staff, particularly in the initial phases of DiGA integration. This additional workload includes patient education on DiGA usage, data interpretation, and ongoing tech support. These findings highlight a discrepancy between the theoretical benefits of apps and the actual complexities involved in their practical application.

The concept of structural change within the healthcare system was also explored in the interviews. Although DiGAs have the capability to extend healthcare beyond traditional settings and improve patient engagement and adherence, as predicted by the theory, they cannot single-handedly resolve all structural challenges in healthcare. This is a critical revelation that underscores the importance of adopting a multifaceted approach to address the structural issues within the healthcare system, beyond the implementation of apps alone.

An important discovery from the interviews was the need for DiGAs to be integrated into regular healthcare practices, requiring more direct involvement from healthcare professionals. This underscores a significant gap between theoretical expectations and real-world application complexities, pointing to a need for more robust support systems within the healthcare framework to fully leverage DiGAs' potential.

The experts also noted the challenge of technology use among seniors, particularly for those unaccustomed to digital devices. This observation supports the theoretical understanding that technology acceptance is a highly individualized experience, influenced by personal circumstances and the usability

of the technology itself. The necessity for apps to focus on user-centric design and clear utility is thus reinforced, aligning with the theory's emphasis on the importance of UX in technology adoption.

In sum, the insights gained from the expert interviews are in concordance with the theoretical perspectives delineated in this study. DiGAs' impact on the elderly's healthcare depends greatly on individualized support and strategic integration within healthcare services. These interpretations connect the empirical data with broader theoretical discussions, pointing to new research directions and practical applications for DiGAs in healthcare. They highlight the imperative for a user-centered approach in the development and implementation of DiGAs to enhance the elderly's healthcare experiences.

4.1.7 Conclusion of Methodology I: Qualitative Expert Interviews

The expert interviews discussed in Chapter 4.1 have provided insightful perspectives on the practical application and challenges of DiGA, illustrating how theoretical assumptions are implemented in reality. While the interviewed physicians recognize the potential of DiGA to support patient care, they simultaneously express skepticism regarding the effectiveness of these technologies and the fast-track approval process. Clinical experiences with patients are predominantly positive, yet there is noticeable hesitation and skepticism among patients toward new digital treatment methods.

A key finding from the interviews is the paramount importance of physicians in patient care, particularly with older patient groups. Doctors play a crucial role in the acceptance and successful implementation of DiGA, as their recommendations can garner patient trust and enhance willingness to adopt new technologies. Despite the potential benefits of DiGA, it is clear that their integration into clinics and practices involves significant additional effort. Training and educating patients often prove to be more time-consuming than anticipated, and the expected workload reduction through DiGA falls short of expectations.

Furthermore, the complexity of integrating DiGA into existing medical infrastructures is emphasized. Many clinics and practices already rely on specialized software solutions, and introducing new interfaces for DiGA presents a considerable challenge. Manual data retrieval, often necessary, increases the workload and reduces the efficiency of DiGA deployment.

Although DiGA are currently not viewed as an adequate solution for the shortage of skilled healthcare workers, challenging a theoretical pillar of this work, the expert statements still demonstrate an optimistic view on the technology acceptance among seniors. The interviews confirm the theory that seniors are willing to adopt new technologies once they recognize their personal benefits. This supports the need for further research to identify the conditions and factors that contribute to the successful integration and utilization of DiGA in the older population. The experts thus underscore the importance of continuing to invest in the development and adaptation of DiGA to maximize their acceptance and effectiveness.

4.2 Methodology II: Empirical Quantitative Data Collection

Within the scope of quantitative empirical research, typical for this approach, data are primarily collected using standardized measurement tools, as well as from as large and representative a sample as possible, to gather numerical measurements. These measurements are then statistically analyzed following the collection process and finally tested against theoretically grounded hypotheses.[297] Another defining

[297] Cf. Bortz/Döring 2006, p. 23

aspect of quantitative research is its reliance on logical sequences and mathematical principles. The range of methods includes various experimental approaches and tests, standardized survey techniques, schematic observational forms, content analysis and statistical procedures, scaling methods, and sociometric techniques for analyzing relationships or structures.[298] “A crucial criterion is that the collected information must have the character of data or measurements so that they can be immediately statistically analyzed without any further semantic interpretation, ensuring their direct applicability for statistical evaluation”.[299] According to Kromrey, quantitative empirical research is characterized by: "... a strictly goal-oriented approach that seeks the 'objectivity' of its results through the most extensive standardization possible of all sub-steps, and which posits the intersubjective verifiability of the entire process as a central norm for quality assurance." [300]

Consequently, the standardization, for example, in the use of questionnaires, means that the order of questions and the answer options are predefined. This primarily aims to ensure that the conditions under which the questions are answered are ideally identical for all participants.[301] Raithel states that at the beginning of each investigation, three essential relationships must be differentiated: What is to be researched? How should something be researched? For what purpose are the results obtained? [302]

Concerning the quantitative research process, there exist many, in some cases, significantly different frameworks. However, based on the relationships described previously, it is possible to define seven essential phases of the research process (see figure below). The sequence of the investigation is characterized by successive steps, which are defined according to Popper's deductive-empirical model of science. Since there are various options in each phase that can significantly influence the research outcome, a multitude of decisions must be made at every step. The choice depends significantly on the research objective itself, the resources available, and one's assessment concerning the research objective.[303] The following is a description of the phases and steps of the quantitative research process as depicted in the figure:

[298] Cf. Hug 2001, p. 22

[299] Cf. Kromrey/Roose/Strübing 2016, p. 24

[300] Cf. Kromrey/Roose/Strübing 2016, p. 25

[301] Cf. Flick/Kardorff/Steinke 2022, p. 25

[302] Cf. Raithel 2006, p. 25f

[303] Cf. Diekmann 2023, p. 165

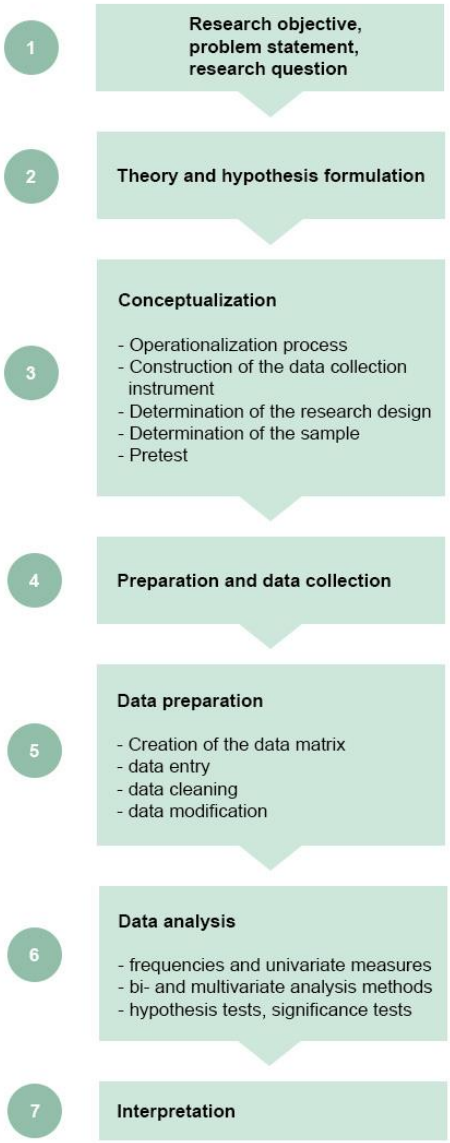

Figure 14 Phases of the quantitative research process. Own representation based on Raithel[304]

Quantitative empirical investigation follows established standards designed to facilitate judgments regarding its caliber. These standards, by their nature, serve as benchmarks for evaluating and defining the research undertaken. As a result, a classification emerges, separating core quality benchmarks like

[304] Cf. Raithel 2006, p. 27

objectivity, reliability, and validity from secondary standards including efficiency, comparability, usefulness, and uniformity.

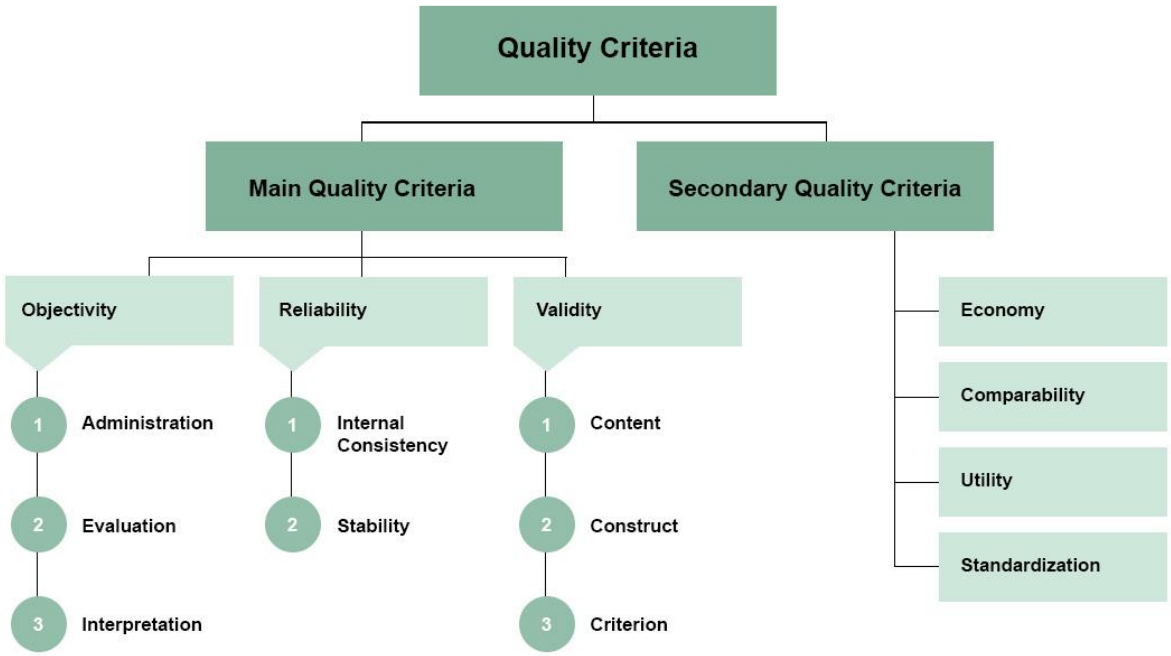

Figure 15 Quality criteria of quantitive empirical research. Own representation based on Bühner.[305]

The following describes the previously mentioned primary quality criteria - objectivity, reliability, and validity:

The criterion of objectivity aims to indicate,"... the extent to which scientific practices such as measuring and analyzing, as well as the results of these practices, are independent of the subjective and collective characteristics of the individuals involved in the research." [306]

When complete objectivity is discussed, it means that the same data is obtained by two users using the same measurement tool. According to Lienert, in this context, a distinction is made between execution objectivity and evaluation objectivity. "The main criterion of objectivity in quantitative research is identified as a prerequisite for the main criterion of reliability, which, in turn, is considered the premise for the criterion of validity."[307, 308]

Reliability, as Raithel explains, is understood as „the extent to which repeated measurements of an object with a measurement tool provide the same values“. Thus, reliability represents the degree of reproducibility of measurement results.[309, 310] Moreover, a distinction is made into four different types of the main criterion of reliability:

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[305] Cf. Bühner 2021, p. 35

[306] Cf. Diaz-Bone/Weischer 2015, p. 294

[307] Cf. Raithel 2006, p. 45

[308] Cf. Diaz-Bone/Weischer 2015, p. 294

[309] Cf. Raithel 2006, p. 45

[310] Cf. Diaz-Bone/Weischer 2015, p 295

- Diachronic reliability assesses the reliability of measurement over time.
- Procedural reliability refers to the optimization of the measurement tool during data collection.
- Quixotic reliability occurs when a measurement tool provides identical measurements at the same time point upon repeated measurements.
- Synchronous reliability exists when different measurement tools yield consistent results. [311]

At its core, the key measure of validity (or correctness) essentially checks if a tool used for measurement in research is accurately capturing what it's supposed to. Validity doesn't have a straightforward scale or unit for measurement; instead, its assessment depends on comparing it with other measurements. When it comes to testing validity, a few specific methods stand out:

- Expert validity
- Known group
- Content validity
- Criterion validity
- Construct validity [312, 313]

4.2.1 Determination of the Survey Method

Surveys remain the standard tool for the purpose of collecting data, facts, knowledge, etc., in empirical social research. Depending on the mode of administration, the following types can be distinguished:

- Written survey,
- Oral survey,
- Telephone interview, and
- Internet-based survey (email survey or web survey).[314]

For the implementation of the current study, a standardized survey in the form of a web survey was chosen. The following advantages of conducting a survey using a standardized questionnaire over other types of surveys can be mentioned:

- The time, cost, and personnel effort is significantly lower.
- Reflecting on the posed questions is facilitated, as there is no time restriction for answering them.
- The interviewer has no influence on the respondents and can thus be excluded as a source of error.[315]

The construction of the questionnaire, in the course of a survey, should be undertaken with the utmost care to avoid potential problems such as response biases. To ensure this, the following construction criteria should be considered when creating a standardized questionnaire:

- Function, form, or structure of the questions

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[311] Cf. Diaz-Bone/Weischer 2015, p. 350

[312] Cf. Atteslander 2010, p. 122

[313] Cf. Diekmann 2023, p. 244f

[314] Cf. Schnell/Hill/Esser 2011, p. 314

[315] Cf. Raithel 2006, p. 67

- Formulation of the questions
- Structure of the survey instrument[316]

A crucial criterion for any questionnaire is that it should be self-explanatory in principle and also kept very simple in terms of design. The declared goal here is that the questionnaire can be easily answered or filled out, making it understandable for all participants at any time.[317]

4.2.2 Konzeption des Fragebogens – Aufbau und Inhalt

The development of a questionnaire as a data collection tool in empirical research requires a methodological foundation aligned with the specific goals of the research project. In this thesis, the questionnaire was specifically tailored to the variables of the research model, which were derived from theoretical considerations. This methodological decision ensures that the collected data directly contribute to the research questions, thus strengthening the study's validity. By incorporating six differentiated categories in the questionnaire, complemented by qualitative expert interviews, a comprehensive mixed-methods analysis is enabled, integrating both quantitative and qualitative perspectives.

The first category of the questionnaire focuses on capturing the demographic data of the participants. This category is crucial as it allows the interpretation of the research findings against the backdrop of sociodemographic variables, thereby drawing conclusions about the generalizability of the results. Categorizing the participants also identifies relevant patterns and differences in the data that may be significant for answering the research questions. The second category is dedicated to the participants' prior experiences with technologies and apps. This section is of particular interest as it provides insights into the respondents' technological understanding and usage habits. These pieces of information are essential to comprehend the acceptance and attitudes towards new technological solutions, like digital health applications. The third category specifically focuses on DiGA apps. This category is central to the study as it aims to gain specific insights into the experiences and perceptions of dealing with these apps. Collecting this data is crucial for analyzing the acceptance, usage, and user behavior in the context of digital health solutions. The fourth category examines the User Experience of DiGA apps using the User Experience Questionnaire Short (UEQ-S).[318] The UEQ-S was chosen for its brevity and specificity to minimize the burden on participants and ensure a high response rate. To enable comparison, the fourth category was divided into A-B testing.[319] Variant A received a descripted scenario where the patient goes to their general practitioner and receives medication for sleep disorders, covering a very conventional treatment. Variant B describes a scenario where the general practitioner suggests an app to collaboratively understand the sleep disorder. The decision to use descriptions instead of direct interactions with the apps was made due to the high costs and access restrictions to DiGA. This methodological adjustment allows, despite practical limitations, valuable insights into the perceived UX to be gathered.[320]

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[316] Cf. Raithel 2006, p. 67

[317] Cf. Raithel 2006, p. 67

[318] Cf. Schrepp/Hinderks/Thomaschewski 2017b

[319] Cf. Hinderks/Schrepp/Thomaschewski 2018

[320] Cf. Schrepp/Hinderks/Thomaschewski 2017a

The fifth category focuses on identifying and analyzing the barriers and concerns expressed by the study participants. In this phase, it is crucial to gain a comprehensive understanding of the potential obstacles and reservations of the subjects to ensure the validity and effectiveness of the investigation. Following this, as part of the final category, a free text field is implemented. This component allows participants to provide independent input that may not have been covered in the previous sections of the survey. This approach helps maximize the depth and breadth of insights gained. Furthermore, this segment is used to explicitly thank the participants for their valuable participation and contribution to the study. The integration of this element emphasizes the researchers' appreciation towards the participants and fosters a positive relationship between both parties.

4.2.3 Pre-Test

In preparation for a quantitative survey, a crucial step towards ensuring the questionnaire's quality involved conducting a pre-test. This methodical preliminary examination aimed to identify and eliminate potential sources of error and ambiguities in the questionnaire, thereby securing the validity and reliability of the subsequent data collection.

For the pre-test, a total of four individuals, consisting of family members of the researcher, specifically parents and grandparents, were recruited. This selection helped create a familiar and open feedback atmosphere, advantageous for the quality of the pre-testing process. Participants were asked to fill out the questionnaire under the researcher's direct observation, with communication facilitated via video conferences. This technical integration allowed the researcher to watch the filling process in real time and receive immediate feedback.

During the process, subjects were instructed to verbalize their thoughts, a procedure known as "think aloud." This method, established in usability testing, provides insights into the participants' cognitive processes, thereby clarifying potential difficulties or misunderstandings regarding the questionnaire's questions. This approach revealed several minor errors and ambiguities.

The identified minor issues were subsequently systematically analyzed, and appropriate corrections were made to the questionnaire. To preserve data integrity, the researcher decided to remove the responses generated in the pre-test by the four subjects from the dataset. This measure ensures that the main survey's results are based exclusively on data collected under standardized conditions.

After the necessary adjustments were made, the optimized questionnaire could be used for the main survey of the study. This meticulously conducted pre-test enhances the reliability and significance of the research findings by helping to minimize systematic errors in the questionnaire before the actual data collection.

4.2.4 Sample Determination

In every investigation of facts and the testing of hypotheses, it is of great importance to define clearly about whom statements are to be made. Therefore, a precise definition of the units under investigation is indispensable. Typically, the study is conducted on a previously selected segment or part of the relevant group - a sample. The aim in selecting the sample is, therefore, to make generalizations or general statements about the entire population.[321] For a better understanding, the definition of the sample and the population is provided below:

[321] Cf. Raithel 2006, p. 54

"The population encompasses all potentially investigable units or elements that share a common characteristic (or combination of characteristics). A sample represents a subset of all units under investigation, which ideally reflects the relevant characteristics of the population as accurately as possible." [322]

In the course of this quantitative study, the selection of the sample was based on previously defined criteria. Consequently, a deliberate selection of the units under investigation was made based on the following aspects:

- Substantive Delimitation: The decisive criterion for the selection of the sample is the age of the participants. Therefore, the survey targeted seniors above the age of 65.
- Spatial Delimitation: Spatially, the sample was limited to Germany, as the study focuses on German demographics and structural changes. This limitation naturally arose because the survey was formulated in German and were only distributed in Germany.
- Temporal Delimitation: The time frame for conducting the survey was restricted to February 2024. Therefore, participation in the survey was only possible during the specified period.

The survey was conducted using an internet-based survey tool - Microsoft Office Forms - which facilitates and significantly simplifies the creation, editing, and management of surveys. Other tools such as SurveyMonkey, LimeSurvey, and Google Forms were also tested but found to be unsuitable. Invitations to the survey were sent via a link, which could be emailed directly during on-site surveys or filled out on the provided 2-in-1 touch laptop. By accessing the link, participants could take part in the survey, with their responses being anonymized. Additionally, editing or revisiting the questionnaire was not permitted, ensuring that each participant could only take the survey once. In this study, participants were only identified based on the specified demographic variables, allowing for the substantive limitation of the sample to be ensured.

4.2.5 Conducting the Data Collection

In the course of the conducted study, there was a need to recruit seniors as the target group, which proved to be particularly challenging in the direct environment. To overcome this difficulty, regional gatherings of older people were identified, and contact was subsequently made - whether by phone, email, or through personal conversations with the officials of the respective institutions.

Determining the response rate in this context poses a challenge, as the exact number of sent emails remains unknown. Furthermore, the survey was also shared within personal networks via WhatsApp and various social media, accompanied by the request to forward it to potential participants, such as grandparents. Members of the contacted associations also agreed to distribute the survey within their circle of acquaintances. Additional senior meetings were contacted to achieve broader participation through distribution or communal filling out of the questionnaire. Thus, the initially directly contacted 28 institutions via emails and calls could be used as veritable multipliers and are considered as such in this work.

Institution	***category***	***Mode of Contact***	***Version sent***
[redacted]	Leisure Senior Meetup	Phone, E-Mail	A
[redacted]	Leisure Senior Meetup	Phone, E-Mail	B
[redacted]	Senior Pastoral Care	E-Mail	A
[redacted]	Senior Pastoral Care	E-Mail	B

[322] Cf. Raithel 2006, p. 54

[redacted]	Leisure Senior Meetup	E-Mail	A
[redacted]	Leisure Senior Meetup	E-Mail	B
[redacted]	Leisure Senior Meetup	Phone, E-Mail	A
[redacted]	Online Forum for seniors	E-Mail	B
[redacted]	Leisure Senior Meetup	E-Mail	A
[redacted]	Leisure Senior Meetup	E-Mail	B
[redacted]	Community Service	E-Mail	A
[redacted]	Leisure Senior Meetup	Phone, E-Mail	B
[redacted]	Leisure Senior Meetup	E-Mail	A
[redacted]	Leisure Senior Meetup	E-Mail	B
[redacted]	Community Service	E-Mail	A
[redacted]	Senior Pastoral Care	Phone, E-Mail	B
[redacted]	Community Service	E-Mail	A
[redacted]	Leisure Senior Meetup	E-Mail	B
[redacted]	Senior Pastoral Care	E-Mail	A
[redacted]	Community Service	E-Mail	B
[redacted]	Senior Pastoral Care	E-Mail	A
[redacted]	Community Service	E-Mail	B
[redacted]	Leisure Senior Meetup	Phone, E-Mail	A
[redacted]	Community Service	E-Mail	B
[redacted]	Senior Pastoral Care	E-Mail	A
[redacted]	Community Service	E-Mail	B
[redacted]	Community Service	E-Mail	A
[redacted]	Community Service	E-Mail	B

table 5 Overview of Directly Contacted Senior Institutions

A significant breakthrough was achieved with the [redacted]. Following a discussion, it was agreed upon to perceive the survey as an interactive and engaging exchange with the senior members. Given that many members lacked even basic internet access, it was decided that the survey would be conducted face-to-face during two sessions on-site.

An iPad of [redacted] and a 2-in-1 touch laptop, which was carried along, primarily served as the primary input devices. The choice of this devices was due to their larger screen, offering enhanced readability and increased accuracy for touch inputs. This was particularly relevant given that many participants might not own a personal device or could find the process of sending/receiving a link or scanning a QR code overwhelming. This approach ensured that not only tech-savvy seniors are reached via email but also those less familiar with IT are directly supported.

Although the option of conducting the survey on paper was considered, it was ultimately decided against this method to simplify data collection and minimize sources of error that could arise from using two different data mediums.

Despite the challenges of reaching the specific target group, in collaboration [redacted] 19 survey responses were collected on site (8 for Survey A and 11 for Survey B). Additionally, with other contributions from the distributed multipliers, the quantitative study reached a total of n=83 (37 for Survey A and 46 for Survey B), enabling further progress to the next phase of the project.

4.2.6 Evaluation of Survey Results

In empirical research, quantitative surveys are a fundamental tool for systematically collecting data on the behavioral patterns and attitudes of a target group.[323] This methodology allows for deeper insights into the subjects under study through the analysis of extensive datasets. In this chapter, the results of the conducted surveys are thoroughly evaluated to understand how the participants' responses illuminate the research questions posed in this study.

The evaluation of the survey results is crucial to ensure the validity and reliability of the collected data and to draw scientifically grounded conclusions. By using advanced statistical methods and software such as IBM SPSS and Microsoft Excel, the gathered data were precisely analyzed. These analyses include descriptive statistics to depict the basic distribution of the variables as well as inferential statistical procedures that allow for generalizations beyond the sample. The main goal of this chapter is to decipher complex data patterns and identify significant correlations between the variables. This creates a solid foundation for a deeper understanding of the dynamics underpinning our research questions. Furthermore, the significance of these results is discussed in the context of existing scientific literature to emphasize their relevance and contribution to academic discourse.

The interpretation of the results is discussed not only in light of statistical analysis but also through the integration of theoretical frameworks and previous studies. This approach allows for a comprehensive assessment of the data and encourages a critical examination of the findings obtained. Additionally, this chapter outlines potential limitations of the study and provides recommendations for future research to further explore identified research gaps and continuously improve the methodology.

Section 1: Demographic presentation of the participants

S1Q1: In the first question of the first section on the demographic characteristics of the study sample, the age distribution of the participants is analyzed to understand the demographic composition of the sample and assess its relevance for the study of technology acceptance among seniors. The age structure of the respondents is crucial to ensure the applicability of the research findings to the target group. The age distribution of the survey participants is as follows:

- 65-74 years: This age group constitutes the largest portion of the sample at 57.8%.
- 75-84 years: Individuals in this category account for 22.9% of the responses.
- 85 years and older: This group of participants comprises 15.7% of the sample.

Individuals under 65 years were also reached, but their responses (3.6% of the total sample) were excluded from further analysis due to the study's specific focus on seniors and their experiences with digital health applications. This decision reinforces the study's focus on the older population, which is particularly important as older individuals often have different needs and challenges in dealing with new

[323] Cf. Baur/Blasius 2014, p. 997

technologies, as revealed in the theoretical analysis. The well-represented age groups of 65-74 and 75-84 years provide an excellent basis for examining the acceptance and use of digital health applications and exploring potential age-specific designs and features.

How old are you?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	65-74	48	57,8	57,8	57,8
	75-84	19	22,9	22,9	80,7
	85 und älter	13	15,7	15,7	96,4
	Unter 65	3	3,6	3,6	100,0
	Total	83	100,0	100,0	

table 6 Age of the quantitative survey participants

S1Q2: The gender distribution of the participants provides insightful information about the sample of this study. In the survey, 49 participants identified as female and 34 as male, leading to a total of 83 participants, with no diverse responses recorded. The gender distribution within the age categories is as follows:

- 65-74 years: 22 male and 26 female participants
- 75-84 years: 7 male and 12 female participants
- 85 years and older: 4 male and 9 female participants
- Under 65 years: 1 male and 2 female participants

The analysis of the gender distribution within the survey participants reveals a remarkable dominance of female respondents. With a total of 49 responses from women compared to 34 from men, and none from individuals identifying as diverse, there is an increased proportion of women. This result contrasts sharply with expectations based on age structure counts published by the Federal Agency for Civic Education, which had predicted a lower tendency for female participation.

To investigate the relationship between the variables of age and gender, a Pearson Chi-Square test was performed. With an asymptotic significance value (p-value) of 0.745, it appears that there is no statistically significant correlation between the two variables. Such a finding is generally accepted when the p-value is below the conventional significance threshold of 0.05. The p-value of 0.745 thus allows the interpretation that the differences or correlations observed between the groups are likely to be random. This means that there are no sufficiently strong evidences to suggest that a systematic relationship exists in the overall population from which the sample was drawn.

The reasons for the unexpectedly high response rate from women in this study could be manifold and require a more detailed analysis of possible influencing factors. These could include differences in affinity for digital health applications, variability in health behavior, or socio-demographic differences between genders. Additionally, methodological aspects such as access to the survey or willingness to participate in such studies could also play a role. Further research is needed to contextualize these results and understand the underlying dynamics.

Age * Gender

Count

		Gender		
		Male	Female	Total
Age	65-74	22	26	48
	75-84	7	12	19
	85 und älter	4	9	13
	Unter 65	1	2	3
Total		34	49	83

table 7 Crosstab Age*Gender of Participants

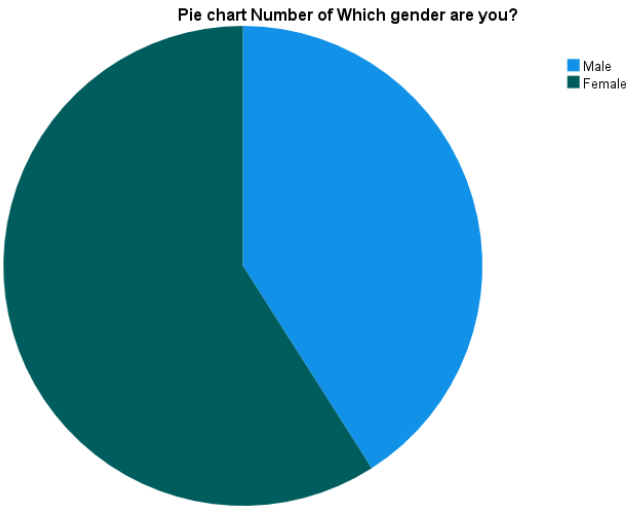


table 8 Pie Chart of Male/Female distribution

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1,235[a]	3	,745
Likelihood Ratio	1,253	3	,740
N of Valid Cases	83		

a. 2 cells (25,0%) have expected count less than 5. The minimum expected count is 1,23.

table 9 Chi-Square Age*Gender

S1Q3: In the quantitative survey undertaken to gather empirical data, the educational background of the participants was meticulously evaluated. The responses were sanitized, primarily due to the multiple utilizations of the miscellaneous text field titled "Others“ (Sonstige). This necessitated the introduction of novel terms such as apprenticeships "Ausbildung" and "Höhere Ausbildung" to accurately represent vocational training as well as advanced qualifications such as master craftsman (Meisterausbildung) and specialized business administrator certifications (Fachwirt). The subsequent table and bar chart

exhibit the consolidated educational levels of the participants. The tabulated data delineate the distribution of educational qualifications among the 83 valid respondents, detailed as follows:

What is your highest education level?

		Frequency	Percent	Cumulative Percent
Valid	No school leaving certificate	4	4,8	78,3
	Haupt-/Volksschulabschluss	16	19,3	39,8
	Mittlere Reife / Realschulabschluss	18	21,7	100,0
	(Fach-)Abitur	12	14,5	14,5
	University degree	25	30,1	69,9
	Apprenticeship	5	6,0	20,5
	Higher Apprenticeship	3	3,6	73,5
	Total	83	100,0	

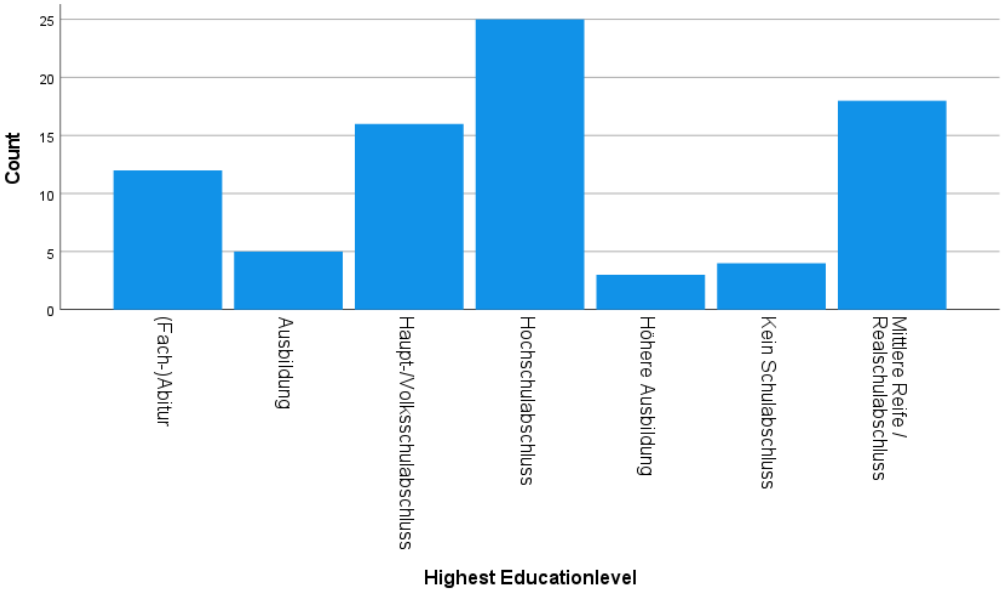


table 10 Education Level of Participants

The corresponding bar chart reinforces the tabulated data, presenting a visual distribution of educational levels. The highest prevalence is observed for university degrees, followed by 'Mittlere Reife / Realschulabschluss' and 'Haupt-/Volksschulabschluss', indicating a significant portion of the participants possessing formal education ranging from intermediate to higher education.

The educational composition of the survey's respondents suggests a diverse cross-section of educational attainment, reflecting a skew towards higher education with a prominent representation of university degrees. This distribution may influence the respondents' receptiveness to digital transformation and automated solutions, potentially correlating with a higher level of digital literacy and acceptance of digital health applications, given their academic background.

The significant number of respondents with formal vocational training and advanced apprenticeships implies a practical orientation in their professional capabilities, which could translate into an appreciation for pragmatic digital solutions that enhance efficiency in their respective fields.

In conclusion, the educational diversity within the participant pool provides a robust basis for assessing the user experience and technology acceptance across a spectrum of educational backgrounds, even if the sample does not correspond to other larger studies, which makes generalization and representation difficult.

S1Q4: The empirical data from the quantitative survey includes an assessment of the participants' self-reported knowledge about their own health, encapsulating an understanding of their bodies and any illnesses they might have. This measure of 'health awareness' serves as the variable of interest. Table 11 presents the findings from the survey question "How would you rate your knowledge about your own health?"

- 1/5 – bad: No participants rated their knowledge as poor.
- 2/5: 4 individuals, accounting for 4.8%.
- 3/5: 19 individuals, comprising 22.9%.
- 4/5: A majority of 42 individuals, making up 50.6% of the sample, indicating a good level of knowledge.
- 5/5 – good: 18 individuals, representing 21.7%, who believe they have a very good knowledge of their health.

Cumulatively, the responses suggest that over 70% of participants rated their health knowledge as good to very good.

How would you rate your knowledge about your own health?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1/5 = bad	0	0	0	0
	2/5	4	4,8	4,8	4,8
	3/5	19	22,9	22,9	27,7
	4/5	42	50,6	50,6	78,3
	5/5 = good	18	21,7	21,7	100,0
	Total	83	100,0	100,0	

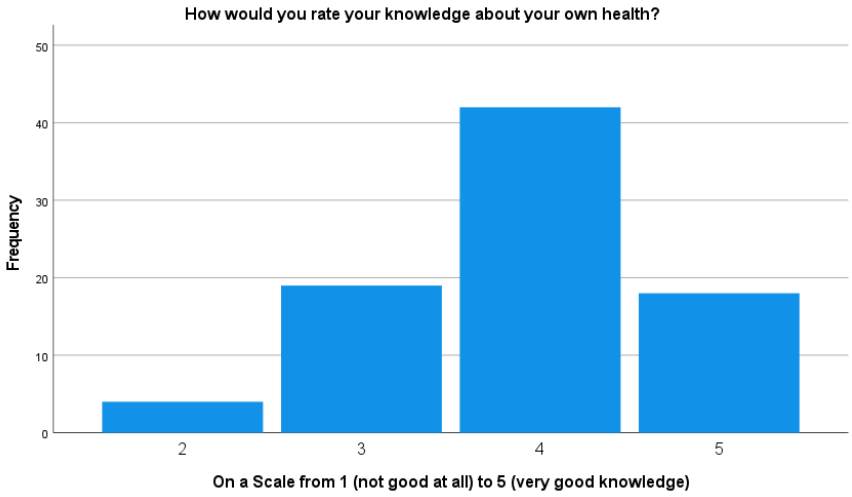


table 11 Assessment of own level of knowledge about the participants own health

The self-assessment of health awareness reveals a generally positive perception among the senior participants regarding their understanding of their own health. The absence of responses in the lowest category (1/5 – bad) suggests a baseline confidence across the surveyed group in their health lite-racy.

A significant majority rating their knowledge in the higher bands (4/5 and 5/5 combined at 72.3%) indicates a heightened awareness and likely engagement with their health and wellness. This level of health consciousness could imply that the participants are proactive in managing their health, potenti-ally through informed decisions about lifestyle choices, medication adherence, and willingness to en-gage with healthcare providers.

The data signifies that seniors are not passive recipients in their healthcare journey; rather, they exhibit a commendable level of awareness and involvement. This engagement is crucial when considering the integration of digital health tools and prescription apps that require user interaction and comprehensi-on. Such an informed user base might be more amenable to adopting health-related technology soluti-ons, provided these tools are user-friendly and cater to the informational needs of this demographic. It also suggests that digital health applications designed for this group could benefit from interactive fea-tures that leverage the users' existing health knowledge, while also providing educational content to further enhance their understanding.

However, the presence of a small segment (4.8%) rating their knowledge as 2/5 highlights a potential gap that digital health solutions could aim to bridge. This underscores the importance of user experi-ence tailored to varying levels of health literacy within the senior population.

Section 2: Previous experience with technology and apps

S2Q1: In light of these findings, developers and healthcare providers should ensure that digital health appli-cations are accessible and comprehensible to all seniors, regardless of their initial health awaren-ess level. By doing so, they can foster a supportive environment that empowers all seniors to take an ac-tive role in managing their health. In the exploration of the participants' use of smartphones or tablets, the data indicates a substantial inclination towards technology usage within the surveyed demographic. The quantitative results demonstrate that 85% of the participants (68 out of 80) confirmed using a smart-phone or tablet, suggesting a strong presence of technology adoption among the senior participants.

Do you use a smartphone or tablet?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Ja	68	85,0	85,0	85,0
	Nein	12	15,0	15,0	100,0
	Total	80	100,0	100,0	

table 12 Particent usage of a smartphone or tablet

The high affirmative response to smartphone or tablet usage in the sample diverges from other studies, where the prevalence of such technology usage among seniors is reported to be lower. For instance, broader surveys suggest that 53% of individuals over the age of 65 do not use smartphones, with only 69% of those aged 65-69 years using them.[324, 325] This discrepancy suggests that the sample under study may consist of a subgroup with a higher affinity for information technology, and those with less IT exposure may not have been effectively reached to allow for a robust significance analysis in a representative sense.

The imbalance in IT affinity could be anticipated given the methodology of data collection, which was skewed towards digital surveys rather than face-to-face interactions, such as those conducted at the Seniorentreff Mohren in Nagold. Therefore, the data may reflect an inherent selection bias towards individuals who are more receptive and familiar with digital platforms.

In conclusion, while the survey sample exhibits a high rate of technology adoption, this rate is not necessarily representative of the broader senior population. This finding is critical for the interpretation of the survey's broader implications, particularly in assessing the receptiveness of digital health applications among seniors. The insights derived could guide future research methodologies and the development of digital solutions to ensure inclusive access and engagement across varying levels of IT literacy among the senior demographic.

S2Q2: The quantitative survey inquired about the types of apps used by the target group of seniors, allowing for multiple responses to capture a comprehensive scope of app usage. The survey findings indicate a preference for certain types of applications, as presented in the collected data.

		Messenger Apps	Telephone	Games	Fitness Apps	Social Media	Health Apps	Others
N	Valid mentions	58	58	24	22	43	16	14
	Percentage of respondents in this category	72,5	72,5	30	27,5	53,8	20	17,5

[324] Seifert/Ackermann 2020

[325] Paulsen/Vogt-Hohenlinde 2021

table 13 Information on which apps the target group uses

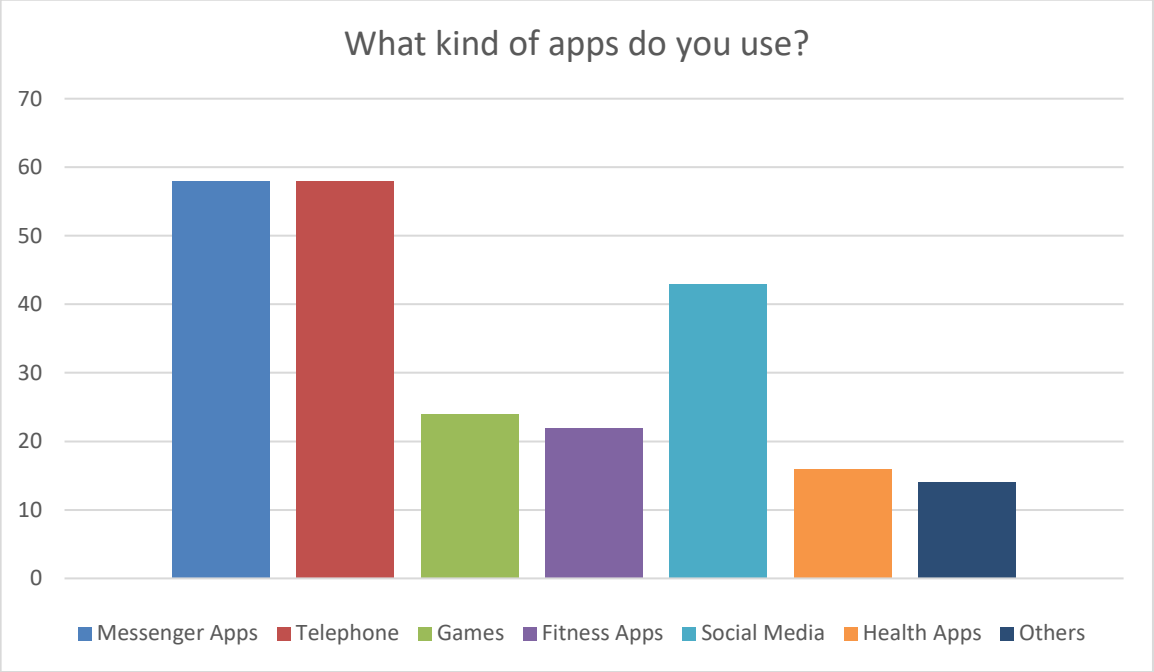


table 14 bar chart showing which apps the target group uses

The utilization patterns of apps among seniors in this survey reveal a notable preference for communication-based applications, with both messenger and telephone apps being used by a majority (72.5%) of the respondents. Following these, social media applications hold the next highest usage rate (53.8%). These statistics illuminate a significant inclination towards apps that facilitate social interaction and connectivity among the seniors.

While the adoption of fitness apps (27.5%) and health apps (20%) is less pronounced, their presence indicates an awareness and willingness among seniors to engage with applications that could influence their well-being. However, it's important to note that the definitions and boundaries between app categories are not universally clear or distinct. The survey's results thus reflect the respondents' subjective interpretations of the app categories presented to them. During face-to-face survey administration, it became evident that the app categories needed detailed explanations to ensure seniors comprehended the distinctions. This necessity points towards a potential discrepancy in the understanding of app classifications among the senior demographic.

Such nuances and the inherent limitations of the methodology, along with the need for clear explanations, will be discussed more specifically in the discussion section of this work. The identification of these limitations is essential for a comprehensive evaluation of the data and the subsequent implications for developing senior-friendly digital solutions.

S2Q3: The subsequent question in the survey focused on participants' self-assessment of their proficiency and knowledge regarding smartphones and tablets. The data showcases the respondents' perceived levels of experience, highlighting a notable self-reported familiarity with these technologies. According to the survey data, the self-evaluation of experience with smartphones and tablets is categorized as follows:

How would you describe your experience with smartphones or tablets?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Absolute beginner (I have little or no experience with smartphones or tablets).	12	15,0	15,0	15,0
	Beginner (I use basic functions but still feel insecure).	13	16,3	16,3	31,3
	Advanced (I regularly use various functions and apps, but still have questions from time to time).	33	41,3	41,3	72,6
	Experienced (I am familiar with most functions and apps and can solve problems myself).	14	17,5	17,5	90,1
	Expert (I know my way around and can give other users help and tips).	8	10,0	10,0	100
	Total	80	100,0	100,0	

table 15 Overview of seniors' own assessment of the topic "How would you describe your experience with smartphones or tablets?"

The self-assessment concerning smartphone and tablet expertise again indicates a high degree of IT affinity within the sample, with 41.3% of respondents identifying themselves as advanced users. This significant proportion of the sample claiming advanced skills reinforces the inference that the study's participants are relatively tech-savvy compared to the general population of seniors.

This perception is subjective, as respondents' assessments are based on personal judgments. Despite attempts to clarify categories through detailed definitions and example statements, variations in individual self-assessment accuracy are inevitable. The distribution of responses suggests a gradient of self-perceived proficiency, from absolute beginners to experts. The presence of 10% of the respondents who consider themselves experts is noteworthy, as it suggests that these individuals are not only comfortable using various functions and apps but are also capable of problem-solving and potentially providing guidance to others.

The survey's structure, aimed at a more nuanced categorization, intended to minimize the range of subjectivity in responses. However, the subtleties in personal interpretations of skill levels underscore the qualitative aspect of this data point. The findings provide insights that are vital for the implementation and design of digital health applications targeted at seniors. They suggest that while a segment of the senior population has a strong grasp of modern technology, a tailored approach is still necessary to accommodate the entire spectrum of user expertise.

In conclusion, while the self-reported data portrays a skewed picture towards higher technology literacy, the actual range of expertise likely spans a broader spectrum. This distribution needs to be considered when developing digital solutions for seniors to ensure inclusivity and accessibility for users at all levels of proficiency.

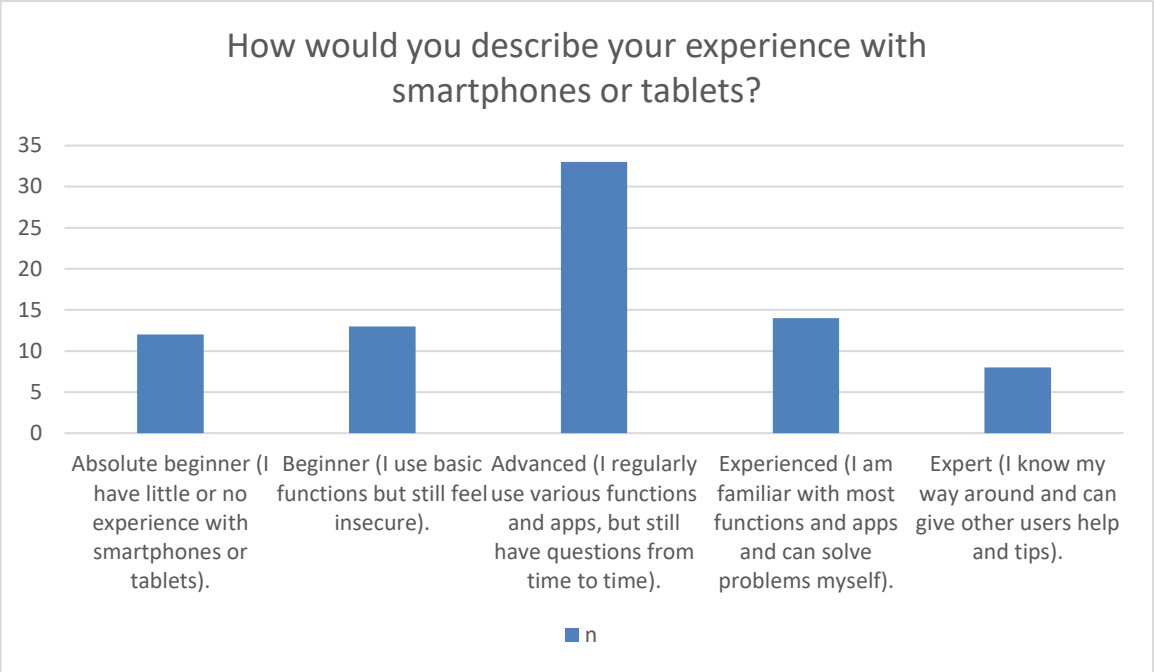


table 16 Overview chart of seniors' own assessment of the topic "How would you describe your experience with smartphones or tablets?"

S2Q4: The survey addressed in the next question the frequency of health or fitness app usage among the senior participants, seeking to understand their engagement with digital tools related to health management and physical activity. The responses gathered were visually represented in a bar chart, facilitating the analysis of the data.

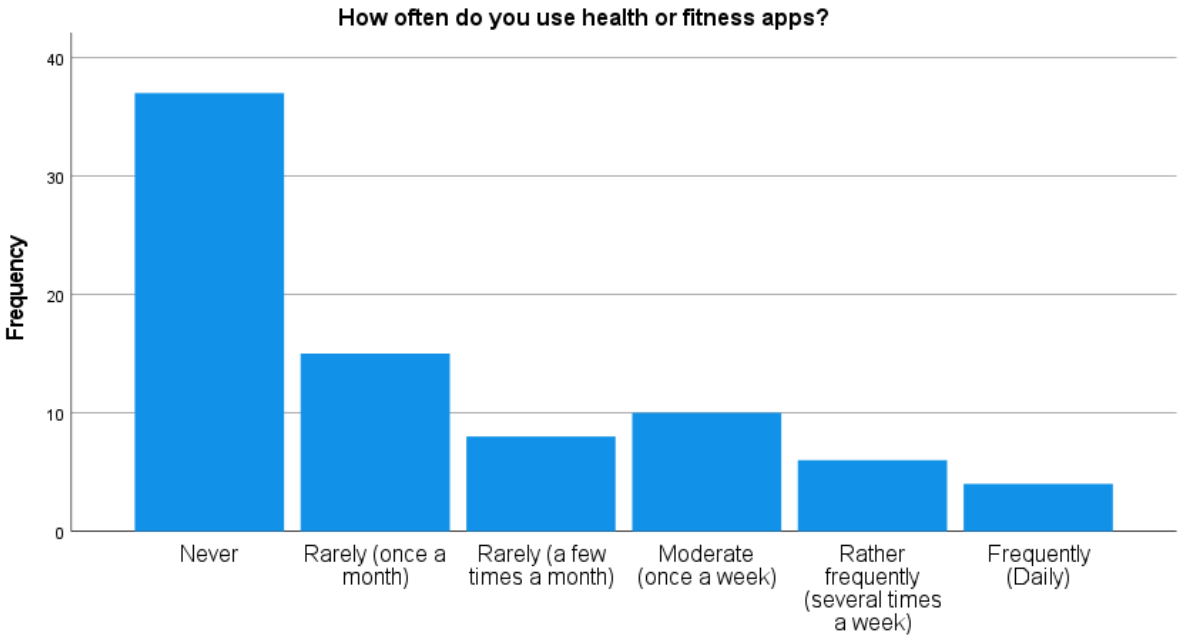


table 17 Overview of how often respondents use health or fitness apps

The clear majority of participants reported "Never" using health or fitness apps, revealing a significant portion of the demographic remains disengaged from these digital tools. This finding raises questions about the accessibility, relevance, or awareness of such apps among the senior population surveyed. The data indicates a declining trend of app usage frequency, with a small proportion of respondents using these apps on a daily or almost daily basis. This trend may reflect a lack of interest, perceived need, or technological barriers preventing more frequent use.The infrequent use of health or fitness apps could be attributed to various factors, including a preference for traditional health management methods, potential usability issues within the apps themselves, or a general lack of familiarity or comfort with the digital tools available.Given the increasing emphasis on digital healthcare solutions and the potential benefits of health and fitness apps for the senior demographic, the low uptake suggests a missed opportunity for health promotion and engagement. This observation emphasizes the need for more user-friendly designs, targeted educational campaigns to increase awareness, and possibly a more personalized approach to integrating these digital solutions into the lives of seniors.

In conclusion, the survey results underscore the importance of understanding the user experience of seniors to encourage the adoption of health and fitness apps. Developers and healthcare providers must consider the specific needs, preferences, and technology comfort levels of older adults to design solutions that are not only effective but also widely adopted and integrated into daily health practices.

S2Q5: The next question of the survey aimed to ascertain the usage of various health devices by seniors. Participants were provided with multiple response options, ranging from traditional devices without digital display to comprehensive health management platforms.

Statistics

		No Devices	Basic Devices	Digital Basic Devices	Wearables	Mobile Health Apps	Connected Health Devices	Integrated Health Systems	Comprehensive Health Management Platforms
N	Valid mentions	4	18	25	9	12	3	0	3
	Percentage of respondents in this category	5	22,5	31,25	11,25	15	3,75	0	3,75

table 18 Overview of the mentioned health devices of seniors

It is clear that a substantial portion of respondents (31.25%) indicated they use basic digital devices for health purposes. These include electronic blood pressure monitors or digital thermometers, suggesting a general acceptance of new and digital health support within the sample.

The use of mobile health apps, reported by 15% of respondents, reflects the growing interest and practical utility of app-based solutions for health monitoring. The comparatively low usage of wearables (11.25%) and connected health devices (3.75%), as well as integrated health systems and comprehensive health management platforms (each at 3.75%), suggests that the integration and daily application of more advanced digital health technologies are still in their infancy.

It is evident that despite an understanding and willingness to use digital health devices, there is still significant potential for a broader introduction and usage of innovative health technologies. In particular,

the low adoption rate of comprehensive health management platforms and specialized DiGA apps may indicate a need for informational and educational initiatives to communicate and clarify their benefits and applicability to older adults.

These insights emphasize the necessity for health technology solutions that cater to various levels of technical proficiency and comfort among older adults. They should be user-friendly, offer clear health benefits, and be well integrated into the daily routines of seniors to encourage wider acceptance of these digital health tools.

Section 3: Perception and acceptance of digital health applications

S3Q1: The next survey segment in question was designed to assess the awareness and acceptance of prescription digital health applications among seniors. Specifically, the participants were asked whether they had heard of Digital Health Applications (DiGA or app on prescription) developed for preventive healthcare.

Have you ever heard of prescription digital health applications (DiGA or app on prescription) that have been specially developed for preventive healthcare?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	59	73,8	73,8	73,8
	No	21	26,3	26,3	100,0
	Total	80	100,0	100,0	

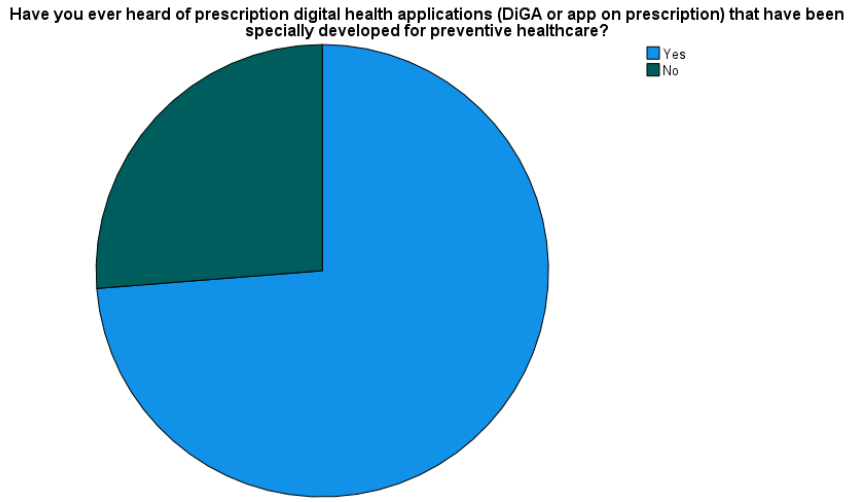


table 19 Overview and pie chart of the answers to the Questen, if the seniors heard of digital health applications, DiGA or "App on prescription"

The responses indicate that a substantial majority (73.8%) of the survey sample is aware of prescription digital health applications specifically developed for preventive healthcare. This high level of awareness suggests that digital health applications are successfully reaching a broad audience within the senior demographic and potentially being perceived as a beneficial tool for health management. This awareness could also reflect the effectiveness of public health campaigns, healthcare providers' efforts to inform patients about digital health options, or the general spread of information in communities. The

fact that nearly three-quarters of the sample is informed about DiGA indicates a solid foundation for the potential use and integration of these applications into routine preventive healthcare for seniors.

However, the remaining 26.3% who are unaware of such applications highlight an opportunity for further outreach and education to ensure that a larger segment of the senior population can benefit from digital health innovations. It is essential for healthcare providers and app developers to address this gap by increasing visibility and understanding of DiGA, ensuring that seniors are not only aware of these resources but also feel empowered to use them effectively.

In summary, the high level of awareness of DiGA among the survey respondents is promising for the future of digital health technology adoption. Still, continued efforts are needed to foster comprehensive understanding and utilization across the entire senior population.

S3Q2: The survey proceeded to probe the willingness of seniors to consider utilizing prescription digital health applications to support their health. This question directly addressed the participants' openness to integrating DiGA into their personal healthcare regimen.

Would you consider using a prescription app to support your health?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes, definitely	12	15,0	15,0	15,0
	No, by no means	6	7,5	7,5	22,5
	Undecided	17	21,3	21,3	43,8
	Unlikely	12	15,0	15,0	58,8
	Probably	33	41,3	41,3	100,0
	Total	80	100,0	100,0	

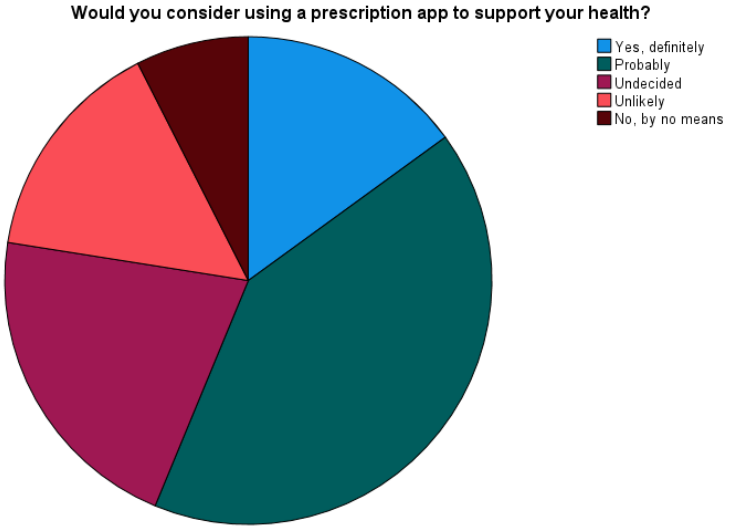


table 20 Overview and pie chart, whether the seniors would consider DiGA for their personal treatment

The survey findings exhibit a noteworthy inclination towards the acceptance of prescription digital health applications, with a combined 56.3% of the participants expressing at least a "Probably" or "Yes, definitely" stance towards using DiGA. This positive reception underscores the potential receptiveness of the senior demographic to adopting digital health technologies for personal healthcare management.

The 15% of respondents affirming a definitive willingness to use such apps suggests a segment of the senior population is ready to embrace digital healthcare innovations actively. On the other hand, the

7.5% of participants firmly against using DiGA reflects a subset of the population that remains resistant or skeptical about the role of digital tools in personal health management. The "Undecided" and "Unlikely" responses represent a collective 36.3% of participants, indicating a significant portion of the sample is either ambivalent about or leaning against the use of DiGA, possibly due to uncertainties or lack of information regarding the efficacy, usability, or benefits of these applications. Overall, the data points to a positive tendency towards the integration of digital health applications among seniors, with over half of the respondents open to or certain about the utility of DiGA. It also reveals an opportunity for healthcare providers and digital health developers to address concerns, provide clarity, and foster confidence among seniors regarding the adoption of these technologies.

In conclusion, while a promising majority demonstrates openness to using prescription digital health applications, there is a critical need for targeted educational initiatives to convert the undecided and increase the likelihood of adoption among skeptics. The success of such efforts could lead to more seniors benefiting from the advancements in digital healthcare.

S3Q3: The survey questioned in the next question the participants on the significance they place on a doctor's recommendation when choosing a treatment method. This inquiry serves to understand the level of trust and importance the senior demographic attributes to professional medical advice in their health-related decision-making process.

How important is a doctor's recommendation to you when choosing a treatment method?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very important	26	32,5	32,5	32,5
	Teils/teils	7	8,8	8,8	41,3
	Important	47	58,8	58,8	100,0
	Total	80	100,0	100,0	

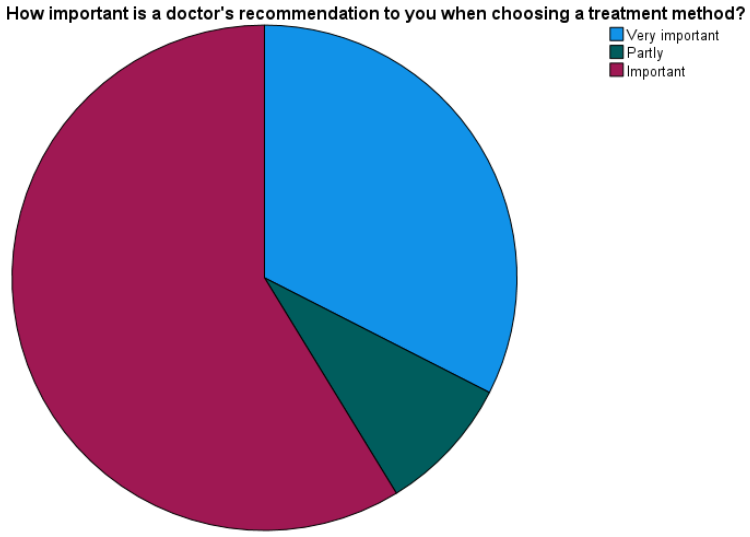


table 21 Overview and pie chart, how the support of the attending physician is perceived

The survey results reveal a pronounced deference to medical professionals among the senior participants, with a combined 91.2% indicating that a doctor's recommendation is at least important, if not very important, in their decision-making regarding treatment methods. This overwhelming majority underscores the pivotal role that healthcare providers play in influencing treatment choices among this demographic.

The absence of responses in the "less important" and "not at all important" categories signifies unanimous respect for and reliance on medical expertise within the sample. The small proportion (8.8%) that reports a neutral stance, labeled as "Partly," might suggest some degree of self-reliance or alternative information sources in making health-related decisions. The high regard for medical guidance is indicative of potential receptivity to adopting treatments, including digital health applications, if they are recommended by a trusted physician. This insight is essential for healthcare practitioners and digital health developers, as it highlights the importance of physician endorsement in the successful adoption of new health technologies among seniors.

In summary, the doctor's recommendation emerges as a crucial factor in treatment method selection for the majority of seniors. Health interventions, especially digital ones, are likely to gain traction if they are presented or supported by medical professionals. For the minority who are ambivalent, additional information and reassurance from their healthcare providers could be key in guiding their healthcare choices.

S3Q4: The survey posed a question about the influence of friends and family on seniors' decisions to try new products. This question aimed to measure the impact of social support on the adoption of new technologies or solutions within their lifestyle.

To what extent do friends and family influence your decision to use new products?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all	7	8,8	8,8	8,8
	Hardly	18	22,5	22,5	31,3
	Very strong	2	2,5	2,5	33,8
	Strong	11	13,8	13,8	47,5
	Partial	42	52,5	52,5	100,0
	Total	80	100,0	100,0	

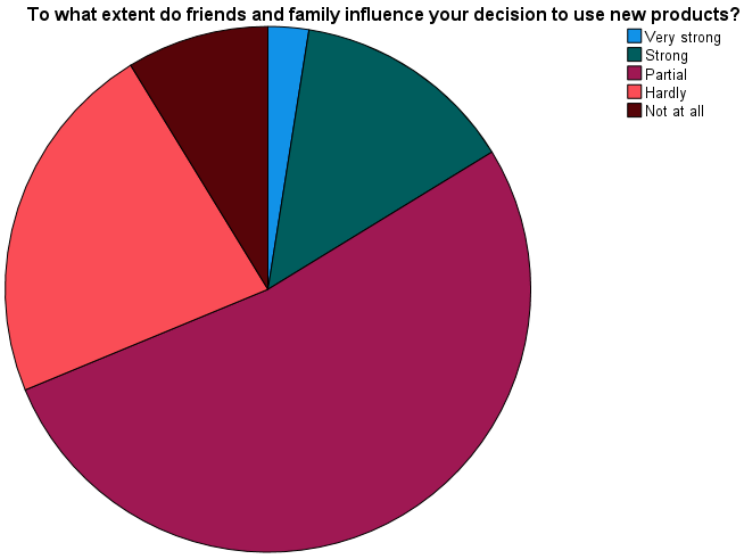


table 22 Overview and pie chart, the extent to which family and friends influence seniors to try new things.

The results indicate that friends and family have a mixed level of influence on seniors' decision-making when it comes to trying new products. A majority (52.5%) selected "Partial," suggesting that while social support does play a role, it is not the sole determining factor. This majority occupies the middle ground, implying that other factors may also significantly impact their decision-making. The extreme ends of the spectrum ("Not at all" and "Very Strong") show relatively lower percentages (8.8% and 2.5%, respectively), suggesting that friends and family are neither entirely disregarded nor overwhelmingly persuasive in influencing seniors' choices. The distribution of responses hints at a bell-curve-like pattern, with the highest frequency in the middle category of "Partial," which tapers off towards both ends of the spectrum. This pattern suggests that while seniors value the opinions of their social circles, they maintain a level of independence and may consider various sources of information when making decisions about new products.

In summary, the social support from friends and family is part of a broader constellation of factors that seniors consider when approaching new products. This insight is vital for marketers and product developers, indicating that while peer influence is significant, it should be complemented with other forms of engagement and information to effectively encourage the adoption of new products among this demographic.

Section 4: Evaluation of the treatment method

S4: The next section deals with the UX evaluation from a conventional treatment method to a treatment with DiGA. For this purpose, A-B versions of the survey were created, whereby A received a scenario in which a case was described in which the patient goes to the doctor and the doctor classically suggests a conventional treatment. The B version received the same case, but with the difference that here the doctor now suggests a DiGA for closer examination. in both cases, the respondents were then asked to complete and rate the matrix according to UEQ-S.

A/B Testing Results via UEQ-S Analysis:

Scenario A - Traditional Treatment:

- Pragmatic Quality (Efficiency, Perspicuity, Dependability): Scores range from 0.5 to 1.7, suggesting that users find the traditional treatment method from moderate to good in terms of usability and functionality.
- Hedonic Quality (Stimulation, Novelty): Negative scores (as low as -2.3) indicate a lack of stimulation and perceived novelty, pointing to a potentially uninspiring or outdated perception of traditional methods.
- Overall Impression: The overall impression falls below the neutral mark, suggesting that the traditional treatment method may lack appeal or engagement with the target audience.

Scenario B - Digital Health Application (DiGA):

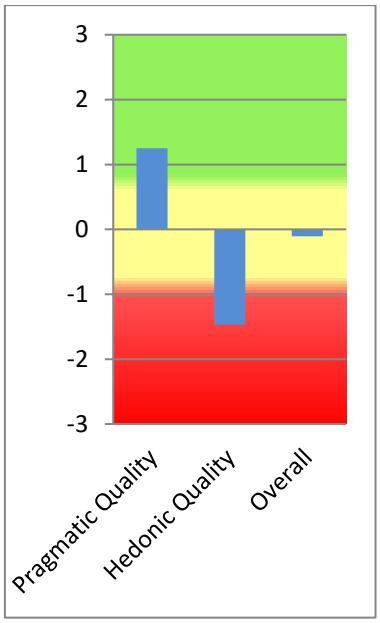
- Pragmatic Quality: Scores from 0.7 to 1.3 indicate a good level of usability and efficiency, slightly lower than the traditional method but still positive.
- Hedonic Quality: Significantly higher than scenario A, with scores up to 1.6, showing that DiGA is perceived as more stimulating and novel.
- Overall Impression: Reflecting a predominantly positive response, DiGA appears to be more favorable compared to the traditional treatment method.

Item	Mean	Variance	Std. Dev.	No.	Negative	Positive	Scale	
1	1,7	1,9	1,4	36	obstructive	supportive	Pragmatic Quality	
2	1,5	2,0	1,4	36	complicated	easy	Pragmatic Quality	
3	0,5	2,4	1,6	36	inefficient	efficient	Pragmatic Quality	
4	1,3	2,6	1,6	36	confusing	clear	Pragmatic Quality	
5	-0,8	2,4	1,5	36	boring	exciting	Hedonic Quality	
6	-0,8	2,2	1,5	36	not interesting	interesting	Hedonic Quality	
7	-2,0	1,3	1,1	36	conventional	inventive	Hedonic Quality	
8	-2,3	1,0	1,0	36	usual	leading edge	Hedonic Quality	

table 23 UEQ-S Version A: Detailed overview of the 8 Items

Short UEQ Scales	
Pragmatic Quality	1,250
Hedonic Quality	-1,469
Overall	-0,109

table 24 UEQ-S Version A: Short Summary of Pragmatic and Hedonic Quality



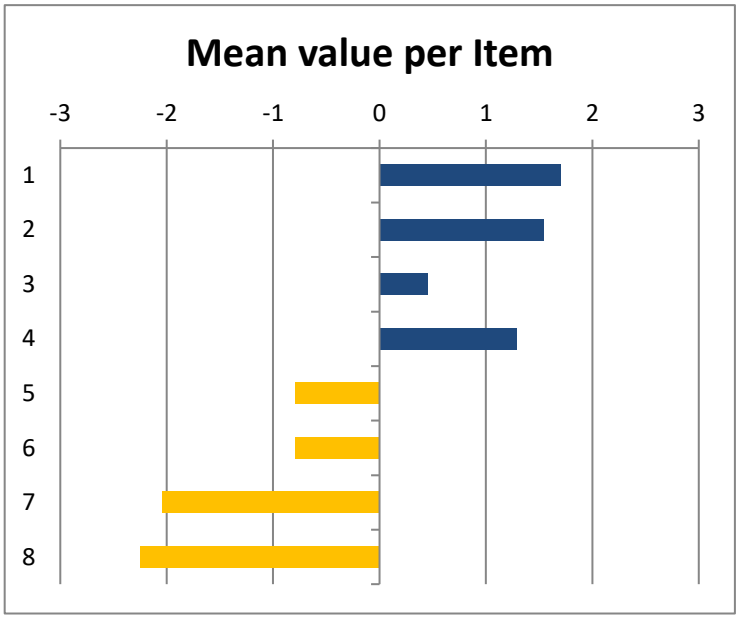


table 25 UEQ-S Version A: Bar charts to visualize the summary and also the 8 items

Item	Mean	Variance	Std. Dev.	No.	Negative	Positive	Scale	
1	1,1	2,5	1,6	44	obstructive	supportive	Pragmatic Quality	
2	0,7	3,9	2,0	44	complicated	easy	Pragmatic Quality	
3	0,8	2,1	1,5	44	inefficient	efficient	Pragmatic Quality	
4	0,7	3,9	2,0	44	confusing	clear	Pragmatic Quality	
5	1,3	2,8	1,7	44	boring	exciting	Hedonic Quality	
6	1,3	2,9	1,7	44	not interesting	interesting	Hedonic Quality	
7	1,1	2,3	1,5	44	conventional	inventive	Hedonic Quality	
8	1,6	2,6	1,6	44	usual	leading edge	Hedonic Quality	

table 26 UEQ-S Version B: Detailed overview of the 8 Items

Short UEQ Scales	
Pragmatic Quality	0,822
Hedonic Quality	1,313
Overall	1,068

table 27 UEQ-S Version B: Short Summary of Pragmatic and Hedonic Quality

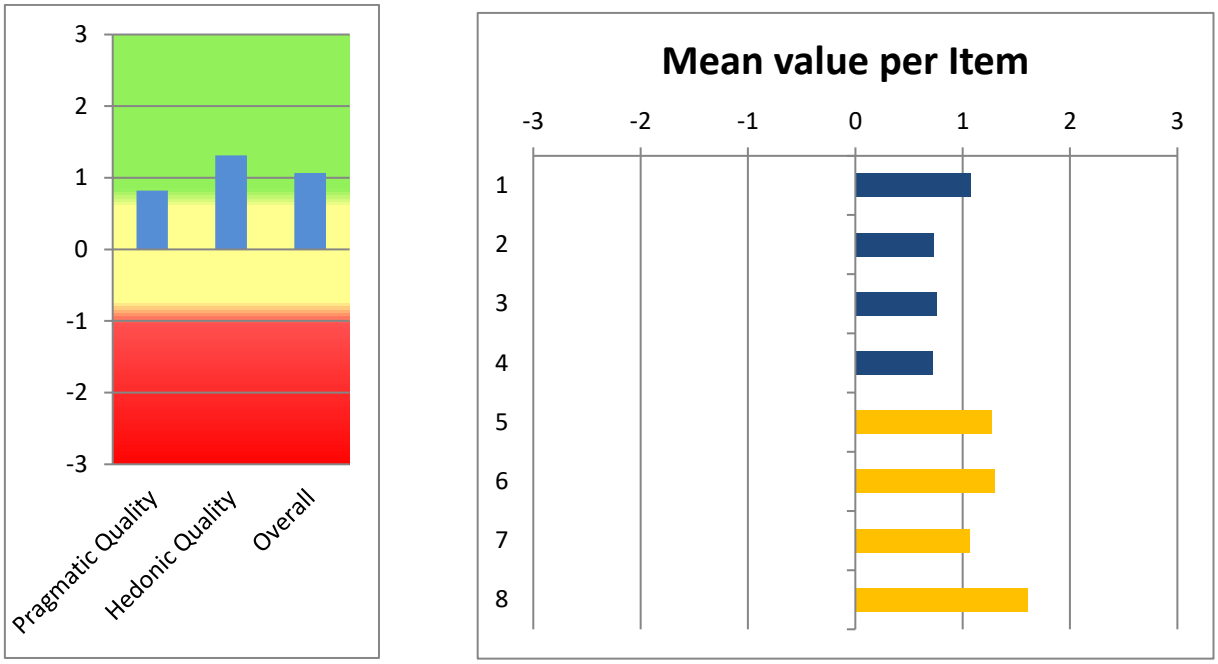


table 28 UEQ-S Version B: Bar charts to visualize the summary and also the 8 items

Regarding Scenario A, it was observed that there was a lower variance and standard deviation among the items, particularly in the domain of pragmatic quality. This suggests that respondents' perceptions were consistent, indicating uniform expectations from conventional healthcare methods. In contrast, Scenario B exhibited greater variability, especially within the hedonic quality spectrum. Such a discrepancy implies a diversity of expectations and experiences concerning digital health technologies.

The response range for both scenarios predominantly conformed to the typical expectations for the UEQ-S scale, with extreme values being a rarity. This pattern suggests that evaluations were provided with a level of discernment, eschewing any tendency towards hyperbolic or overly critical responses. Notably, a skewness in the hedonic quality responses within Scenario B was detected, indicating varied levels of enthusiasm for innovative health treatments—a consideration of importance for practitioners and developers within the digital health landscape. A comparative analysis between the two scenarios revealed that traditional healthcare methods are perceived as dependable, yet they fall short in terms of engagement and excitement when juxtaposed with DiGA offerings. Conversely, DiGA's modest decline in pragmatic scores signals a potential area for refinement to achieve parity with the dependability of traditional methods. The stark contrast in hedonic quality between scenarios A and B underscores an opportunity for traditional healthcare approaches to integrate more engaging elements to bolster user motivation. For DiGA, an emphasis on enhancing pragmatic facets, such as usability and predictability, is posited as a pathway to higher adoption rates.

In summation, the UEQ-S findings elucidate user experience preferences within the healthcare domain. While traditional methods are esteemed for their dependability, there exists a necessity for augmentation in the realm of stimulation and novelty. DiGA, although celebrated for its innovative and motivating aspects, must strive to attain a perception of reliability akin to traditional healthcare avenues. A harmonized

user experience, leveraging the reliability of traditional healthcare with the innovation of digital applications, emerges as a pivotal goal. Achieving this balance is deemed essential for the advancement of patient-centric healthcare solutions.

Section 5: Barriers and concerns

S5Q1: Upon examining the next question inquiry pertaining to concerns regarding app usage among senior individuals, the apprehensions are largely centered around data protection and operational difficulties. The data highlights that 68.8% of respondents identified data privacy and security as their primary concern, reflecting a prevalent anxiety about the safeguarding of personal information in the digital domain. This finding is congruent with existing literature that underscores the importance of robust data protection mechanisms in fostering trust and confidence among app users, particularly within the senior demographic, which is often more cautious about digital privacy matters.

Closely following, operational challenges in using apps were indicated by 52.5% of participants. This percentage illuminates the apprehension surrounding the usability of digital applications, signifying a need for more intuitive and user-friendly designs that cater to the capabilities and limitations of the elderly user base. The concern regarding the readability of text on digital platforms, as suggested by 51.25% of respondents, underscores the necessity for adaptable interface options that can accommodate varying visual acuity levels among users. Lesser, but still significant, concerns include unclear instructions, as reported by 21.3% of survey participants, pointing to a demand for straightforward and easily comprehensible guidance within the app's functionality. The survey further revealed that 31.3% of seniors questioned the meaningfulness and clear added value of using such apps, which implies that there is a gap in conveying the tangible benefits that digital health applications can provide to this particular age group. A marginal number of respondents expressed a lack of interest or need for these apps, which could reflect either a contentedness with their current health management systems or a potential unawareness of the benefits that such digital tools could offer.

Statistics

		Data protection and security of my data	Meaningfulness / Recognizing clear added value	No interest or need	Difficulties in operating	Too small font	Unclear instructions	Fear of fraud and hidden costs	None of mentioned	What "intuition" is assumed?	The doctor is overwhelmed by questions
N	Valid mentions	55	42	8	41	17	25	1	1	1	1
	Percentage of respondents in this category	68,8	52,5	10	51,25	21,3	31,3	1,3	1,3	1,3	1,3
	Other single mentiones							yes	yes	yes	yes

table 29 Overview of the survey answers of the question, what barriers the seniors estimate

The survey results encapsulate a spectrum of reservations harbored by senior individuals regarding the usage of apps, with data security emerging as the paramount concern. This predominant worry reflects a combination of unfamiliarity and trepidation surrounding the mechanisms and implications of new

technologies, signifying a substantial information void or perhaps a deep-rooted apprehension towards the digital transformation in healthcare.

To address these concerns effectively, it is imperative that any educational endeavors specifically target the elucidation of data protection protocols, aiming to demystify the operations of digital health applications. The qualitative expert interviews at hand suggest that such educational initiatives, particularly when delivered by medical professionals, could play a pivotal role in alleviating the unease associated with these technologies. A tailored approach to education, encompassing detailed explanations and demonstrations by healthcare practitioners, could significantly bridge the knowledge gap. By providing clarity on how personal data is managed, secured, and utilized within these apps, the medical community can help foster a sense of security and trust amongst this user group.

Conclusively, it is essential to recognize and address the root of these barriers—a lack of understanding and the consequent fear of the unknown. Interventions such as specific training sessions and in-depth, jargon-free explanations by medical experts are not merely beneficial but necessary. These steps are crucial to empower seniors, ensuring they are equipped with the knowledge to confidently navigate the landscape of digital health technology.

S5Q2: In addressing age-appropriate user experience amidst digital transformation and technology acceptance among seniors, the issue of accessibility problems in new health apps is scrutinized in the next question. This question sheds light on the specific barriers that older adults face when using new health applications. The survey reveals that the most significant hurdle lies in the complexity of navigation and menu design, followed closely by inadequate font size and screen layout not tailored to seniors. The lack of communicated benefits is also distinctly highlighted. Additional substantial challenges include a dearth of instructions or explanations specifically tailored to older users, and the absence of support through audio or video tutorials. A smaller group of users expresses no concerns or perceives new apps as generally accessible.

Statistics

		Navigation or menu guidance too complex	Font size and screen layout not suitable for senior citizens	Benefits not communicated	Lack of instructions or explanations tailored to older users	Lack of support through audio or video instructions	No concerns; I find new apps generally accessible	Not interested	Too much information	Possibly "illogical" or not always optimized menu navigation, as well as errors	Provider uses my data without permission
N	Valid mentions	57	38	38	35	22	9	2	1	1	1
	Percentage of respondents in this category	71.3	47,5	47,5	43.8	27,5	11,3	2,5	1,3	1,3	1,3
	Other single mentiones							yes	yes	yes	yes

table 30 Evaluation of the results of the question which age-specific accessibility problems influence the use of a new health app

These results underscore that specific aspects of user experience (UX) are central, requiring alignment with the cognitive and sensory abilities of older users. The frequency of mentions for each category not only emphasizes the prevailing UX issues but also indicates potential areas for innovation in digital

health solutions aimed at the elderly population. Academically considered, these empirical findings support the concept of user-centered design. They underscore the necessity for intuitive interfaces and clear communication tailored to the needs of seniors. The findings highlight the importance of including seniors in the design process and advocate for participatory design practices to ensure digital health applications meet the pragmatic and hedonic quality expectations of this demographic group.

By integrating these empirical insights with established acceptance models and UX principles, this thesis contributes a novel perspective to the discourse on age-appropriate digital health solutions, anchoring the structural narrative with concrete, user-derived evidence.

S5Q3: In the next question, assessing the willingness of seniors to adopt health applications following a personal training session, the data reveals a largely positive inclination among this demographic. A substantial 68.8% of respondents indicated that personal training would likely or definitely enhance their willingness to use health apps, signifying a crucial factor in the potential acceptance and utilization of such technologies.

Would your willingness to use a health app be increased by testing the app in advance in a personal training session?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes, definitely	24	30,0	30,0	30,0
	No, that wouldn't make any difference	4	5,0	5,0	35,0
	Uncertain	7	8,8	8,8	43,8
	Probably yes	31	38,8	38,8	82,5
	Probably no	14	17,5	17,5	100,0
	Total	80	100,0	100,0	

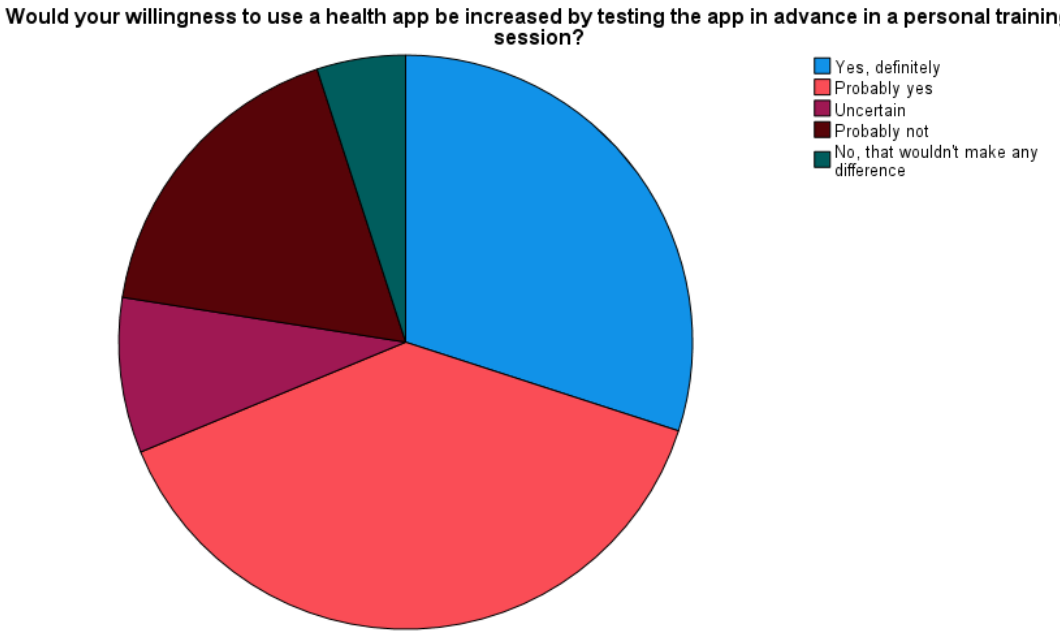


table 31 Overview and pie chart, whether personal training would persuade seniors to try a DiGA

The interpretation of these results must be considered in light of previous findings from this research, which underscored concerns among the senior population regarding new technologies, particularly surrounding issues such as data security. The prevailing apprehensions point to a need for education and clear communication about the functioning and benefits of health applications. To address this, the qualitative expert interviews emphasized the importance of specialized training and detailed explanations by medical professionals. Drawing from the insights, it's evident that personal training sessions represent a significant opportunity to bridge the gap in technology acceptance among seniors. Through these sessions, seniors can gain a deeper understanding of the applications, allay fears associated with new technology, and recognize the value and practicality of incorporating these digital tools into their healthcare management. The data further suggests that by focusing on individualized education and hands-on experience with health apps, seniors can overcome initial barriers to adoption. With almost 68,8% of participants open to using health apps post-training (Yes, definitly and Probably yes), the evidence points toward a proactive approach where engagement and reassurance from trusted healthcare providers play a pivotal role in integrating digital health solutions into seniors' lives.

In conclusion, the findings suggest that while there is a tangible readiness among seniors to engage with health apps, particularly when supported by personalized training, the onus lies on healthcare professionals to ensure that such educational interventions are comprehensive and address the unique needs of this demographic. This approach can effectively mitigate the concerns and enhance the user experience, fostering a more inclusive digital health environment for seniors.

S5Q4: The final open-ended question in the survey provided respondents with a space to express any remaining thoughts or opinions that had arisen during the survey or that had not been specifically addressed. While not yielding quantitative data, the 17 submissions offer qualitative insights that afford a nuanced perspective on the sample's sentiment.

Translated statement: Are there any other comments, suggestions or concerns you have regarding the use of DiGA apps?	**Mood**
This is no longer for me	Resignation
I trust the underlying algorithm - but the operation is hopefully sufficiently tested and error-tolerant!	Sceptism
I'm always open to new things, but would make the use of it dependent on a corresponding need.	Added value not clear
I'm too old for that	Resignation
I think the DiGA apps are fine	Good
I don't understand it anyway	Resignation
I trust my doctors above all.	Sceptism
A lot of private data and information on the Internet is used by the big Internet companies for sales and advertising purposes. I would like this to be excluded in the area of my health data.	Rejection
It's a very exciting topic	Good
A competent doctor would be more important to me	Sceptism
I would have to try it out	Added value not clear
No	-
No	-
Training for doctors	Not clear context
Difficult to answer if you haven't seen the app before	Feedback
"Skeptical about the smooth functioning of the app (crashing, logging in again, updates).	Sceptism

In addition to sleep problems, there may also be annoying recording of times. (Unless the sleep phases are recorded automatically) Problem: accuracy of the measurements. It remains to be seen whether the cost justifies the benefit. "	Sceptism

table 32 List of responses from the sample to the open text field at the end of the survey

Within these narrative responses, themes of resignation and skepticism were prevalent. Statements like "This is no longer for me" and "I'm too old for that" resonate with a sense of resignation, indicating a segment of the population who perceives the digital health revolution as beyond their scope of adaptation. This resignation is contrasted by expressions of trust in the operational effectiveness of digital health solutions, yet with an undertone of skepticism, notably concerning the sufficiency of testing and error-tolerance.

Skepticism was also apparent in concerns about privacy and the use of personal data by large internet companies—a significant barrier to acceptance. Such skepticism extends to doubts about the practical functionality of the apps, with users expressing hesitancy about smooth operation without crashes or login issues, as well as the accuracy of health data recording.

Conversely, some respondents showed a positive outlook, considering digital health topics exciting and acknowledging the potential benefits of DiGA applications. The acceptance here hinges on the clear articulation of added value and the practical benefits of such applications.

The mixed sentiments highlight the need for a multifaceted approach to addressing the concerns and harnessing the optimism surrounding digital health applications. Medical professionals, serving as trusted advisors, play a critical role in mitigating skepticism and resignation through personalized explanations and demonstrations of the benefits and functionalities of digital health applications.

In conclusion, the qualitative feedback underscores the importance of personalized education and the role of healthcare providers in bridging the gap between digital health innovation and user acceptance. These insights suggest that alongside technological development, concerted efforts in building trust, clarifying value, and ensuring user comfort with digital tools are essential for wider adoption among the senior population. The responses, though not quantifiable, are invaluable for tailoring digital health strategies that resonate with the needs and apprehensions of this demographic.

4.3 Methodology III: Evaluation of existing DiGA apps

Following a qualitative analysis conducted in Method I, which offered profound insights into practical application through the survey of prescribing doctors, and a quantitative study in Method II, delivering crucial findings via a survey among the senior demographic, a comprehensive understanding of the potential, technology acceptance, and specific requirements for digital health applications was developed. Building on these insights, a third methodological approach now leverages this accumulated knowledge to evaluate existing digital health applications. The objective is to provide a well-founded assessment of how these apps meet the needs of seniors and whether they could offer added value in their treatment context.

4.3.1 Selection of a Evaluation tool

In the scientific literature on eHealth, particularly in the field of mHealth applications, established academic evaluation systems exist. A widely used tool for this purpose is the Mobile App Rating Scale

(MARS) by Stoyanov.[326] This is recognized as one of the most frequently used tools for assessing the quality and content of mHealth applications.[327, 328, 329, 330, 331]

The validity of MARS was verified through a meta-analysis based on data from 15 studies that assessed the quality of mHealth applications using MARS. The construct validity of the scale was examined by "applying confirmatory factor analysis to evaluate competing models," incorporating evaluations of 1,299 apps from 15 different health sectors. This evaluation confirmed that MARS is "excellently suited for the quality assessment of mHealth applications.".[332]

In the German-speaking area, an adapted and validated version of the scale, known as the German Mobile App Rating Scale (MARS-G), is specifically applied for the evaluation of German-language mHealth applications.[333] However, given that the literature provides more guidance and instructions from the original author, Stoyanov, on the original MARS evaluation matrix, and the added value of MARS-G is seen primarily in the translation of the original MARS, this work will focus on the original form of MARS. This decision is grounded in the comprehensive support available for the original framework, which facilitates a more informed and reliable application of the evaluation matrix, ensuring that the assessment adheres closely to the foundational principles laid out by its creator.

Given the focus of this work on seniors, including their specific requirements, technology acceptance, and user experience, the existing characteristics within MARS are examined and analyzed to determine how well these needs are met. If necessary, the evaluation criteria within MARS are expanded or the weighting of evaluations adjusted to ensure that the added value of insights from Methods I and II is also evident in the MARS evaluation. This tailored evaluation process enables a detailed assessment of the suitability of digital health applications for seniors and illustrates to what extent these digital applications can meet the specific requirements and expectations of this target group.

Applying these evaluation scales to existing DiGA apps facilitates a methodologically sound and systematic evaluation aimed at determining the suitability of these digital applications for the senior demographic and assessing their potential added value in medical treatment and care.

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[326] Cf. Stoyanov et al. 2015

[327] Cf. Bardus et al. 2016

[328] Cf. Salazar et al. 2018

[329] Cf. Knitza et al. 2019

[330] Cf. Sander et al. 2020

[331] Cf. Terhorst et al. 2018

[332] Cf. Terhorst et al. 2020, p. 2

[333] Cf. Messner et al. 2020

	MARS Categories	*Correlated aspect in the UX*	*Correlated aspect in the TAM*	*Correlated aspect in the Age-specific Requirement*
		Hedonic Quality = 1	*Perceived Ease of Use = 1*	*Tech. Capabilities = 1*
		Functionality = 2	*Perceived Usefulness = 2*	Accessibility = 2
		Usability = 3	*Behavioural Intention = 3*	*Social Support = 3*
			Usage Behaviour = 4	*Health Awareness = 4*
Section A	Entertainment	1	2	2
	Interest	1	3	2
	Customisation	1, 2, 3	1, 2, 3	1, 2
	Interactivity	1, 2	3	1, 2
	Target Group	1, 2, 3	1, 2, 3, 4	1, 2
Section B	Performance	3	1	1
	Ease of Use	3	1	1, 2
	Navigation	2, 3	1, 2	1, 2
	Gestural design	2, 3	1, 3	1, 2
Section C	Aestethics	1	1, 3, 4	2, 4
	Graphics	1	1, 3, 4	2
	Visual Appeal	1	2, 3	1, 2
Section D	App description	2, 3	2	3
	Goal	2	2, 3	4
	Quality of information	2, 3	1, 2	4
	Quantity of information	2, 3	1, 2	4
	Visual information	1, 3	2, 3	2
	Credibility	1, 2	2, 3	4
	Evidence base	1, 2	2, 3	4
Section E	Recommendation	1	3	(3)
	Relevance	1, 2	2, 3	-
	Usage Prediction	1	3	-
	Willingness to Pay	1, 2	1, 2, 3	-
	Overall Star Rating	1, 2, 3	1, 2, 3	-
Section F	Awareness	2	2	4
	Knowledge	2	2	4
	Attitudes	1	3	4
	Intention to change	1	3	4
	Help seeking	1	1, 2, 3	4
	Behaviour change	1	3	4

table 33 Evaluation of MARS Categories: Coverage of UX Aspects, TAM, and Age-Specific Requirements Variables, Own Representation

Upon closer examination of the MARS evaluation, it becomes apparent that a significant number of categories encapsulate aspects of UX. Hedonic qualities, functionality, and usability are therefore well-suited for assessment through MARS. The categories of the Technology Acceptance Model are also comprehensively covered. However, when it comes to age-specific requirements, it is noticeable that categories such as social support and accessibility are not sufficiently addressed. In this context, it is advisable to introduce a Section G, specifically designed to consider characteristics of the apps beyond their use. Since UX encompasses interaction with the product before, during, and after usage, the following aspects are also queried:

- Informational material independent of the app: How much and how easily can materials related to the app's use be found?
- Support: How quickly and specifically can a real person be reached who can assist with problems?
- Data Privacy: How is the secure handling of sensitive data communicated and transparently presented? And how well is it comunicated to its users?
- Training: How openly are training opportunities communicated or even directly offered on the website, in the app or otherwise?

Each of the new metrics introduced in the newly added Section G can be rated on the same scale as the original MARS metrics, ranging from 1 (poor) to 5 (good). Given the absence of guidelines and evaluative directions in the literature for these specific categories, a subjective evaluation system is established, where failure to address the question results in a score of 1. The remaining gradations are determined relative to each other, meaning that the option deemed most effectively addressed will receive the highest rating. This approach is necessary because of the expansion of the existing MARS evaluation matrix with categories specifically designed and adapted for this study, ensuring a comprehensive assessment tailored to the unique objectives of the research.

4.3.2 Selection of Apps for Evaluation

To evaluate DiGAs, a preliminary selection process is essential. This process commenced with a search through the official DiGA directory on the website of the Federal Institute for Drugs and Medical Devices (BfArM) for suitable applications. Given that all approved DiGAs must be listed here, this directory served as a logical starting point. The search was refined using filters for platform, status, and age group. Only apps falling into the mobile health application eHealth category were considered, aligning with the focus of this thesis. Web applications were excluded from this selection.

Only apps that were neither revoked nor provisionally accepted were taken into account to ensure a clean and clear representation of established and approved DiGAs. The target demographic, consistent with the focus of this work, was individuals over 65 years of age. The resulting list of potential apps formed the basis for subsequent inquiries via email, seeking trial access to the apps. Given the high costs of DiGAs, which are usually covered by health insurance, this step was unavoidable. Although all apps are available for free download, utilizing them requires creating a profile with an activation code, and it was this code that was sought.

Specific App	*Company*	*Status of the request*
Kalmeda	Mynoise GmbH	Denied
Cara Care	HiDoc Technologies GmbH	Access Granted (1 device - 14 days)
Kranus Edera	Kranus Health GmbH	Denied
Meine Tinnitus App	BAYOOCARE GmbH	Denied
Mindable	Mindable Health GmbH	Denied
neolexon Aphasie	Limedix GmbH	Denied
NichtraucherHelden-App	Sanero Medical GmbH	Denied
Oviva Direkt für Adipositas	Oviva AG	Denied
PINK! Coach	PINK gegen Brustkrebs GmbH	Denied
Selfapys	Selfapy GmbH	Denied
somnio	mementor DE GmbH	Access Granted (1 device - 28 days)
Vivira	Vivira Health Lab GmbH	Denied
zanadio	Sidekick Health Germany GmbH	Denied

table 34 Overview of requested Apps

After receiving a disappointingly positive response from only two apps, the initial experts from Method I were consulted to facilitate contacts. Through this, Sabine Braun, a sales representative at DiGA Info who typically assists and advises doctors on transitioning to DiGA apps, was identified. She was able to provide access to four additional apps. Hence, the following list comprises all the accesses that can be considered together:

DiGA	*Company*	*Diga Status*	*Target Group*	*Access*
Cara Care	HiDoc Technologies GmbH	Permanently recorded	18-65, 65+	1 device - 14 days
somnio	mementor DE GmbH	Permanently recorded	18-65, 65+	1 device - 28 days
Selfapy	Selfapy GmbH	Permanently recorded	18-65, 65+	1 device - 14 days
sinCephalea	Perfood GmbH	Provisionally accepted	18-65	1 device - 14 days
Vivira	Vivira Health Lab GmbH	Permanently recorded	18-65, 65+	1 device - 7 days
zanadio	Sidekick Health Germany GmbH	Permanently recorded	18-65, 65+	1 device - 7 days

table 35 Overview of all DiGA with granted access

Despite sinCephalea being only provisionally accepted through the Fast-Track procedure and not specifically targeting the demographic of individuals aged 65+, it has been included in this evaluation to potentially serve as a negative example.

4.3.3 Evaluation of Apps Using the Expanded MARS Evaluation Matrix

The evaluation of the selected digital health applications was conducted using an expanded version of the Mobile App Rating Scale (MARS), which integrates additional criteria specifically tailored to this study. The original MARS framework, developed to assess the quality of mobile health applications, was augmented to encompass variables critical to the elderly demographic and the specific functionalities of DiGAs. This enhanced evaluation matrix allowed for a comprehensive analysis of each application, focusing on aspects such as usability, accessibility, and relevance to the senior age group. The evaluation criteria were systematically applied to each app, with scores ranging from 1 (poor) to 5 (excellent), providing a quantifiable measure of each app's effectiveness and suitability for the target audience.

To apply the MARS evaluation matrix as accurately as possible, the video training published by Stoyanov for training purposes was thoroughly reviewed, and the apps were extensively tested over a period of 2-3 days each.[334] Screenshots of the apps, along with the detailed completed evaluation forms, are included in the appendix. Regrettably, the screenshot functionality was disabled in three applications, preventing the capture of screenshots for these specific apps. In the following is a summary of the evaluation.

			Cara Care	***somnio***	***Selfapy***	***Vivira***	***zanadio***	***sinCephalea***
Section A	Engagement	Entertainment	3	4	3	5	4	4
		Interest	4	4	4	4	5	4
		Customisation	3	3	3	4	4	4
		Interactivity	5	3	3	3	5	5
		Target Group	4	5	4	4	3	4
		=	**3,8**	**3,8**	**3,4**	**4**	**4,2**	**4,2**
Section B	Functionality	Performance	5	5	4	4	4	4
		Ease of use	4	5	3	5	4	3
		Navigation	4	4	4	4	4	4
		Gestural Design	3	4	4	4	5	3
		=	**4**	**4,5**	**3,75**	**4,34**	**4,25**	**3,5**
Section C	Aesthetics	Layout	3	5	4	4	4	3
		Graphics	3	5	4	4	4	4
		Visual Appeal	3	5	3	5	4	4
		=	**3**	**5**	**3,67**	**4,34**	**4**	**3,67**
Section D	Information	Accuracy	4	4	4	5	5	3
		Goals	5	5	5	5	5	4
		Quality	4	4	3	5	5	4
		Quantity	3	4	3	5	4	5
		Visual	4	5	4	4	2	4
		Credibility	4	4	4	5	3	5
		Evidence base	5	5	5	5	3	4
		=	**4,1**	**4,4**	**4**	**4,9**	**3,86**	**4,14**
Section E	Sub. Quality	Recommend	3	4	3	5	4	5
		Usage	5	5	5	5	4	5
		Paying	3	5	4	5	5	5
		Rating	3	4	3	4	4	4
		=	**3,5**	**4,43**	**3,75**	**4,75**	**4,33**	**4,75**

[334] Cf. Stoyanov 2017

Section F	Health specific	Awareness	5	5	5	5	5	5
		Knowledge	5	5	5	5	5	5
		Attitudes	4	5	4	5	4	4
		Intention	4	5	4	5	4	5
		Help seeking	5	4	5	4	5	5
		Behaviour	5	5	5	4	4	4
		=	**4,6**	**4,83**	**4,67**	**4,67**	**4,5**	**4,67**
Section G	For Seniors	Orientation	5	5	5	5	4	5
		Social Support	4,5	3	5	3,5	5	4
		Data Security	3	2	3	5	2	3
		Training	1	1	4	3	1	2
		=	**3,38**	**2,75**	**4,25**	**4,13**	**3**	**3,5**
		Overall average Ra-	**3,77**	**4,2**	**3,9**	**4,45**	**4,0**	**4,1**
		Playstore Rating	3,8	4,4	3,3	4,4	4,4	4,6

table 36 Overview of the evaluated Apps via extended MARS (1 low, 5 high)

Cara Care

Cara Care is an mHealth platform that provides personalized treatment and management for people with digestive diseases. The app allows users to log symptoms, track food intake and monitor personal progress. By providing nutrition plans and access to licensed nutritionists, it bridges the gap between patients and healthcare providers and promotes a proactive approach to managing digestive disorders.[335]

The app encourages senior engagement through an intuitive user interface that supports easy navigation. Interactive elements such as symptom trackers and diary functions increase user interaction and facilitate daily data entry. Cara Care's website provides additional engagement through easily accessible information and a direct contact option, which is beneficial for older users who prefer human interaction. The functionality of the Cara Care app and website is measured by how effectively it meets the needs of seniors. Both platforms provide a clear structure of features, such as nutritional advice and symptom monitoring, which are essential for self-management of health conditions. However, accessibility is key, especially readability on different devices and compatibility with assistive technologies such as screen readers. The aesthetic design of both platforms presents a modern and appealing design that can evoke positive emotional reactions and thus promote adherence. The use of warm color tones and the avoidance of excessive design clutter are aspects that meet the visual requirements of older users. The provision of information is a critical aspect of UX for seniors. Cara Care ensures a clear and understandable presentation of health information, both in the app and on the website. Large fonts and the avoidance of jargon make it easier to read and understand. The web platform complements this with comprehensive FAQ sections and information resources that are easy to navigate. Examination of the Cara Care app and website shows a high level of engagement, functionality, aesthetic quality and informational value tailored specifically to the needs of seniors. While the overall design and interfaces of the platforms are rated positively, constant evaluation of accessibility and usability is crucial to ensure ongoing suitability for the target audience.

[335] Cf. Mapes/Sommer/HiDoc Technologies GmbH 2024

somnio

somnio is an mHealth application designed to assist individuals in achieving better sleep quality through cognitive behavioral therapy for insomnia. The platform offers personalized sleep coaching, monitoring tools, and educational resources to enhance users' understanding and management of sleep patterns. Alongside the application, the somnio website provides additional resources and access points for users to engage with the service.[336]

Engagement within somnio is facilitated by interactive elements such as sleep diaries and tracking features, which are integral to maintaining user involvement. The design encourages routine interaction, which is crucial for the success of insomnia programs. The website complements the app by offering an informative gateway, addressing the needs of seniors who may prefer initial exploration of services through a web browser. The functionality of the somnio app and website is gauged by their efficacy in meeting the practical needs of senior users. Both platforms provide structured, user-friendly functions essential for autonomous health management, including guided sleep assessments and personalized therapy plans. Accessibility remains a vital consideration, particularly in terms of readability on various devices and compatibility with assistive technologies. Aesthetics play a vital role in the user experience, influencing user satisfaction and adherence. somnio employs a design that is both modern and visually appealing, potentially eliciting positive emotional responses that encourage continued use. The color scheme and layout are crafted to accommodate the visual preferences of seniors, prioritizing clarity and simplicity. The provision of information is crucial for senior users within the UX framework. somnio ensures that health information is presented in a straightforward and accessible manner, both in the app and on the website. The platforms facilitate readability and comprehension through the use of large fonts and avoidance of medical jargon. The website further supports this through well-organized educational sections and resources, ensuring ease of navigation for the end-user. The examination of somnios' app and website reveals a robust engagement, functionality, aesthetic appeal, and informative content, tailored to address the senior population's requirements. While the design and interfaces of both platforms are evaluated positively, continuous assessment of accessibility and usability is imperative to maintain ongoing suitability for seniors.

Selfapy

Selfapy offers online courses to help users with mental health challenges. The modern app and accompanying website have a clear interface that aims to guide users through their therapeutic pathways. However, despite its appealing minimalism, the reduced design could raise questions about navigation and functionality for older users.[337]

Selfapy encourages user engagement through a minimalist design that allows for focused interaction without distraction. However, the clean lines and organized layout could lead to a lack of guidance for some seniors, especially if they are unfamiliar with such interfaces. A balance between simplicity and intuitive design is crucial for senior user engagement. The functionality of the Selfapy app and website is characterized by simple interaction mechanisms that enable ease of use. While the clarity of the application could be positively received by tech-savvy seniors, there is a risk that the minimalist presentation does not provide enough contextual cues for all users, which can lead to confusion. The aesthetic design of Selfapy is contemporary and creates a calming environment to encourage users to use the application regularly. The use of contrast and generous white space can improve legibility, which is

[336] Cf. Lorenz/Jekerle/mementor DE GmbH 2024

[337] Cf. Kassab/Selfapy GmbH 2024

particularly beneficial for seniors with impaired vision. However, the challenge remains that the aesthetics, while appealing, may not provide sufficient guidance for older users. Selfapy shows strengths in a modern UX design, which could be particularly attractive to users who are familiar with minimalist interfaces. However, for the specific target group of seniors, it is essential that the design of the user experience is based on a balance of simplicity and intuitive guidance. Future adaptations that include additional contextual information and clearer calls to action could help to make the app even more accessible and user-friendly for an older audience.

ViViRA

The ViViRA app is a therapeutic training program for back pain. It is aimed at users with non-specific low back pain and osteoarthritis of the spine. Among other things, the app offers personalized and therapeutic training content that adapts based on user feedback, options for monitoring training activity and disease progression, options for testing mobility and educational content on the health of the musculoskeletal system.[338]

Vivira offers an interface design that is characterized by a high degree of clarity. Users are guided through clearly structured menus that facilitate access to relevant functions. The use of sample images and videos to illustrate the exercises is a well thought-out feature that provides concrete and easy-to-understand instructions, especially for senior citizens. Vivira's intuitive structure encourages regular use as users are supported by visual cues and step-by-step instructions. The provision of videos and images to demonstrate the exercises increases user confidence and safety, especially for seniors learning new exercises. The functionality of the Vivira platform is rated as excellent as it takes a structured approach to presenting therapy progress and health status. The export function for health data builds a bridge between the user and healthcare professionals without overwhelming the user. The aesthetics of Vivira are designed to create a clear, calm and professional atmosphere. The use of colors and visual elements is balanced and contributes to overall usability, especially in terms of readability and navigation for older users. The information provided on the Vivira platform is comprehensive yet well-structured. The presentation of progress and health information is logical and understandable, which is especially important for seniors who may not be familiar with complex data visualizations. Vivira's UX analysis shows that the platform is well adapted to the needs of seniors in terms of engagement, functionality, aesthetics and information provision. The intuitive and supportive nature of the application, combined with the careful presentation of information, makes Vivira a suitable choice for this target group. To further improve user-friendliness, greater personalization of content according to the specific needs of seniors could be considered. Ongoing evaluation and adaptation to user feedback should form a central part of the development process.

Zanadio

Zanadio is a digital application that aims to help users lose weight through personalized plans and support. This application uses approaches from behavioral therapy and nutritional science to promote lasting lifestyle changes. The following chapter presents an examination of the user experience (UX) of Zanadio, with a particular focus on functionality and accessibility for seniors.[339]

The Zanadio app offers a less intuitive user experience compared to other health applications. The loading times of the app are long, which can be a deterrent, especially for seniors who prefer quick

[338] Cf. Vivira Health Lab GmbH 2024

[339] Cf. Sidekick Health Germany GmbH 2024

feedback and fast operation. Small areas for call-to-action (CTA) elements can make it difficult to navigate and interact with the app, as older users may struggle with fine motor skills or visual difficulties. In terms of functionality, Zanadio offers an acceptable navigation structure. However, the initial step-by-step explanation of how to use the app is insufficiently clear, which can prolong the initial familiarization period and lead to frustration. For seniors, who often need more detailed instructions, this can be an obstacle to using the app effectively. Aesthetically, Zanadio offers a modern design, but the visual presentation can affect the user experience of older people due to the small size of interactive elements and text. The readability and clarity of the information is crucial for the acceptance and continued use of the app by seniors. Zanadio's website provides little additional material or training, which would be particularly important for providing comprehensive support to seniors. The lack of supplementary educational resources and clear guidance may prevent older users from using the app to its full potential. The current version of Zanadio's UX shows weaknesses that can be particularly challenging for seniors. The long loading times and small interaction areas reduce user-friendliness and engagement. In addition, better structuring and provision of information is needed to ease the learning curve for older users and ensure they can use the application effectively. It is recommended to continuously optimize the UX to improve accessibility and operation for seniors, as well as to provide additional materials and training to ensure a comprehensive understanding and thus higher effectiveness of the application.

sinCephalea

The sinCephalea migraine app offers users the opportunity to track and analyze their migraine episodes. The minimalist design of the app and website aims to avoid overwhelming users and focus on the essential functions. The use of modern illustrations in the design language and graphics contributes to an appealing aesthetic. The app still appears to be designed primarily for a younger target group.[340]

The minimalist structure of the sinCephalea app prevents users from being overwhelmed by superfluous information or functions. This clear structure could be particularly beneficial for seniors who prefer simple and direct user guidance. The functionality of sinCephalea is underlined by the possibility of exporting reports that visualize tangible developments in the course of migraines. However, manual data entry is required, which may be challenging for some seniors, especially if they are less familiar with digital technologies. The modern aesthetic of the app is emphasized by the use of illustrations that speak a fresh and clear design language. Although this may resonate well with a younger target audience, it could be that the graphical representation is too abstract for some seniors and needs more context. The information within the app is mainly presented graphically. For older users who prefer a more precise and detailed explanation, this could be a hurdle. While the option to export data is beneficial for sharing with healthcare professionals, interpreting this data could be difficult for seniors without appropriate training. The sinCephalea app could be usable for seniors in principle, but may require more intensive introduction and training to get the most out of the application. Compared to applications such as Vivira or Somnio, which support onboarding through chatbots, sin-Cephalea could benefit from a similar function to make it easier for seniors to configure and use the app. In conclusion, it can be said that adapting the sinCephalea app to the specific needs of older people could increase usability and enable a broader acceptance of this target group.

[340] Cf. Burziwoda/Perfood GmbH 2024

4.3.4 Interpretation of the results

In the context of the present evaluation, based on the extended Mobile Application Rating Scale (MARS), a nuanced picture emerges regarding the orientation of digital health applications toward the senior demographic. The analysis of the apps indicates that a specific address to this user group is generally not a primary focus. Particularly highlighted in the sample were concerns related to the communication of data privacy. Despite similar approaches across the applications, a comprehensible communication about data privacy aspects in the apps themselves is often lacking.

Typically, upon initial configuration and installation, users are only made aware of the required permissions, followed by lengthy text documents. However, there is a lack of presentation that meets the unique understanding needs of seniors. Some providers attempt to bridge this gap through special sections on their websites that emphasize efficacy, added value, and user experiences. Nonetheless, data protection seems to be taken for granted and treated less as a critical point of communication.

The evaluation results suggest that all apps could alleviate fundamental concerns regarding complex navigation. They adhere to proven design principles with burger menus and a profile area. This aspect is particularly appreciated for the senior-friendly design of user interfaces as it promotes intuitive operation.

Regarding training, this component was specifically communicated by sinCephalea, ViViRA, and Selfapy, with the latter offering a notable integration of training material both for app usage and regarding disease profiles directly in the app.

The heterogeneous focuses of the evaluated apps, ranging from the treatment of various diseases to addressing different target groups and providing diverse functions, complicate direct comparability. Subjective perceptions could be experienced differently by older individuals with that specific disease, indicating untapped research potential.

For future studies, a collaboration with the providers would be advisable to test the applications directly with seniors. In this work, such an approach was not optimally feasible due to limited access to the apps and the target group. This indicates a significant field for future research endeavors, aiming to provide a comprehensive and substantiated assessment of the apps, taking into account the specific needs and perceptions of seniors.

5 Diskussion

This chapter critically evaluates the implications and findings of the preceding research on technology acceptance among seniors for prescription digital health applications (DiGAs). As digital transformation continues to permeate the healthcare sector, understanding the barriers and facilitators to technology adoption by older adults is crucial for the successful implementation of DiGAs. The investigation has revealed nuanced insights into seniors' acceptance and user experience, influenced by various technological, individual, and contextual factors. This discussion will synthesize the key findings from the empirical data, compare them with existing literature, and explore the theoretical contributions of this study. Additionally, the methodological approaches adopted in the research will be scrutinized for their efficacy and limitations. This analysis not only highlights the practical implications for healthcare professionals and policymakers but also sets the stage for future research directions in enhancing digital inclusivity and technology use in aging populations. Thus, the subsequent sections will delve into the examination of hypotheses, implications of the findings, assessment of methodologies, and propose avenues for further investigations.

5.1 Examination of Hypotheses

In this chapter of the dissertation, the focus will shift to a meticulous examination of the hypotheses established through theoretical frameworks. Insights derived from qualitative interviews with medical professionals have provided a deep understanding of the practical implementation of digital health applications and their interaction with senior patients. Furthermore, the subsequent method involving quantitative survey results enabled direct questioning of the senior participants themselves. Methodology three extended the analysis to include not just the two primary stakeholders—physicians and patients—but also a third crucial player in the implementation of DiGA: the software itself. By engaging in a detailed exploration of these three impacted areas, the following sections will systematically address and discuss each hypothesis individually.

H1	***High expectations of effectiveness positively influence seniors' intentions to use prescription digital health applications.***	***Technology Acceptance***	***Independent Variable: Health Consciousness (effectiveness expectations)*** ***Dependent Variable: Technology Acceptance***

Hypothesis H1, deeply rooted in the TAM, suggests that perceived usefulness and ease of use are significant predictors of technology adoption among seniors. The hypothesis specifically considers 'effectiveness expectations'—defined as the perceived benefits of managing health more effectively—as a proxy for perceived usefulness. These expectations are influenced by seniors' health consciousness, which encapsulates their proactive attitudes towards health management and awareness of health issues.

Here, the insights from RQ2 derived from the expert interviews provide additional understanding. Clear communication of the added value creates higher expectations regarding the effectiveness of the applications. Consequently, as seen in the Technology Acceptance Model (TAM), there is a causal relationship between understanding the added value and expectations, which likely increases the intention to

use these apps. As observed in question S3Q1, 73.8% of the sample were already aware of DiGA. Of these, 64.4% (n=38) would probably or definitely use DiGA to support their health. Conversely, among those who learned about DiGA for the first time in the survey, only 33.3% (n=7) could imagine using DiGA likely or definitively. This can also be inferred that longer familiarity and more points of contact enhance expectation and assessment of effectiveness, as each DiGA is thoroughly regulated and clinically tested for efficacy according to the theory discussed in section 2.5.1. When seniors engage with this information, they recognize this fact.

Subgroup B from the sample provides an attempt at a descriptive data analysis. They rated a treatment with a DiGA app in the UEQ-S according to perceived efficiency. Enclosed is the cross tabulation of the willingness to use a DiGA and the efficiency rating of the treatment with a DiGA.

Intention to use DiGA * UEQ-S 3 Crosstabulation

Count

		UEQ-S 3 Inefficient - Efficient					
		1	2	3	4	5	Total
Would you consider using a prescription app to support your health?	No, by no means	2	0	1	0	0	3
	Unlikely	0	0	6	1	0	7
	Undecided	0	2	5	2	0	9
	Probably	0	0	6	9	3	18
	Yes, definitely	0	0	1	2	4	7
Total		2	2	19	14	7	44

table 37 Intention to use DiGA * UEQ-S 3 Crosstabulation

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	54,483[a]	16	,000
Likelihood Ratio	37,177	16	,002
Linear-by-Linear Association	19,505	1	,000
N of Valid Cases	44		

a. 23 cells (92,0%) have expected count less than 5. The minimum expected count is ,14.

table 38 Chi-Square Tests Intention to use DiGA * UEQ-S 3

Symmetric Measures

		Value	Asymptotic Standard Error[a]	Approximate T[b]	Approximate Significance
Nominal by Nominal	Phi	1,113			,000
	Cramer's V	,556			,000
	Contingency Coefficient	,744			,000
Interval by Interval	Pearson's R	,673	,084	5,905	,000[c]
Ordinal by Ordinal	Spearman Correlation	,651	,089	5,556	,000[c]
N of Valid Cases		44			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Based on normal approximation.

table 39 Symmetric Measures Intention to use DiGA * UEQ-S 3

The Pearson Chi-Square test is highly significant with a value of 54.483 and a p-value of less than 0.001, indicating that there is a statistically significant association between the two variables. The Likelihood Ratio also supports this with a p-value of 0.002. The Linear-by-Linear Association has a p-value of less than 0.001, suggesting a significant linear trend in the relationship between intention to use and the perceived efficiency of treatment with the DiGA app. In the Symmetric Measures, the Phi coefficient is 1.113, and Cramer's V is 0.556, both showing a very strong association. The Contingency Coefficient is 0.744, which again suggests a strong relationship between these variables. Pearson's R has a value of 0.673, indicating a strong positive linear correlation, and the Spearman Correlation is also high at 0.651, suggesting a strong monotonic relationship.

In summary, the analysis indicates that the stronger the intention to use the DiGA app is, the perceived efficiency is higher. The relationship is not only statistically significant but also strong, as evidenced by multiple measures. However, it is important to note that many cells have expected counts less than 5, which may affect the reliability of the Chi-Square test. Despite this, the overall trend is clear and suggests a very strong relationship between the evaluated efficiency of the DiGA app and the intention to use it.

Therefore, the empirical research conducted through quantitative surveys and expert interviews provided significant insights into how these expectations affect technology acceptance. The surveys revealed that clear communication about the benefits of the apps plays a crucial role in shaping these expectations. Seniors expressed reluctance to use apps whose benefits were not clearly communicated, highlighting the need for effective communication strategies to enhance acceptance. Furthermore, expert interviews indicated that a positive user experience significantly enhances perceived effectiveness and, consequently, technology acceptance. A well-designed UX makes the apps appear more useful, increasing their likelihood of acceptance among seniors.

The findings from this study confirm the theoretical assertions of TAM and demonstrate its applicability to digital health technologies for senior users. The acceptance of these technologies by seniors hinges heavily on their perceptions of the tangible benefits these technologies bring to their health management routines. This acceptance is further mediated by the quality of the user experience, emphasizing the need for well-designed, senior-friendly interfaces that reinforce the perceived effectiveness of the applications.

In conclusion, based on the evidence gathered and analyzed, Hypothesis H1 is supported. The expectations of effectiveness, shaped by seniors' health consciousness and the UX of digital health applications, positively influence their technology acceptance. This underscores the critical roles of targeted communication and UX design in the successful adoption of health technologies by the elderly.

H2	***Seniors' willingness to try prescription digital health applications increases when perceived benefits align with their expectations and when supported by their social environment. This reflects the study's discussion on the role of social influence and perceived usefulness in technology acceptance.***	***Technology Acceptance***	***Independent Variables: Technological Capabilities and Accessibility (perceived value), Social Support (social environment)*** ***Dependent Variable: Technology Acceptance***

Hypothesis 2 addresses the acceptance of prescription digital health applications among seniors and explores how the perception of their benefits and support from their social environment influence their willingness to use these technologies. Results from a quantitative survey indicated that seniors place significant value on the advice of physicians, highlighting the importance of professional support in their decision to adopt technology. This observation was also confirmed in expert interviews, suggesting a high dependence on medical authority and expertise.

It was found that trust in the social environment, such as family and friends, varies; it is not consistently strong or influential. While some seniors report that their family often introduces technology and communicates its benefits clearly, other parts of the survey showed that seniors' assessment of their social environment might have been impacted by the method of survey distribution (digitally via email). This method could have predominantly reached seniors with higher IT affinity, potentially skewing the results. However, this assumption remains unproven and indicates a possible limitation of the study.

Expert interviews (RQ4, RQ6) and theoretical discussions (Chapter 2.6) further support the notion that both the perceived technological capabilities of the apps and social support are crucial factors for technology acceptance among seniors. Particularly, user experience appears to play a critical role: A positive UX can enhance the perceived effectiveness of the technology and thereby improve acceptance. In summary, Hypothesis 2 is supported by empirical data, with expectations of effectiveness, shaped by health consciousness and UX, positively influencing technology acceptance. These findings emphasize the critical role of targeted communication and UX design in the successful implementation of health technologies for older adults.

H3	***Doctor recommendations significantly influence seniors' acceptance of new digital treatment methods, underlining the study's insight into the trust and authority figures' impact on technology acceptance.***	***Technology Acceptance***	***Independent Variable: Social Support (doctor's recommendation)*** ***Dependent Variable: Technology Acceptance***

Hypothesis 3 posits that recommendations from doctors significantly influence the acceptance of new digital treatment methods among seniors, underscoring the importance of trust and authority in technology acceptance. This assumption was strongly confirmed by both the results of the quantitative survey

and the expert interviews. It is evident that trust in doctors is very high and that seniors are much more willing to try new treatment methods when recommended by their treating physician.

The quantitative data from S3Q3 highlight a high readiness among seniors to follow medical advice, especially concerning the adoption and use of new digital health applications. This high level of trust is also reflected in the qualitative data from expert interviews in RQ4, where the significance of medical recommendations is emphasized as a crucial factor for technology acceptance. Thus, doctors play a central role as trusted and authoritative figures who can significantly help overcome skepticism towards new technologies.

These results affirm the theoretical considerations regarding the influence of social support on technology acceptance and broaden the understanding of how specifically recommendations by medical professionals can impact older individuals' willingness to adopt digital health solutions. Clear communication of the benefits of these technologies by familiar and respected doctors could therefore serve as a key mechanism to enhance acceptance rates among seniors.

Overall, the strong empirical support for this hypothesis underscores the need to further develop strategies to promote technology acceptance among the older population. Particular attention should be given to the role of medical personnel as mediators and promoters of the use of digital health applications.

H4	***The skepticism of seniors towards digital treatment methods requires targeted and comprehensive training to facilitate acceptance, highlighting the need for clear communication and education on digital health tools as discussed in the document.***	***UX***	***Moderating Variables: Technological Experience and Anxiety, Cognitive and Physical Abilities (skeptical attitude and training needs)*** ***Dependent Variables: Technology Acceptance, User Experience***

Hypothesis 4 addresses the scepticism of seniors towards digital treatment methods and the need for targeted and comprehensive training to promote acceptance. These trainings aim to enhance clear communication and education about digital health tools, as discussed in the documents. The empirical investigation reveals that seniors consider the usability and clarity of new apps extremely important, which falls directly within the realm of user experience. These findings support the thesis that high scepticism towards a technology increases sensitivity to UX flaws, thereby emphasizing the necessity for a target group-appropriate and error-free UX implementation to avoid intensifying initial scepticism.

Both qualitative (RQ3, RQ4, RQ7) and quantitative (S5Q3) research have also shown that personalized training in a protected setting could increase the willingness to use a digital health application. This reinforces the role of social support, which includes not only personal consultation and training but also explaining new technologies. If the app functions smoothly and offers recognizable added value, this can help to reduce scepticism towards the app.

However, the data and qualitative insights suggest that this hypothesis is only partially confirmed and not fully supported by the collected empirical evidence. Therefore, a specific follow-up study is recommended to further explore the effects of targeted training programs on scepticism and to fully validate the hypothesis.

H5	***The younger the age within the senior demographic, the higher the tendency to consider using a prescription medical app, suggesting a gradient of technology openness within the age group.***	***Technology Acceptance***	***Independent Variable: Age-specific Requirements (younger age within the senior demographic)*** ***Dependent Variable: Technology Acceptance***

Hypothesis 5 of the current research model proposes that younger seniors are more likely to consider the use of prescription medical applications. This indicates a gradient of technology acceptance within this age group. Theoretically, it has been observed that with increasing age, the phenomenon of multimorbidity increases, which can complicate the usability of technological applications and reduce their apparent benefit to seniors. As indicated by expert interviews and quantitative surveys, the clear value of an application is crucial for its acceptance among seniors.

The extended Technology Acceptance Model (TAM), integrated into this study's research model, emphasizes that technology acceptance presupposes a satisfactory user experience. Issues such as limited vision, motor skills, or memory loss can impair this user experience and thus diminish the perceived benefit, ultimately leading to lower technology acceptance.

The empirical data support this reasoning and confirm the hypothesis that there exists a clear gradient of technology openness within the older demographic group, significantly influenced by age-specific limitations.

Would you consider using a prescription app to support your health? * How old are you? Crosstabulation

Count

		How old are you?			
		65-74	75-84	85 and older	Total
Would you consider using a prescription app to support your health?	No, by no means	2	0	4	6
	Unlikely	5	3	4	12
	Undecided	10	5	2	17
	Probably	21	9	3	33
	Yes, definitely	10	2	0	12
Total		48	19	13	80

table 40 Crosstab Age*Willingness to use DiGA

The analysis of the quantitative data from the sample reveals intriguing insights into the acceptance of DiGAs across different age groups. The Chi-Square Test of Independence, yielding a Chi-Square value of approximately 9.72 with 8 degrees of freedom, indicates that there is no significant statistical relationship between the age of respondents and their willingness to use health apps. The obtained p-value of around 0.286 is well above the conventional significance level of 0.05, supporting the hypothesis of independence between the two variables. These findings suggest that the decision to employ health apps for personal health support is not substantially influenced by the respondent's age group. Such results could have implications for the design and marketing of DiGAs, indicating that cross-age factors may play a more significant role than previously assumed.

However, for a more comprehensive confirmation of these results, further research is recommended. Particularly, future studies should focus more specifically and representatively on different age groups and perform a more detailed classification of age groups to more precisely capture the dynamics of technology acceptance and user experience.

An alternative hypothesis may posit that the propensity to engage with a digital health application does not decrease with age; rather, it escalates in conjunction with educational attainment. To investigate this proposition, a cross-tabulation was constructed and examined, facilitating a nuanced exploration of the relationship between educational levels and the willingness to use such health technologies. This analytical approach seeks to discern patterns and trends that might confirm or refute the hypothesis, thereby contributing to a more comprehensive understanding of the determinants influencing the adoption of digital health interventions.

Would you use a DiGA?* Educational level Crosstabulation

Count

		Eduvation level							Total
		1,00	2,00	3,00	4,00	5,00	6,00	7,00	
Would you consider using a prescription app to support your health?	No, by no means	0	3	1	0	0	1	1	6
	Unlikely	4	2	1	1	1	0	3	12
	Undecided	0	4	6	0	3	1	3	17
	Probably	0	4	5	4	7	1	12	33
	Yes, definitely	0	3	3	0	1	0	5	12
Total		4	16	16	5	12	3	24	80

table 41 Crosstable Intention to use DiGA and the Educational level of the sample

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	42,851[a]	24	,010
Likelihood Ratio	37,097	24	,043
Linear-by-Linear Association	4,414	1	,036
N of Valid Cases	80		

a. 31 cells (88,6%) have expected count less than 5. The minimum expected count is ,22.

table 42 Chi-Square Test Intention to use DiGA and the Educational level of the sample

Symmetric Measures

		Value	Asymptotic Standard Error[a]	Approximate T[b]	Approximate Significance
Nominal by Nominal	Phi	,732			,010
	Cramer's V	,366			,010
	Contingency Coefficient	,591			,010
Interval by Interval	Pearson's R	,236	,114	2,148	,035[c]
Ordinal by Ordinal	Spearman Correlation	,250	,116	2,285	,025[c]
N of Valid Cases		80			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Based on normal approximation.

table 43 Symmetric Measures Intention to use DiGA and the Educational level of the sample

The cross-tabulation reveals that responses are concentrated mostly within the "Intention" categories 4 and 5 (Probably and Yes, definitely), indicating a generally high willingness to use DiGA.

Turning to the Chi-Square tests, the Pearson Chi-Square value stands at 42.851 with an asymptotic significance (p-value) of 0.010, signifying a statistically significant association between the level of education and willingness to use. Similarly, the Likelihood Ratio also indicates significance with a p-value of 0.043, and the Linear-by-Linear Association shows a significant linear trend with a p-value of 0.036. The symmetrical measures further support this relationship, with Phi and Cramer's V values at 0.732 and 0.366, respectively, indicative of a strong association. The Contingency Coefficient value of 0.591 reinforces this strong relationship. Both Pearson's R and Spearman's Correlation yield values of 0.236 and 0.250, suggesting a low to moderate correlation.

These statistical measures suggest a statistically significant relationship exists between educational level and willingness to use the item or service in question. Higher levels of education appear to correlate with an increased likelihood of usage. Combining the significant Chi-Square test result with the symmetrical measures suggests a positive correlation, implying that as educational level rises, so does the willingness to use DiGA. Although Spearman's Correlation, which is a rank correlation, and Pearson's R, which measures linear correlation, do not show a strong correlation, their combined results with other tests point to a positive trend.

H6	***The efficiency and quality of the results produced by new technology are directly correlated with its perceived usefulness, reflecting the study's focus on the importance of tangible benefits for technology acceptance.***	***Technology Acceptance***	***Independent Variable: Technological Capabilities and Accessibility (efficiency and quality)*** ***Dependent Variable: Technology Acceptance (perceived usefulness)***

Hypothesis 6 in this study posits that the efficiency and quality of the outcomes from new technologies are directly correlated with their perceived usefulness, highlighting the importance of tangible benefits for technology acceptance. The independent variable in this context is the technological capabilities and accessibility (efficiency and quality), while the dependent variable is technology acceptance (perceived usefulness).

Qualitative interviews and quantitative surveys have indicated that the current communication of the benefits of digital health applications is insufficient. It is crucial that physicians not only mention these applications but also provide training to elucidate their benefits. These findings confirm the hypothesis by demonstrating that the recognizable value of a new technology enhances its perceived usefulness and thereby its acceptance.

However, results from the User Experience Questionnaire (UEQ-S) suggest that the efficiency rated between Version A (without apps) and Version B (with apps) was similar, implying that technological efficiency alone may not be sufficient to increase perceived usefulness. The range of quality was not definitively clarified in the study, which points to a gap in the research.

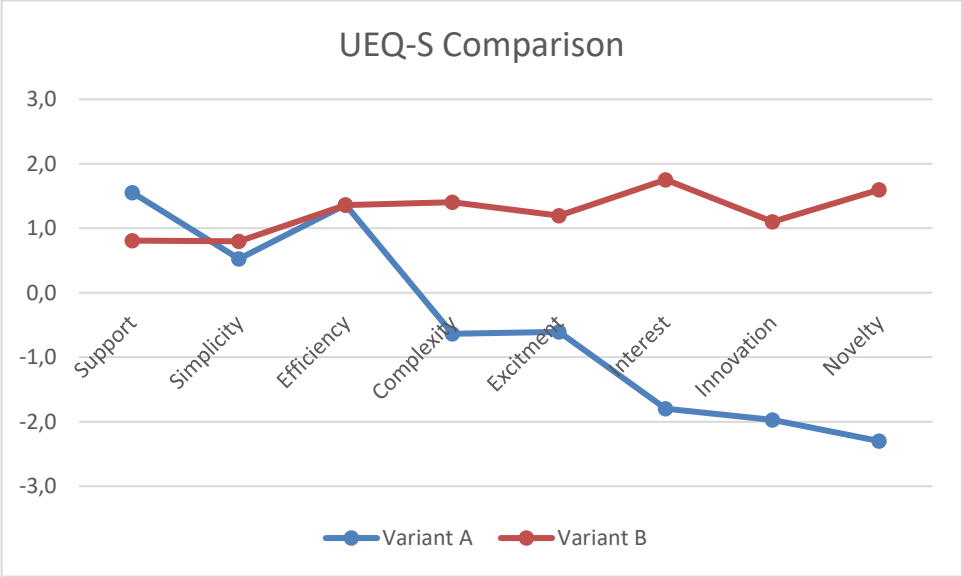

table 44 UEQ-S Comparison Variant without App A and Variant with App B

Despite the data limitations, it is evident that seniors show increased technology acceptance when the treatment is effective. Since DiGA must demonstrate their effectiveness to be approved, it is likely that treatments via apps provide added value. Nevertheless, discussions from expert interviews suggest that the willingness to use apps may not necessarily depend on improved efficiency or quality of the treatment but rather on the trust patients place in their doctors when they recommend a treatment.

This complex relationship between technology efficiency, quality, and technology acceptance requires further investigation to draw more specific conclusions, especially regarding the different age groups and their specific needs concerning digital health applications.

H7	***The comprehensibility and reliability of new technology are directly correlated to its perceived user-friendliness, echoing the study's emphasis on ease of use as a critical factor for senior users.***	***UX***	***Independent Variable: Technological Capabilities and Accessibility (comprehensibility and reliability)*** ***Dependent Variable: User Experience (perceived user-friendliness)***

Hypothesis 7 explores the direct correlation between the comprehensibility and reliability of new technologies and their perceived user-friendliness, reflecting the study's emphasis on usability as a critical factor for older users. The independent variables in this hypothesis include technological capabilities and accessibility, specifically comprehensibility and reliability, while the dependent variable is user experience, particularly perceived user-friendliness.

Research findings suggest that enhanced comprehensibility and reliability of technology significantly contribute to user-friendliness. Notably, the quantitative responses to questions S5Q1 and S5Q2, which inquire about disruptors and concerns in app usage, fall into the categories of comprehensibility and reliability. Users' comments about difficulties in operation and concerns regarding complex navigation and menu structures affirm the hypothesis that clear comprehensibility and reliable navigation and control of the app are crucial for users. This is particularly relevant for older users, who may not be as technologically savvy and benefit from straightforward, dependable applications. Such user-friendliness is essential for the acceptance of new technologies among seniors as it strengthens trust in the application and increases their willingness to use these technologies.

The discussion within the context of the study highlights that the design of technologies aiming to meet the specific needs of older individuals must not only ensure high functionality but also be easily accessible and intuitively usable. The results support the hypothesis that there is a direct correlation between comprehensibility, reliability, and user-friendliness, which is a central element of technology acceptance among older users. Further research is recommended to validate these results more comprehensively and to investigate more deeply the specific requirements of older users in various technological scenarios.

H8	***The excitement and innovativeness of new technology are directly correlated with the user's intention to use new technology, which may be explored further in the context of seniors' openness to innovation.***	***UX***	***Independent Variable: Technological Capabilities and Accessibility (innovativeness)*** ***Dependent Variable: Technology Acceptance***

The discussion surrounding Hypothesis 8 highlights the relationship between the innovativeness of new technologies and users' intention to use them, particularly in the context of older individuals' openness to innovation. The hypothesis emphasizes that the excitement and innovativeness of new technology directly correlate with users' intentions to utilize these technologies, which can further be explored through the lens of older adults' readiness for innovation.

This study is predicated on the assumption that hedonic qualities, such as the sense of novelty and originality, can influence technology acceptance. Specifically, this study explored aspects like excitement, interest, and originality through the User Experience Questionnaire (UEQ-S) to measure seniors' subjective perceptions. Results indicate that treatments supported by apps are perceived as interesting and novel compared to traditional treatment methods.

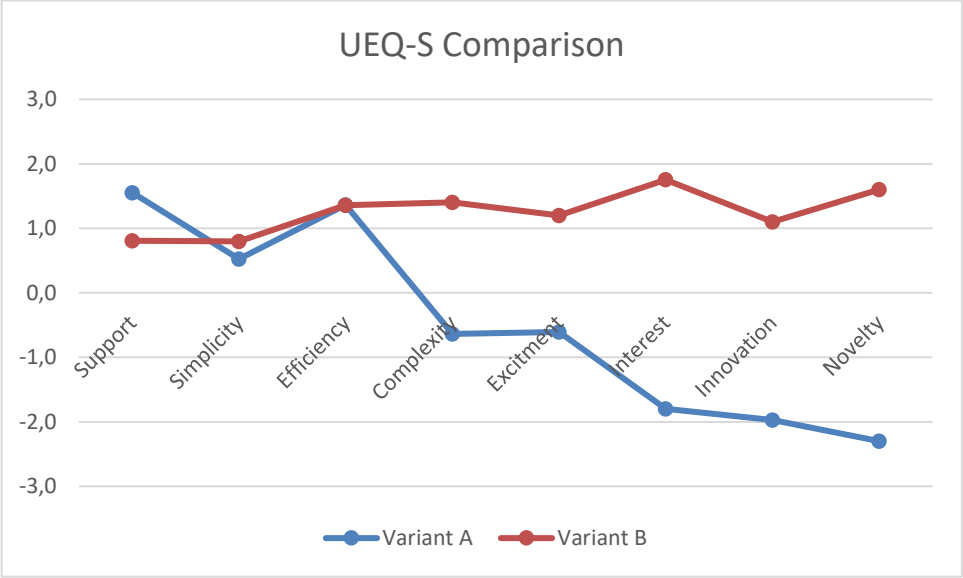

table 45 UEQ-S Comparison Variant without App A and Variant with App B

However, the empirical data did not reveal a definitive trend as to whether the willingness to use a digital health application is due to its novelty, since the use of apps for health treatment is fundamentally considered exciting and novel, regardless of the readiness to use them personally. Theoretical considerations and expert interviews suggest that seniors are receptive to new technologies and digital solutions provided the added value of these technologies is clearly communicated and a tangible additional benefit is present.

Would you consider using a prescription app to support your health? * UEQ-S Innovativeness Crosstabulation

Count

		UEQ-S 7					
		conventional	-	-	-	innovative	Total
Would you consider using a prescription app to support your health?	No, by no means	2	0	0	0	1	3
	Unlikely	0	1	1	4	2	8
	Undecided	0	0	3	5	1	9
	Probably	0	1	6	7	5	19
	Yes, definitely	0	0	3	3	1	7
Total		2	2	1	19	10	46

table 46 Crosstab on Willingness to use DiGA and their rating of the Innovatiness of DiGA of the sample, who evaluated Version B (with App)

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	34,918[a]	16	,004
Likelihood Ratio	20,816	16	,186
Linear-by-Linear Association	1,549	1	,213
N of Valid Cases	44		

a. 23 cells (92,0%) have expected count less than 5. The minimum expected count is ,14.

table 47 Chi-Square Tests Crosstab on Willingness to use DiGA and their rating of the Innovatiness of DiGA of the sample, who evaluated Version B (with App)

Symmetric Measures

		Value	Asymptotic Standard Error[a]	Approximate T[b]	Approximate Significance
Nominal by Nominal	Phi	,891			,004
	Cramer's V	,445			,004
	Contingency Coefficient	,665			,004
Interval by Interval	Pearson's R	,190	,197	1,253	,217[c]
Ordinal by Ordinal	Spearman Correlation	,042	,168	,275	,784[c]
N of Valid Cases		44			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Based on normal approximation.

table 48 Symmetric Measures Crosstab on Willingness to use DiGA and their rating of the Innovatiness of DiGA of the sample, who evaluated Version B (with App)

The statistical analysis reveals a notable association between the propensity to utilize a digital health app and how innovative users perceive it to be. Specifically, the Pearson Chi-Square test indicates a strong connection with a significant p-value of 0.004. However, this clear association isn't mirrored in the Likelihood Ratio and Linear-by-Linear Association results, both of which fail to reach conventional significance levels with p-values of 0.186 and 0.213, respectively. Further inspection through Symmetric Measures strengthens the case for a robust association. A Phi coefficient of 0.891 and Cramer's V of 0.445 both point to a very potent link between a user's readiness to use the app and their judgment of its innovativeness. This strong relationship is bolstered by a Contingency Coefficient of 0.665. Yet, when we look at Pearson's R—a mere 0.190—it suggests only a faint linear relationship, and the minimal Spearman's Correlation of 0.042 implies an absence of a monotonic relationship. Piecing these findings together, the analysis paints a picture of significant interplay between individual inclination to adopt a digital health application and the perception of its novelty. While users who regard the app as more groundbreaking are more inclined to use it, the nuances of this relationship are not straightforwardly linear or monotonic.

A point of caution is raised by the presence of 23 cells—over half of the dataset—having expected counts under five, potentially impacting the Chi-Square test's reliability. Nonetheless, the overarching evidence suggests that the element of perceived innovation plays a crucial role in influencing users' willingness to embrace the app. Further research with a more extensive and diverse dataset would be required to substantiate these findings and to provide more robust evidence of the relationship between attitudes towards innovation in health technologies and their adoption.

The quantitative survey also revealed that a majority of seniors are already familiar with the term DiGA and use smartphones (S3Q1). Also most respondents consider themselves experienced users, which suggests a positive foundation toward using DiGA apps for health support (S2Q3).

The study suggests that the innovativeness of a treatment method itself does not serve as the primary argument for seniors to use these technologies; rather, the actual benefit and added value are more crucial. Although treatments with apps were perceived as innovative and original, and the data show that increased usage intention correlates with the innovativeness of the technology, there is maybe not a causal relationship. It is therefore recommended to extend the study to gain more detailed insights into the specific factors that enhance technology acceptance among seniors.

H9	***A better user experience of the app significantly increases the willingness to use prescription apps, aligning with the study's discussion on the importance of UX in technology acceptance.***	***UX / Technology Acceptance***	***Independent Variable: User Experience*** ***Dependent Variable: Technology Acceptance (willingness to use prescription apps)***

The discussion of Hypothesis 9 within the context of the extended TAM and the consideration of specific user experience factors reveals that user experience is seen as a significant influencer on the willingness to use prescription apps. This insight is supported by expert statements highlighting that simplicity and intuitive usability, especially for seniors, are essential to avoid frustration and maximize the benefits of the applications.

Quantitative data from questions S5Q1, S5Q2, and S5Q3 of the survey reinforce the need for good UX to successfully convey apps to seniors. It is evident that user-friendliness directly contributes to technology acceptance and should be a central component of technology development. However, it has also

been identified that the crucial factor for readiness to use is not solely an optimized user experience during the application. Rather, the explicit recommendation and endorsement by treating physicians, who can clearly communicate the value of an app, are crucial.

To concretely validate this hypothesis, an alternative methodological approach would be required, in which the target group uses a DiGA and is subjected to A-B testing to see if an improved alternative DiGA UX leads to higher approval in the final survey. The current results and the discussion in the study suggest that a basic positive functional user experience is necessary for the app to operate smoothly and achieve the intended purpose and added value. Considering that the UX, depending on its definition, begins prior to the actual use of the app and encompasses aspects such as clear communication, medical training, and elucidation of the added value etc., it can be postulated that these elements collectively make a substantial contribution to the acceptance and readiness to use new treatment methods involving apps. UX, in the classical and narrowly considered sense of actual daily initiation, maintenance, and utilization of the apps, cannot be concretely addressed with the methods utilized herein, as previously noted. Insights drawn from Methodology 3 suggest that existing apps vary depending on the use case and disease, yet offer a solid foundational experience. Applications such as ViViRA or somnio, according to the MARS evaluation criteria, provide an optimized UX which likely facilitates user onboarding and training due to their highly intuitive design. However, this is a theoretically derived supposition. To make a definitive statement, a specific app would need to be tested in a long-term interaction with senior users.

In general, the following can be stated, that the findings from the extended TAM and the qualitative and quantitative results underscore the importance of a comprehensive and user-centered design strategy, specifically tailored to the needs of older users. This further emphasizes that in addition to intuitive usability, the conveyance of benefits by trusted physicians plays a crucial role in technology acceptance. The study, therefore, recommends further research to specifically explore how improvements in UX concretely affect the willingness to use health apps and whether these improvements are sufficient to overcome other potential barriers.

H10	***Prescription apps that have undergone the DiGA fast-track process are perceived to have better user experience, emphasizing the role of regulatory approval in shaping user perceptions of app quality.***	***UX***	***Independent Variable: Technological Capabilities and Accessibility (DiGA process testing)*** ***Dependent Variable: User Experience***

Hypothesis 10 focuses on the user experience perception of DiGA apps that have undergone the Fast-Track approval process, emphasizing the significance of regulatory approval on app quality perception. This hypothesis emerged from a theoretical analysis and extensive expert discussions. It was evident that the Fast-Track process could be problematic for the overall perception of DiGA itself. Due to the relative novelty of DiGA, not all seniors have had experiences with these technologies. The Fast-Track process does not allow for a long-term and detailed examination of the effectiveness and efficiency of the apps.

If a DiGA suggested to a senior requires considerable persuasion by medical professionals and turns out to be ineffective, it is very likely that this senior will decide against using such an app in the future. Seniors focus primarily on the meaningfulness and visible added value of the apps, which is confirmed

by both qualitative and quantitative results. If these aspects are lacking, technology acceptance is significantly hindered, and the success of DiGA as digital support is compromised.

During the empirical method selection, access to DiGA apps proved very challenging. Access was only obtained to the Fast-Track app, sinCephalea. Therefore, in methodology 3, five established DiGAs and one Fast-Track DiGA were considered. In the evaluation using the extended MARS rating matrix, no disadvantages for the Fast-Track app were detected. However, to concretely answer the hypothesis, these apps would have needed to be analyzed on a medical and efficacy-focused basis by professionals. Consequently, this hypothesis could not be addressed in this work.

As a recommendation for future research, a collaboration in DiGA testing with the Federal Institute for Drugs and Medical Devices (BfArM) is suggested to actually perform a comparison between two apps and thus obtain more substantial insights into the influence of the Fast-Track process on the user experience and perceived quality of DiGA.

H11	***Social support mechanisms embedded within prescription digital health applications enhance seniors' usage intentions, drawing on the study's focus on social influence as a factor in technology acceptance.***	***Technology Acceptance***	***Independent Variable: Social Support (embedded social support mechanisms within digital health applications)*** ***Dependent Variable: Technology Acceptance (seniors' usage intentions)***

This hypothesis focuses on the importance of social support for the acceptance of technology. Within the extended TAM, social support is considered a moderating variable in the conceptual framework, facilitating technology use through training sessions or demonstrations within one's social circle. Hypothesis 11 links social support to the specific research field of the acceptance of digital health applications among seniors. Qualitative interviews have revealed that the opinions and advice of doctors are very receptively received by patients (RQ4). In situations of illness, where a sense of powerlessness often prevails, patients tend to rely on the assistance of professional staff. When such a professional makes a recommendation, it is more likely to be accepted than it would be by free consumers in the open market. This consultation and recommendation by doctors and their positive effect on the willingness to use digital health applications have also been evident in quantitative surveys. It is apparent that the advice of doctors is taken seriously (S3Q3), and there is a high readiness to use the apps, especially if they are introduced in a personal training session beforehand (S5Q3). This is also seen as a form of support, demonstrating the strong influence of the social environment on technology acceptance among seniors, thus confirming this hypothesis.

H12	***Accessibility features and age-specific design considerations in digital health applications positively affect seniors' acceptance and user experience, reflecting the study's emphasis on age-specific requirements and capabilities.***	***Technology Acceptance***	***Independent Variable: Technological Capabilities and Accessibility (accessibility features and age-specific design considerations)*** ***Dependent Variables: Technology Acceptance, User Experience (seniors' acceptance and user experience)***

To discuss Hypothesis 12, which posits that accessibility features and age-specific design considerations in digital health applications positively influence acceptance and the user experience among seniors, it is important to consider the connection between technological capabilities, accessibility, and specific age-related requirements. These aspects are crucial to ensure that digital health solutions take into account the needs and limitations of older users.

Literature analysis and results from the quantitative survey confirmed that seniors have access to smartphones (S2Q1) and do not predominantly consider themselves beginners (S2Q3). Within the framework of the extended model for technology acceptance and user experience among seniors, it has been determined that age-appropriate design not only enhances usability but also increases the general willingness to use digital health applications. The hypothesis emphasizes the importance of accessibility features such as simple navigation options, readable font sizes, and intuitive interaction possibilities, which are specifically tailored to the physical and cognitive abilities of older individuals. When asked about concerns regarding the use of new apps, only 5% of the sample reported having no problems or concerns (S5Q2). The most frequently mentioned issues were related to cluttered menu navigation and complex navigation, closely followed by too small text, explanations not suitable for seniors, and insufficient audiovisual support (S5Q1, S5Q2).

These factors contribute to reducing barriers that could otherwise impair technology acceptance among seniors. The empirical study confirms that a positive user experience, facilitated by these specific adjustments, plays a crucial role in promoting the acceptance of digital health applications. This is reflected not only in increased usage intentions but also in an improved overall user experience, which can significantly enhance the quality of life of older users.

From this, it can be concluded that the hypothesis can be considered confirmed, as a target group-appropriate presentation and support in the form of improved usability, clear visibility, and effective operational aids provide a solid foundation. These ease the overall user experience in the context of treatment and ensure that no obstacles are in the way, but rather a path is paved that promotes usage.

5.2 Assessing Technology Acceptance and User Experience Among Seniors in Digital Health Applications

To answer the research question "Are technology acceptance and User Experience among seniors influenced by age-specific requirements, accessibility, and capabilities when using prescription digital health applications?" the results of the hypothesis evaluations were considered while keeping the three developed methods in mind. The theoretical discussion defined technological capabilities, accessibility, and age-specific requirements as independent variables in the research model, establishing that these variables significantly contribute to seniors' use of digital health applications.

The empirical results show that the majority of seniors possess sufficient technological capabilities to effectively use well-structured apps, as confirmed by quantitative surveys. Furthermore, the evaluation of the third method revealed that none of the examined apps are significantly more difficult to use than general smartphone or tablet use. Although differences in operation and presentation were noted, they did not constitute an insurmountable barrier that could not be overcome by social support such as explanations from a doctor or family, or by the users' health awareness.

The accessibility of DiGA proved to be more complex since specific prerequisites must first be created by the treating physician, such as familiarity with specific apps, their integration into clinical practice, and the necessary approval by health insurance companies. Despite these bureaucratic hurdles, this access method can be seen as positive because it ensures a certain level of seriousness and professionalism that distinguishes DiGA from conventional apps. This accessibility variable is also moderated by social support, which includes the training and explaining of specific apps for specific diseases.

Age-specific requirements were extensively illuminated both in theory and in qualitative interviews and survey results. Older individuals have physical limitations, such as screen readability or dexterity needed to operate devices, requiring specific adjustments. Despite these challenges, the use of apps was perceived as novel, exciting, and innovative.

In conclusion, if the technological capabilities, accessibility, and age-specific requirements are met and moderated by social support and health awareness, technologies are accepted by seniors. User experience is crucial and should be designed to meet fundamental needs and allow users to use technology without frustration. This ensures that DiGA technologies are embraced by seniors.

5.3 Implications of this work

Theoretical implications

The findings of this thesis seamlessly fit into the existing research context and expand the discussion on technology acceptance and user experience among seniors in the area of digital health applications. By integrating theoretical models such as the TAM and UX considerations, it has been demonstrated how age-specific requirements, accessibility, and technological capabilities influence acceptance and user experience. This work confirms that modifying existing models with specific variables representing seniors leads to improved predictive accuracy regarding technology acceptance.

The results of this work contribute to theory building by demonstrating how digital health solutions can be effectively integrated into the lives of older people. A significant theoretical contribution is the realization that including factors such as health awareness and social support can strengthen the relationship between technological capabilities and technology acceptance. Moreover, the work contributes to the further development of technology acceptance theories by suggesting specific adaptations that consider the peculiarities of older users.

Practical implications

The findings of this research have significant practical implications for the development and implementation of digital health applications for older adults. Firstly, the necessity of user-centered design in app

development is emphasized, with a special focus on accessibility and intuitive usability to enhance technology acceptance. Secondly, the results highlight the importance of educational programs and training for seniors to improve their technological skills and increase their health literacy.

Another practical aspect that arises from the evaluation of existing apps is the recommendation for the design of user interfaces and information architecture in new digital health applications for seniors. The results from the third methodology of app evaluation suggest that navigation and information preparation, similar to the existing structures that seniors regularly use, can significantly contribute to focusing users more on the value and utility of the app, rather than having to expend energy on figuring out how to use it.

Best practices can particularly be derived from apps like ViViRA and somnio. These apps implement a simple and step-by-step introduction at the initial use, which significantly eases the entry. A supportive measure that stands out in these apps is the integration of a virtual AI voice that proactively answers frequently asked questions and emphasizes the app's value. ViViRA also excels in the excellent preparation of information, which is organized in a clear and non-overwhelming manner. Additionally, they offer the possibility to export more detailed evaluations, so that treating physicians can also derive direct benefits.

Another significant aspect is the use of imagery that shows real people. This approach promotes user identification with the app, as it provides more realistic and tangible representations compared to the often-found cartoonish illustrations of people and figures in other apps, which are stylistically similar. Therefore, the use of authentic images can be seen as an effective strategy to enhance emotional resonance and user engagement.

Deriving these recommendations from the evaluation of existing apps provides important insights for developers of new applications and should be integrated into the development process to maximize the acceptance and satisfaction of the target group. Moreover, the results indicate that the implementation of guidelines that define clear standards for accessibility and user-friendliness of digital health applications is of great importance. Policymakers could be encouraged by these findings to create frameworks that urge developers to integrate these criteria into their product development.

In summary, this work offers both theoretically sound and practically actionable suggestions that can contribute to improving the quality of life of older people by promoting the adoption and effective use of digital health solutions.

5.4 Limitierungen und Bewertung der Methodiken

The methods used in this study offer both significant strengths and challenges that could have influenced the results. A weakness lies in the selection of experts for the interviews, which included only doctors who already had experience with DiGA. An interesting extension could have been the inclusion of experts who are critical of DiGA. This could have provided a more comprehensive view of the topic. Another issue was the online implementation of the second method. The results of the surveys conducted on-site in Nagold differed significantly from those sent by email, because it also reached people who do not have internet access. This points to a possible limitation of the sample, which may have favored a tech-savvy group. A weakness of the third method was that the MARS evaluation was conducted by only one person per app. An evaluation by multiple individuals, especially from the target group of seniors, could have provided more detailed insights and thus a higher value. Another limitation was the restricted access to the apps, which was not sufficient to conduct a broader analysis. Overall, the high effort resulting from using three methods led to compromises in each method, which could have potentially impacted the quality of the findings. The combination of the three methods—qualitative expert

interviews, quantitative data collection, and the evaluation of existing apps—theoretically complemented each other well to gain a comprehensive understanding of the acceptance and use of DiGA by seniors. Each method illuminated different aspects of the research topic, from theoretical considerations to practical application. However, the methodological restrictions and the associated resource expenditure led to some incoherence in the results, affecting the generalizability and depth of the study outcomes.

The study faced various limitations that affected the choice of methods, sample selection, and the generalizability of the results. A significant restriction was that access to DiGA was only possible via medical prescriptions. This severely limited access to the apps and made it dependent on available resources rather than an optimal selection for research. Ideally, it would have been possible to compare several DiGA that address the same target group and disease. However, this was not feasible due to the conditions. Moreover, access to the apps was time-limited and restricted to one access per person, which limited the possibility of more intensive or long-term collaboration with the target group. These limitations significantly restricted the practical implementation of the chosen methods and had a substantial impact on research freedom. A situation with more temporal and financial independence could have allowed for a more detailed long-term study to investigate the behavior and benefits of seniors with an app more targeted and in more depth.

5.5 Weitere Forschung

This study has provided significant insights into technology acceptance and user experience among seniors within the context of digital health applications. While some barriers have been mitigated, further research is essential to fully comprehend and support the integration and utilization of these technologies by the elderly population. Future research should concentrate on expanding expert interviews to include a diverse array of perspectives, including those that might be critical or divergent towards digital health applications. This approach would contribute to a more balanced view of the challenges and opportunities associated with these technologies.

Additionally, conducting in-depth quantitative analyses that include a broader and potentially less tech-savvy demographic could help paint a more representative picture of technology acceptance and user experience among older individuals. Another crucial area of future research involves directly incorporating seniors into the app evaluation process, which could significantly influence the development of user-friendly interfaces and functionalities.

Building on the identified gaps and the results of the current study, several specific investigations are proposed. Longitudinal studies are necessary to understand the long-term impacts of digital health applications on seniors' health and well-being. Comparative studies between different types of DiGA applications could elucidate which features and design elements most significantly affect user acceptance and satisfaction. Moreover, developing and testing targeted intervention strategies based on the understanding of barriers and drivers of technology acceptance could enhance adoption rates.

A proposed collaboration in DiGA testing with the Federal Institute for Drugs and Medical Devices (BfArM) would involve performing comparisons between two apps, providing deeper insights into the Fast-Track process's influence on user experience and perceived quality of DiGA. These proposed research directions aim to align digital health services more closely with the needs and preferences of older users, thereby enhancing their quality of life through improved health management tools.

6 Conclusion

This study provided valuable insights into the practical application of DiGA through expert interviews. It was clear that DiGA have the potential to extend patient treatment beyond the traditional clinical setting and to create an improved database for medical decisions. However, this does not imply a reduction in work for medical professionals, but rather a transformation in work methods. Doctors need to be enabled to effectively use new technologies, which requires comprehensive training in the apps and a thorough analysis of the DiGA data. Integrating these technologies into existing IT infrastructures presents another challenge. The experts highlighted that seniors are open to new treatment methods if the benefits are clearly and understandably communicated.

The quantitative survey showed that many seniors are already familiar with DiGA and meet the necessary prerequisites for their use, such as owning a smartphone and having basic technical knowledge. The willingness to try DiGA was high, with education, not age, identified as a significant factor for openness towards DiGA. Despite the generally positive reception of DiGA as innovative and exciting, ratings in terms of clarity, efficiency, and support were poorer compared to traditional treatment methods. This underscores the need for medical professionals to be intensively involved in the communication and training of DiGA to ensure the quality of treatment and alleviate seniors' fears.

The app evaluation revealed that the user interfaces are generally user-friendly, but there are shortcomings in meeting age-specific requirements. Best practice examples like ViViRA and Somnio provide comprehensive introductions and supportive materials that facilitate user navigation. However, the communication of data protection provisions was found to be inadequate in all apps, which could potentially impact user trust. Additionally, the lack of training and direct human support was criticized, posing a significant barrier to effective use.

The results from all three methods show that DiGA have the potential to improve and expand medical treatment. However, this requires careful implementation and adaptation to the needs and abilities of users, especially the older generation. The active role of medical personnel in educating, training, and integrating DiGA is crucial to ensure high acceptance and effective use of these technologies. Yet, a core assumption of this work can ultimately be refuted: DiGA are not suitable for effectively counteracting the shortage of skilled workers in healthcare. Instead, they transform work processes, where the initial implementation of the applications even leads to increased workload.

The research findings significantly contribute to understanding technology acceptance among older people and provide valuable insights for developers and healthcare providers to optimize the design and implementation of DiGA. These insights are essential for the development of future health applications to achieve broader acceptance and more effective use. Furthermore, this work provides insightful glimpses into clinical practice, clearly showing that the assumption that DiGA could counteract the shortage of skilled workers in healthcare is refuted as of now. This poses a significant challenge for health management to develop alternative solutions to effectively address the shortage of skilled workers while maintaining the quality of patient care.

The study achieved its primary goal of identifying the factors that influence the acceptance of DiGA among seniors. It covered significant aspects of evaluating the clinical everyday life and provided quantitative insights about seniors' attitudes and opinions towards DiGA, as well as an analysis of existing apps on the market. The investigation revealed that seniors are generally willing to accept these technologies, provided obstacles are removed and requirements such as pragmatic quality are met.

The prerequisites for using DiGA, such as owning a device and the confidence to use such technologies, are likely to continue improving, as shown by the rapid adoption of smartphones during the Covid-19

pandemic. The study revealed that the role of medical personnel is crucial for the overall experience of seniors. Doctors and nursing staff play a central role in supporting seniors before, during, and after using the apps, creating the majority of the user experience.

In the direct application of the apps, the need to consider specific design recommendations became apparent. These include not only intuitive and target group-specific menu navigation and information processing but also clear communication of added value, data protection, and available contact options as well as training offers. The potential of mHealth apps can be enormous and can make medical treatment more efficient, more effective, and, according to experts, more successful, provided all parties work together to fully exploit this potential. However, the current framework conditions slow down this development somewhat, indicating that structural adjustments are necessary to promote the widespread implementation and acceptance of DiGA.

The research methods used in this work enabled a comprehensive insight into the topic of DiGA. The methods included qualitative expert interviews, an empirical quantitative survey, and an evaluation of existing DiGA apps, which together provided a deep understanding of the factors influencing technology acceptance and use by seniors. The qualitative expert interviews proved essential for gaining insights into the actual challenges and hurdles in the practical use of DiGA. Health experts shared valuable experiences and gave assessments of the potential of DiGA, offering a more realistic perspective on the applicability and acceptance of these technologies. Direct questioning of experts allowed for deeper insights that went beyond theoretical considerations and market studies. The quantitative survey provided important data about seniors' attitudes and behavior towards DiGA. However, weaknesses in the methodology, particularly in the selection of participants via online platforms, possibly led to a bias due to a higher IT affinity and higher education level of the sample. This selection compromised the representativeness of the survey results, as a specific group of tech-savvy and educationally advantaged seniors was disproportionately represented. The analysis of the DiGA apps using the extended MARS evaluation matrix was an effective tool for assessing the user-friendliness and functionality of the applications. The method allowed for a systematic evaluation of various aspects of the apps, including their suitability for older users. However, accessibility issues with prescription-only apps and the varying quality of introductions to the apps showed limitations and pointed to the need for more uniform design and clearer communication.

In summary, the combination of the three methods created a broad data base that enabled a detailed analysis of the acceptance and use of DiGA by seniors. Despite some methodological weaknesses, particularly in the selection of participants and the accessibility of the apps, the results provide important insights for future research and the further development of DiGA to improve technology acceptance among older users.

Future studies should expand expert interviews, include a broader range of seniors, and involve them directly in app evaluations. Proposed research includes longitudinal and comparative studies on DiGA, and a collaboration with the Federal Institute for Drugs and Medical Devices to assess the Fast-Track process's impact on app quality and user experience, aiming to better meet the needs of older users.

6.1 Personal Reflection

[redacted]

7 References

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8 Declaration of Independence

I, [redacted] hereby declare that I have independently authored the thesis entitled “Age-appropriate user experience in the digital transformation - technology acceptance of seniors and the UX implications for prescription digital health applications” under the supervision of [redacted] at the Department of [redacted] at [redacted].

I affirm that I have not used any sources or aids other than those specified, and that I have not previously submitted this thesis, either in part or in full, as an examination paper either domestically or abroad. Any parts of this thesis that have been derived from the text or meaning of other works have been appropriately cited. This thesis has not been published in any form to date.

Tools Utilized Section:

Text Processing and Layout: Microsoft Word, Adobe InDesign, Adobe Photoshop

Literature Management and Research: Citavi, Google Scholar, SpringerLink, HNU Online Library, ResearchGate, JSTOR, PubMed, Google Search Engine, Consensus AI, Sci-Hub

Statistical Analysis: IBM SPSS, QCAMap, Microsoft Excel, Microsoft Forms

Translation and Text Review: Google Cloud Text-to-Speech-AI, DeepL, Grammarly AI, ChatGPT

Additional Digital Resources: Desktop PC, Laptop, iPad, Android Smartphone

I confirm that I have used all the aforementioned tools to assist in the creation of this thesis, but the conceptual and textual development was conducted independently.

Place, Date: Nagold, 21.04.2024

Signature [redacted]

Appendix

Appendix A: Health definitions

"Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity." (WHO)
"State of optimal performance of an individual for the effective fulfillment of the roles and tasks for which he or she has been socialized." Parsons, T. (2005): Social structure and personality. Frankfurt am Main, p. 344
"Being healthy in this sense means being able to meet one's own and other people's demands, being strong and vigorous enough for the tasks at hand and being able to manage one's professional and family affairs." Franke, A. (2016): Models of health and illness. Program area Health. Bern, p. 42
Health as "the state of well-being of a person, which is given when this person is physically, mentally and socially in harmony with the given internal and external living conditions." Hurrelmann, K. (2010): Gesundheitssoziologie. Eine Einführung in sozialwissenschaftliche Theorien von Krankheitsprävention und Gesundheitsförderung. Weinheim S. 7
"...the ability of people to deal with stressors or risks of illness." Antonovsky, A. (1996): The salutogenic model as a theory to guide health promotion. In: Health Promotion International 11(1), pp. 11-18

Appendix B: mHealth definitions (cf. Celi et al. 2017, p. 87; cf. Starcevic and Stanimirovic 2019, p. 170)

"mHealth is the use of portable electrical devices for mobile voice or data communication over a mobile network or other wireless network of mobile stations to provide health information." (2010)
"mHealth as medical and public health practices supported by mobile devices, such as cell phones, patient monitoring devices, personal digital assistants (PDAs) and other wireless devices." (WHO, 2011)
"mHealth encompasses any use of mobile technologies to address healthcare challenges such as access, quality, affordability, resource coordination and behavioral norms through the exchange of information." (2012)
"mHealth as the subset of eHealth that includes cell phones, other mobile devices and services delivered over telecommunications networks, the software, platforms, devices and infrastructures used by the mobile devices."
"Subdivision of eHealth focusing on the provision of health-related information, interventions and monitoring through portable electronic and mobile devices and technologies, such as smartphones, tablets and wearables. Examples of mHealth for mental health include smart phone applications ("apps"), text/SMS-enabled interventions and patient monitoring devices."

Appendix for Methodology I: Qualitative Expert Interviews

German original version of the guideline used in the expert interviews:

Leitfaden Experteninterviews

Vor dem Interview

- Der Interviewpartner wird über die Möglichkeit von Vertraulichkeitsvereinbarungen informiert.
- Es wird um Erlaubnis für die Transkription des Gesprächs gebeten.
- Die Möglichkeit der Anonymisierung wird erläutert.

Einführung

Seit 2020 gibt es eine Digitale Gesundheitsanwendungsverordnung und Ärzt:innen dürfen ihren Patient:innen digitale Gesundheitsanwendungen (DiGA) verschreiben. Diese speziellen Apps sollen dabei helfen, Krankheiten zu erkennen und zu behandeln oder die Gesundheitsvorsorge zu unterstützen. Anders als normale Gesundheits-Apps, die man ohne Rezept herunterladen kann, gelten DiGA als Medizinprodukte. Das bedeutet, dass die Hersteller von DiGA spezielle Anforderungen erfüllen müssen, um von Ärzten verschrieben werden zu können. Dies dient dazu sicherzustellen, dass sie sicher und wirksam sind.

Individuelles Wissen über DiGA

- Wann und auf welche Art und Weise sind Sie ursprünglich auf diese verordnungsfähigen medizinischen Gesundheits-Apps aufmerksam geworden?
- Gab es eine ursprüngliche, eher positive oder skeptische Einstellung zu DiGA? Welche Gründe führten zu dieser Einstellung, und gab es Faktoren, die Ihre Meinung geändert haben?
- Verschreiben Sie bereits selber Apps?
- Wie schätzen Sie die Zuverlässigkeit von vom Bundesinstituts für Arzneimittel und Medizinprodukte (BfArM) geprüften digitalen Gesundheitsanwendungen ein? Empfinden Sie sie als vertrauenswürdige Programme, die Ärzt:innen bedenkenlos empfehlen und verschreiben können?
- Welchen Beitrag können DiGA Ihrer Meinung nach zur Gesundheitsvorsorge und Genesung von Patienten leisten, vorausgesetzt sie werden korrekt verwendet?
- In welchen Anwendungsbereichen halten Sie DiGA für besonders sinnvoll und wirkungsvoll bei der Verbesserung des Gesundheitszustands von Patient:innen?
- Welche Vorteile sehen Sie in der Verwendung von DiGA im Praxiskontext? Gibt es bestimmte Nachteile oder Risiken?

Fragen zur Nutzungseinschätzung

- Digitale Gesundheitsanwendungen sind sehr breit aufgestellt. Nach ihrer Einschätzung: Wie hoch ist der Patient:innen-Anteil, der bereits eine digital Anwendung in irgendeiner Form genutzt hat?
- Können Sie die Patient:innengruppe definieren, die ihrer Meinung nach DiGA bereitwillig nutzen würden?
- Wie schätzen Sie die Bereitschaft älterer Patient:innen ein, neue Behandlungsmethoden auszuprobieren?
- Wie schätzen Sie den Einfluss einer medizinischen Empfehlung ein? Hören ältere Patient:innen auf den Rat von Ärzt:innen?

- Was muss eine DiGA Ihrer Ansicht nach erfüllen, damit Sie diese Patient*innen empfehlen bzw. verordnen? Was ist Ihnen dabei besonders wichtig? Bitte nennen Sie bis zu 5 Kriterien.
- Wie schätzen Sie Ihr Wissen und Ihre Kapazitäten ein, wenn es darum geht, das Angebot an verfügbaren DiGA zu überblicken?
- Wie schätzen Sie Ihr Wissen und Ihre Kapazitäten ein, wenn es darum geht, Patient*innen zu DiGA zu beraten?
- Es gibt Hinweise darauf dass viele niedergelassene Ärzt*innen und gerade Hausärzt*innen DiGA noch bislang zurückhaltend begegnen, diese also noch nicht verordnen. Worin liegen Ihrer Auffassung nach die Gründe hierfür?
- Wie schätzen Sie das Potenzial von DiGA ein, dem Fachkräftemangel in der Gesundheitsversorgung entgegenzuwirken?

Bitte teilen Sie Ihre Meinung zu den folgenden Aussagen mit und versuchen Sie, Ihre Standpunkte zu begründen:

- "Die Anwendung von DiGA ist für viele ältere Patienten zu komplex, was zu fehlerhaften Gesundheitsdaten führt und im schlimmsten Fall Therapiefehler verursachen kann."
- "DiGA verbessern die Einhaltung von Therapieplänen durch die Patienten, insbesondere im Krankheitsmanagement und in der Prävention."
- "Durch DiGA können Kommunikation zwischen Praxen und Patient:innen effizienter gestaltet werden."
- "Patient:innen sprechen auf meine Ratschläge an und vertrauen Ärtz:innen, auch wenn neue Bahandlungsmethoden vorgeschlagen werden."
- "DiGA ermöglichen das effizientere Behandeln von älteren Patienten mithilfe von zusätzlichen neuen Kanälen."

QCA table marked passages RQ1, RQ2, RQ3, RQ4, RQ5, RQ6, RQ7, RQ8

[redacted]	Category	Category Title	Marked Text
[redacted]	RQ1-3	Suitability of DiGA in practice	Das war sehr unkompliziert. Ich musste mich nur mit den Infos aus dem Flyer auf einer Webseite anmelden, meine Daten angeben, und dann hat mich jemand zurückgerufen. In dem Gespräch haben sie mir dann erklärt, auf was ich alles achten muss, wenn ich das Tool bei uns im Krankenhaus einführen möchte, zum Beispiel was die Datensicherheit angeht.
[redacted]	RQ1-3	Suitability of DiGA in practice	Testzugängen und Infomaterial bekommen, damit ich mich noch genauer einarbeiten konnte.
[redacted]	RQ1-3	Suitability of DiGA in practice	eine direkte Ansprechperson genannt
[redacted]	RQ1-3	Suitability of DiGA in practice	im Krankenhaus läuft vieles noch ziemlich traditionell. Deshalb fand ich die Idee, neue Technologien einzusetzen, total spannend.
[redacted]	RQ1-2	Usability of DiGA	Die ganze Sache ist ja ziemlich komplex und neu, das lässt einen schon mal zweifeln.
[redacted]	RQ1-2	Usability of DiGA	Ich hab noch nicht super viel Erfahrung damit gesammelt, meistens ergibt sich das im Laufe des Gesprächs
[redacted]	RQ1-1	Effectiveness of DiGA	die Zuverlässigkeit bei der Medikamenteneinnahme, sich verbessert hat, weil die Leute aktiver daran erinnert werden
[redacted]	RQ1-1	Effectiveness of DiGA	Selbstmanagement der Patienten mit chronischen Krankheiten wirkt souveräner, als hätten sie ständig eine helfende Hand dabei
[redacted]	RQ1-1	Effectiveness of DiGA	Es stärkt quasi das Gesundheitsbewusstsein und die Aufklärung
[redacted]	RQ1-3	Suitability of DiGA in practice	Dass diese Apps so streng geprüft werden, macht mich als Arzt echt zuversichtlich, was ihre Zuverlässigkeit und Sicherheit angeht
[redacted]	RQ1-1	Effectiveness of DiGA	dazu beitragen, dass die Motivation gestärkt wird bei den Patienten.
[redacted]	RQ1-1	Effectiveness of DiGA	Insgesamt kann die Compliance verbessert werden, da das Thema Krankheitsbehandlung nicht mehr nur noch im Krankenhaus stattfindet, sondern auch zuhause.
[redacted]	RQ1-1	Effectiveness of DiGA	führt dann auch zu Empowerment der Patienten, und einem besseren und selbstbestimmten Gesundheitsbewusstsein
[redacted]	RQ1-3	Suitability of DiGA in practice	echte Vorteile bei Sachen wie Medikamenteneinnahme oder Therapietreue
[redacted]	RQ1-2	Usability of DiGA	schnelle Erkennen von Veränderungen bei den Patienten
[redacted]	RQ1-2	Usability of DiGA	Wenn genau aufgezeichnet wird, was gegessen wird oder wann Medikamente genommen wurden, hilft uns das enorm. Wir müssen uns nicht mehr nur auf das Wort der Patienten verlassen und können viel gezielter eingreifen.
[redacted]	RQ1-3	Suitability of DiGA in practice	Ich finde, es verringert einfach die Distanz zwischen Arzt und Patienten.
[redacted]	RQ1-3	Suitability of DiGA in practice	Vorteile in einer effektiveren Gestaltung der Arztkontakte, weil einfach mehr Daten vorhanden sind.
[redacted]	RQ1-1	Effectiveness of DiGA	ständige Erinnern und Nutzen der Apps werden auch Probleme wie Fehlmessungen reduziert

[redacted]	RQ1-2	Usability of DiGA	gibt es den Patienten ein Stück Autonomie zurück. Sie nehmen die Bekämpfung ihrer Krankheit selbst in die Hand und haben ein Tool, das sie dabei unterstützt.
[redacted]	RQ1-3	Suitability of DiGA in practice	Der Schutz der persönlichen Daten ist so ein Thema. Was passiert mit den Daten, wer speichert sie und wofür werden sie genutzt? Als Patient hat man da oft keinen genauen Überblick, und bei einer chronischen Krankheit ist man eher bereit, das zu akzeptieren, besonders wenn der Arzt es empfiehlt. Da müssen wir wirklich genauer hinschauen und für Aufklärung sorgen.
[redacted]	RQ1-3	Suitability of DiGA in practice	Die ersten Patienten waren direkt skeptisch und eher ablehnend. Aber dann hab ich in den DiGA-Infomaterialien gelesen, dass man beim Erklären mehr auf die Vorteile eingehen sollte. Und als ich das Ganze dann anders angegangen bin und erklärt habe, was gebraucht wird und dass es eine gute Idee sein könnte, das über das Smartphone aufzuzeichnen, hat es überraschend gut funktioniert.
[redacted]	RQ1-2	Usability of DiGA	Zum Beispiel wärs echt hilfreich für uns, wenn es eine neutrale und verlässliche Informationsplattform gäbe, die staatlich betrieben wird
[redacted]	RQ1-2	Usability of DiGA	Unterstützung für die Patienten von den Krankenkassen wär super
[redacted]	RQ1-3	Suitability of DiGA in practice	eine standardisierte Schnittstelle, damit man die Software leichter ins bestehende System vom Krankenhaus integrieren kann, also mit einer Anbindung an die Kliniksoftware, wäre auch genial
[redacted]	RQ1-3	Suitability of DiGA in practice	eine zentral verwaltete Stelle wäre echt klasse. Bis jetzt ist es so, dass einzelne Vertriebsleute da sind, die jeweils ein paar Apps vertreten und dann dazu beraten, quasi auf Kommissionsbasis. Das funktioniert zwar irgendwie, aber den Überblick zu behalten, ist echt ein Chaos. Es kann passieren, dass ich vielleicht nicht die beste Diabetes-App verschreibe, einfach weil ich nicht weiß, welche es noch gibt.
[redacted]	RQ1-3	Suitability of DiGA in practice	selbst durch einen Testzugang ausprobieren durfte, erklären soll, dann läuft das super.
[redacted]	RQ1-3	Suitability of DiGA in practice	Das könnte natürlich an der fehlenden Datensicherheit und Transparenz liegen, also Fragen wie: Was passiert mit meinen Daten? Wird meine Krankheit getrackt oder so was?
[redacted]	RQ1-3	Suitability of DiGA in practice	es wird vielleicht als Spielerei und nicht ernst zu nehmende Sache angesehen.
[redacted]	RQ1-3	Suitability of DiGA in practice	man Angst hat, zu viel Verantwortung und Eigeninitiative in Sachen Krankheitsbehandlung in die Hände der Patienten zu legen, ohne sicher zu sein, was sie damit anfangen.
[redacted]	RQ1-2	Usability of DiGA	zu viel Verantwortung und Eigeninitiative in Sachen Krankheitsbehandlung in die Hände der Patienten zu legen, ohne sicher zu sein, was sie damit anfangen. Das Letzte, was wir wollen, ist, dass sich ein Patient selbst schadet, weil er versucht, etwas Komplexes alleine zu managen.
[redacted]	RQ1-3	Suitability of DiGA in practice	Ich hab eher das Gefühl, dass wir durch die ganzen zusätzlichen Schulungen und die Einführung neuer Technologien mehr Arbeit auf den Tisch bekommen, anstatt dass uns Arbeit abgenommen wird.
[redacted]	RQ1-3	Suitability of DiGA in practice	was wir wirklich brauchen, ist einfach mehr Personal und mehr Budget, aber das ist wieder ein ganz anderes Thema.
[redacted]	RQ1-2	Usability of DiGA	im schlimmsten Fall zu Therapiefehlern
[redacted]	RQ1-1	Effectiveness of DiGA	Wenn die Apps korrekt genutzt werden, könnten wir viel schneller auf Missbrauch oder Ähnliches reagieren und eingreifen.
[redacted]	RQ1-3	Suitability of DiGA in practice	Ich sehe das Problem tatsächlich eher darin, dass Senioren, die weit von der Technik entfernt sind, sich überfordert fühlen könnten, die Apps zu nutzen.
[redacted]	RQ1-1	Effectiveness of DiGA	Ich sehe ja auch eine Verbesserung im Gesundheitsbewusstsein der Patienten also was mit meinem Körper passiert und wie ich selbst aktiv dazu beitragen kann, meinen Zustand zu verbessern
[redacted]	RQ1-3	Suitability of DiGA in practice	es einfach ein weiteres Werkzeug, das uns hilft zu verstehen, was mit den Patienten passiert, wenn sie unser Haus verlassen.
[redacted]	RQ1-3	Suitability of DiGA in practice	eine App, die schwarz auf weiß festhält, was passiert und was gemacht wird, echt hilfreich.

[redacted]	RQ1-3	Suitability of DiGA in practice	unter der Voraussetzung, wie vorhin erwähnt, dass man selbstbewusst und mit Nachdruck betont, dass es dem Patienten wirklich hilft. Wenn der Nutzen klar verstanden wird, dann werden auch andere Methoden gut aufgenommen
[redacted]	RQ1-1	Effectiveness of DiGA	ein zusätzliches Werkzeug, um mehr Daten und mehr Transparenz zu erhalten
[redacted]	RQ1-3	Suitability of DiGA in practice	die Bürokratie mit den Krankenkassen und das Überreden der Patienten
[redacted]	RQ1-1	Effectiveness of DiGA	Es wird stets stark beworben, dass vor der Zulassung die Apps auf Wirksamkeit etc. geprüft worden sind. Da vertraue ich darauf.
[redacted]	RQ1-3	Suitability of DiGA in practice	Große Vorteile der Apps sehe ich daran, dass der Patient nicht mehr nur in der Klinik betreut wird.
[redacted]	RQ1-1	Effectiveness of DiGA	Das schafft sozusagen viel Transparenz und wir können gezielter agieren.
[redacted]	RQ1-1	Effectiveness of DiGA	Die kontinuierliche Messung vom Blutzucker hilft uns enorm nachzuvollziehen, wann und weshalb die Werte steigen oder fallen.
[redacted]	RQ1-2	Usability of DiGA	Ich sehe auch, wie die Patienten durch diese Apps ein anderes Bewusstsein für ihre Krankheit entwickeln. Sie werden selbst zu Experten, da sie genau nachvollziehen können, wann und wie sich ihr Körper worauf verhält.
[redacted]	RQ1-2	Usability of DiGA	Es ist auch sehr witzig zu sehen, wieviel Spaß einige daran haben, ständig ihre Werte am Smartphone sehen zu können.
[redacted]	RQ1-3	Suitability of DiGA in practice	der optimale Bereich vermutlich Krankheiten, die wir über einen längeren Zeitraum verfolgen müssen, wie Ernährungs-, Darm- oder Herz-Kreislaufkrankheiten.
[redacted]	RQ1-1	Effectiveness of DiGA	bessere und transparente Verfolgen von Krankheitsverläufen
[redacted]	RQ1-3	Suitability of DiGA in practice	die Tatsache, dass wir mehr Arbeit haben. Wir müssen die Auswertungen der Apps lesen, die Patienten schulen und alles klären.
[redacted]	RQ1-2	Usability of DiGA	Gewisse Risiken gibt es auch, wenn zum Beispiel der Patient die App falsch verwendet oder absichtlich falsche Werte eingibt.
[redacted]	RQ1-2	Usability of DiGA	Smartwatches sehe ich auch immer häufiger an Menschen
[redacted]	RQ1-3	Suitability of DiGA in practice	Man tendiert natürlich eher bei jüngeren dazu, das anzusprechen.
[redacted]	RQ1-3	Suitability of DiGA in practice	Es muss helfen und es muss sinnvoll sein, das zu verwenden. Wenn es mehr Arbeit macht und nicht effektiv ist, dann macht das einfach keinen Sinn.
[redacted]	RQ1-2	Usability of DiGA	müssen ebenfalls Dinge wie leichte Bedienbarkeit gegeben sein. Und dass der Patient nicht so leicht falsche Daten einpflegen kann
[redacted]	RQ1-3	Suitability of DiGA in practice	Ich könnte mir vorstellen, dass es viele noch als Gimmick sehen. Eine Spielerei, die nicht wirklich dem Bild von klassischer Medizin entspricht.
[redacted]	RQ1-3	Suitability of DiGA in practice	Es braucht ja egal wieviele Apps wir haben, es braucht immer medizinisches Personal, welches die Daten auswerten kann. Und individuell in Zusammenhänge bringe kann. Es bringt halt eine bessere Datenerfassung bzw eine regelmäßige Datenerfassung
[redacted]	RQ1-2	Usability of DiGA	kann es für viele durch eine benutzerfreundliche Oberfläche auch einfach mehr Spaß machen Daten regelmäßig festzuhalten.
[redacted]	RQ1-1	Effectiveness of DiGA	Auf lange Sicht, wenn diese Apps sich etwas mehr etabliert haben, kann ich mir vorstellen, dass weniger Zeit darauf verwendet werden kann Patientendaten geordnet festzuhalten, aber es wird dadurch nicht das fehlende Fachkräftepersonal ersetzt.

[redacted]	RQ1-3	Suitability of DiGA in practice	Wahrscheinlich ist nicht um Patientenschulungen drumrum zu kommen, damit die Patienten zum Beispiel wissen, was sie bei fehlerhaften Einträgen machen oder wie sie insgesamt die Apps verwenden können
[redacted]	RQ1-1	Effectiveness of DiGA	Die größte Hürde besteht in der Nutzung der Apps selbst wenn dies einmal überwunden ist, glaube ich, dass es für die meisten Patienten ein toller Weg ist ihre eigene Gesundheit aufrechtzuerhalten, zu erforschen und an sich selbst anzupassen.
[redacted]	RQ1-3	Suitability of DiGA in practice	Wir sind in diesem Moment nur noch diejenigen, die die Patienten beraten und Feedback geben können, aber an sich können viele Patienten dadurch ihre Gesundheit selber sehr gut im Auge behalten. Eine App ist natürlich auch viel schöner fürs Auge als ein Blatt Papier oder die trockenen Daten, die wir ihnen runterbeten können. Und alles, was uns hilft die Compliance der Patient*innen zu steigern, ist für uns ein Gewinn.
[redacted]	RQ1-3	Suitability of DiGA in practice	Es sollte kein Ersatz sein für das Arzt-Patient*innen-Gespräch, aber wir kriegen genau die Daten, die wir brauchen.
[redacted]	RQ1-2	Usability of DiGA	Oft dauert es eine Weile, bis eine Patient*in den Umgang mit seiner Krankheit durchblickt hat und versteht, welche Daten uns wichtig sind. Eine App ist ein großartiges Tool für den Patienten sich selbst und seine Krankheit zu verstehen und dann ins Arztgespräch die übrig gebliebenen Fragen und die wichtigen Daten mitzubringen.
[redacted]	RQ1-1	Effectiveness of DiGA	Ich habe das Gefühl, viele Patient*innen freuen sich über den Autonomiegewinn durch Apps. Über eine Krankheit zu erfahren ist einem gewissen Sinne ein Kontrollverlust für jemanden. Durch diese Apps sind die Patient*innen nicht mehr so vollkommen dem Gesundheitssystem ausgeliefert, sondern kriegen das Gefühl, dass sie das selbst auch im Blick haben und etwas tun können.
[redacted]	RQ1-3	Suitability of DiGA in practice	Es gibt natürlich auch älteren Patient*innen, für die solche Apps sehr neumodischer Kram sind, aber da können solche Apps auch von den Angehörigen für diese übernommen werden. Überraschend oft werden Apps positiv aufgenommen und es wird sich immer über einen ärztlichen Therapievorschlag gefreut, der nicht - noch eine Tablette am Abendbedeutet.
[redacted]	RQ1-2	Usability of DiGA	Es gibt ältere Menschen, die, wenn sie können, auf Arztbesuche verzichten und sich freuen autonom eine Übersicht über ihre medizinischen Parameter zu haben.
[redacted]	RQ1-1	Effectiveness of DiGA	Ich kann eingreifen, wenn es starke Normabweichungen gibt, aber habe auch eine detailliertere Übersicht über längere Zeiträume, sodass ich die medizinische Versorgung dementsprechend anpassen kann. Das ist perfekt für mich als Ärztin und bietet eine wunderbare Unterstützung.
[redacted]	RQ1-3	Suitability of DiGA in practice	Es fehlt an Transparenz und einer tiefgreifenden klinischen Überprüfung, um die Wirksamkeit und Sicherheit dieser Anwendungen zu gewährleisten. Ausserdem gefällt mir diese Fast-Track-Zulassung nicht.
[redacted]	RQ1-3	Suitability of DiGA in practice	Ich ziehe es vor, auf traditionellere Methoden und persönliche Beratung zurückzugreifen. Wenn ich Apps verschreibe, dann nur nach gründlicher Prüfung und mit Vorbehalt.
[redacted]	RQ1-3	Suitability of DiGA in practice	Wenn Interesse besteht, eigenständig eine App auszuprobieren, unterstütze ich und bereite alles gemeinsam vor, sodass die Bürokratie auch mit den Krankenkassen reibungsfrei funktioniert.
[redacted]	RQ1-1	Effectiveness of DiGA	Das Potenzial ist abhängig von der Art der Anwendung und der Bereitschaft des Patienten, diese regelmäßig zu nutzen.
[redacted]	RQ1-2	Usability of DiGA	Es gibt auch ein Risiko der Überinformation oder Fehlinformation.
[redacted]	RQ1-3	Suitability of DiGA in practice	die schwierige Kommunikation von uns, dem Hausarzt und den Krankenkassen ist da nicht besonders hilfreich.
[redacted]	RQ1-2	Usability of DiGA	Nicht alle Patienten haben die Mittel oder das Wissen, um mit diesen Technologien umzugehen, was zu einer ungleichen Versorgung führen kann.
[redacted]	RQ1-3	Suitability of DiGA in practice	Eine umfassendere Aufklärung und Schulung sowohl für Ärzte als auch für Patienten wäre ein Anfang.
[redacted]	RQ1-1	Effectiveness of DiGA	Erstens, bei der Betreuung von chronischen Erkrankungen, wie Diabetes oder Herz-Kreislauferkrankungen, können diese Apps eine konstante Überwachung und somit eine bessere Kontrolle ermöglichen.
[redacted]	RQ1-1	Effectiveness of DiGA	in der Prävention, indem sie zum Beispiel durch Bewegungserinnerungen oder Ernährungstipps einen gesünderen Lebensstil fördern.

[redacted]	RQ1-1	Effectiveness of DiGA	in der Rehabilitation, beispielsweise nach Operationen, wo sie die Fortschritte der Patienten dokumentieren und die Einhaltung der Therapiepläne unterstützen
[redacted]	RQ1-2	Usability of DiGA	Wichtig ist, dass die Anwendungen intuitiv und leicht zugänglich sind, um eine breite Akzeptanz und effektive Nutzung zu gewährleisten.
[redacted]	RQ1-3	Suitability of DiGA in practice	Es ist schwer, eine genaue Zahl zu nennen, aber ich würde sagen, ein wachsender Anteil unserer Patienten hat schon Erfahrungen mit digitalen Gesundheitsanwendungen gemacht.
[redacted]	RQ1-3	Suitability of DiGA in practice	Natürlich gibt es eine gewisse Skepsis, vor allem bei neuen Technologien. Aber mit der richtigen Herangehensweise, Geduld und klaren Erklärungen, wie diese Methoden ihre Lebensqualität verbessern können, sind viele bereit, es zumindest zu versuchen. Die Schlüssel sind Vertrauen und eine gute Beziehung zum behandelnden Arzt sowie einfache, zugängliche Anwendungen.
[redacted]	RQ1-3	Suitability of DiGA in practice	Zunächst muss die Anwendung einen nachgewiesenen Nutzen für den Patienten haben, basierend auf soliden wissenschaftlichen Erkenntnissen.
[redacted]	RQ1-2	Usability of DiGA	die Anwendung sollte so gestaltet sein, dass auch Patienten, die nicht so oft am Smartphone hängen, sie problemlos nutzen können.
[redacted]	RQ1-3	Suitability of DiGA in practice	eine nahtlose Verbindung zwischen den Apps und der elektronischen Patientenakte geben, um Doppelarbeit zu vermeiden und einen schnellen Informationsfluss zu gewährleisten.
[redacted]	RQ1-3	Suitability of DiGA in practice	Ein wesentlicher Punkt ist sicherlich der Mangel an verlässlichen Informationen über die Wirksamkeit und Sicherheit dieser Anwendungen.
[redacted]	RQ1-3	Suitability of DiGA in practice	Auch die Sorge, dass die persönliche Beziehung zum Patienten durch den Einsatz digitaler Apps und der Telemedizin leiden könnte, spielt eine Rolle.
[redacted]	RQ1-3	Suitability of DiGA in practice	Durch Automatisierung routinemäßiger Aufgaben und die Bereitstellung von Selbstmanagement-Tools für Patienten können sie das medizinische Personal entlasten und ihm ermöglichen, sich auf die komplexeren und dringenderen Fälle zu konzentrieren.
[redacted]	RQ1-2	Usability of DiGA	Es stimmt, dass einige ältere Patienten Schwierigkeiten haben könnten, mit der Komplexität moderner Technologien umzugehen. Das Risiko von Fehlbedienungen und daraus resultierenden fehlerhaften Gesundheitsdaten ist nicht von der Hand zu weisen. Dies kann in der Tat zu Missverständnissen und sogar zu Therapiefehlern führen, wenn beispielsweise falsche Werte eingegeben oder Missinterpretationen der Daten durch den Patienten oder das medizinische Personal nicht erkannt werden.
[redacted]	RQ1-3	Suitability of DiGA in practice	Allerdings bedeutet dies nicht, dass digitale Gesundheitsanwendungen generell ungeeignet für ältere Menschen sind. Vielmehr zeigt es die Notwendigkeit, bei der Entwicklung dieser Technologien auf Einfachheit, intuitive Bedienbarkeit und klare Anleitungen zu achten.
[redacted]	RQ1-2	Usability of DiGA	Apps können beispielsweise Erinnerungen an die Medikamenteneinnahme senden, was besonders bei komplexen Behandlungsschemata hilfreich ist. Wichtig ist jedoch, dass die Anwendungen auf die individuellen Bedürfnisse der Patienten zugeschnitten sind.
[redacted]	RQ1-3	Suitability of DiGA in practice	Beispielsweise ermöglichen Patientenportale einen direkten Zugriff auf medizinische Daten, Befunde und Therapiepläne, was die Transparenz erhöht und den Informationsaustausch vereinfacht.
[redacted]	RQ1-2	Usability of DiGA	Über solche Plattformen können Patienten auch einfacher und schneller Fragen stellen oder Rückmeldungen geben, ohne dafür extra in die Praxis kommen zu müssen.
[redacted]	RQ1-3	Suitability of DiGA in practice	Kontakt zum Arzt, ohne dass der Patient vor Ort sein muss
[redacted]	RQ1-3	Suitability of DiGA in practice	Als Arzt trage ich eine große Verantwortung für die persönlichen Daten meiner Patienten. Die Einführung einer neuen Technologie wirft daher zunächst Fragen nach der Sicherheit dieser Informationen auf.
[redacted]	RQ1-2	Usability of DiGA	Mehr Technik bedeutet für die Patienten weniger Kontakt mit dem Arzt selbst, mögliche Gespräche fallen flach wenn man sich nur noch auf technische Daten fokussiert.
[redacted]	RQ1-3	Suitability of DiGA in practice	Für uns ist das außerdem mehr Arbeit und es bleibt weniger Zeit für das tatsächliche Behandeln von Patienten.
[redacted]	RQ1-1	Effectiveness of DiGA	Die Patienten konnten ein größeres Bewusstsein für ihre Gesundheit entwickeln und wurden motiviert, aktiver an der Verwaltung ihrer Erkrankungen teilzunehmen.

[redacted]	RQ1-2	Usability of DiGA	das Gefühl, auch selber etwas tun zu können.
[redacted]	RQ1-1	Effectiveness of DiGA	die Verbesserung der Selbstmanagementfähigkeiten. Viele Apps bieten Werkzeuge und Ressourcen, die Patienten dabei unterstützen, ihre eigene Gesundheit aktiver zu managen. Sie können ihre Symptome besser tracken
[redacted]	RQ1-1	Effectiveness of DiGA	eine Erhöhung der Therapietreue ist dadurch möglich
[redacted]	RQ1-1	Effectiveness of DiGA	eine Frühzeitige Erkennung von Verschlechterungen
[redacted]	RQ1-3	Suitability of DiGA in practice	Allerdings sind nicht alle gleich technikaffin, was eine individuelle Unterstützung notwendig macht.
[redacted]	RQ2-1	Experiences and assessments of seniors regarding the acceptance	Wenn ich merke, dass die traditionellen Behandlungsmethoden nicht so richtig gefruchtet haben oder der Patient aufgeschlossen und technikbegeistert genug erscheint, es mal zu versuchen, dann schlage ich es vor. Und dann entscheiden wir gemeinsam.
[redacted]	RQ2-1	Experiences and assessments of seniors regarding the acceptance	Ich hab bemerkt, dass die Compliance, also die Zuverlässigkeit bei der Medikamenteneinnahme, sich verbessert hat, weil die Leute aktiver daran erinnert werden.
[redacted]	RQ2-1	Experiences and assessments of seniors regarding the acceptance	Wir müssen uns nicht mehr nur auf das Wort der Patienten verlassen und können viel gezielter eingreifen.
[redacted]	RQ2-1	Experiences and assessments of seniors regarding the acceptance	Durch das ständige Erinnern und Nutzen der Apps werden auch Probleme wie Fehlmessungen reduziert.
[redacted]	RQ2-1	Experiences and assessments of seniors regarding the acceptance	Meistens ist es für die Leute was ganz Neues und sie sind anfangs ein bisschen skeptisch, weil es vielleicht erstmal wie ein Spielzeug wirkt.
[redacted]	RQ2-1	Experiences and assessments of seniors regarding the acceptance	Aber sobald ich ihnen die Vorteile erkläre, zum Beispiel wie es die Behandlung enger und sogar krankenhausübergreifend machen kann, sind eigentlich alle ziemlich offen und interessiert.
[redacted]	RQ2-1	Experiences and assessments of seniors regarding the acceptance	Die ersten Patienten waren direkt skeptisch und eher ablehnend.
[redacted]	RQ2-1	Experiences and assessments of seniors regarding the acceptance	Und als ich das Ganze dann anders angegangen bin und erklärt habe, was gebraucht wird und dass es eine gute Idee sein könnte, das über das Smartphone aufzuzeichnen, hat es überraschend gut funktioniert. Mit der Zeit hab ich dann so meine Routine entwickelt und war wahrscheinlich auch selbstsicherer, diese Therapieoption vorzustellen. Danach lief es eigentlich ganz gut.
[redacted]	RQ2-1	Experiences and assessments of seniors regarding the acceptance	vom Feedback der Patienten kann ich berichten, dass sich einige über die Benutzeroberfläche der Apps beschwert haben, weil sie nicht so intuitiv zu bedienen sind, wie sie es von anderen Apps gewohnt sind, also beim Navigieren und so weiter.
[redacted]	RQ2-1	Experiences and assessments of seniors regarding the acceptance	Außerdem sollten die Apps so gestaltet sein, dass sie keine unnötigen Gesundheitsängste schüren, zum Beispiel durch Vermeidung von Fehlinterpretationen durch die Patienten oder eine zu starke Fokussierung auf einzelne Vitalwerte.

[redacted]	RQ2-1	Experiences and assessments of seniors regarding the acceptance	Ich sehe das Problem tatsächlich eher darin, dass Senioren, die weit von der Technik entfernt sind, sich überfordert fühlen könnten, die Apps zu nutzen. Diese Sorge verstehe ich, auch wenn ich persönlich bisher nicht wirklich gravierende Probleme in dieser Hinsicht erlebt habe.
[redacted]	RQ2-1	Experiences and assessments of seniors regarding the acceptance	Wenn der Nutzen klar verstanden wird, dann werden auch andere Methoden gut aufgenommen
[redacted]	RQ2-1	Experiences and assessments of seniors regarding the acceptance	Die kontinuierliche Messung vom Blutzucker hilft uns enorm nachzuvollziehen, wann und weshalb die Werte steigen oder fallen. Und ebenfalls haben die Patienten Vorteile, wie Wegfallen vom aufwändigen Stechen der Fingerkuppen.
[redacted]	RQ2-1	Experiences and assessments of seniors regarding the acceptance	Ich sehe auch, wie die Patienten durch diese Apps ein anderes Bewusstsein für ihre Krankheit entwickeln. Sie werden selbst zu Experten, da sie genau nachvollziehen können, wann und wie sich ihr Körper worauf verhält.
[redacted]	RQ2-1	Experiences and assessments of seniors regarding the acceptance	Die größte Hürde besteht in der Nutzung der Apps selbst
[redacted]	RQ2-1	Experiences and assessments of seniors regarding the acceptance	Über eine Krankheit zu erfahren ist einem gewissen Sinne ein Kontrollverlust für jemanden. Durch diese Apps sind die Patient*innen nicht mehr so vollkommen dem Gesundheitssystem ausgeliefert, sondern kriegen das Gefühl, dass sie das selbst auch im Blick haben und etwas tun können.
[redacted]	RQ2-1	Experiences and assessments of seniors regarding the acceptance	Es gibt natürlich auch älteren Patient*innen, für die solche Apps sehr neumodischer Kram sind, aber da können solche Apps auch von den Angehörigen für diese übernommen werden.
[redacted]	RQ2-1	Experiences and assessments of seniors regarding the acceptance	Überraschend oft werden Apps positiv aufgenommen und es wird sich immer über einen ärztlichen Therapievorschlag gefreut, der nicht - noch eine Tablette am Abendbedeutet.
[redacted]	RQ2-1	Experiences and assessments of seniors regarding the acceptance	Es gibt ältere Menschen, die, wenn sie können, auf Arztbesuche verzichten und sich freuen autonom eine Übersicht über ihre medizinischen Parameter zu haben.
[redacted]	RQ2-1	Experiences and assessments of seniors regarding the acceptance	Das erledige ich meist im Dialog und zeige die Optionen auf. Wenn Interesse besteht, eigenständig eine App auszuprobieren, unterstütze ich und bereite alles gemeinsam vor
[redacted]	RQ2-1	Experiences and assessments of seniors regarding the acceptance	Das Potenzial ist abhängig von der Art der Anwendung und der Bereitschaft des Patienten, diese regelmäßig zu nutzen.
[redacted]	RQ2-1	Experiences and assessments of seniors regarding the acceptance	sehe ich eine große Herausforderung in der digitalen Kluft. Nicht alle Patienten haben die Mittel oder das Wissen, um mit diesen Technologien umzugehen, was zu einer ungleichen Versorgung führen kann.
[redacted]	RQ2-1	Experiences and assessments of seniors regarding the acceptance	Das Risiko von Fehlbedienungen und daraus resultierenden fehlerhaften Gesundheitsdaten ist nicht von der Hand zu weisen.

[redacted]	RQ2-1	Experiences and assessments of seniors regarding the acceptance	Beispielsweise ermöglichen Patientenportale einen direkten Zugriff auf medizinische Daten, Befunde und Therapiepläne, was die Transparenz erhöht und den Informationsaustausch vereinfacht
[redacted]	RQ2-1	Experiences and assessments of seniors regarding the acceptance	Die Patienten konnten ein größeres Bewusstsein für ihre Gesundheit entwickeln und wurden motiviert, aktiver an der Verwaltung ihrer Erkrankungen teilzunehmen.
[redacted]	RQ2-1	Experiences and assessments of seniors regarding the acceptance	Viele berichteten von einer Verbesserung ihrer Lebensqualität und das Gefühl, auch selber etwas tun zu können.
[redacted]	RQ2-1	Experiences and assessments of seniors regarding the acceptance	Ich habe gemerkt, dass immer mehr meiner Patienten digitale Gesundheitsanwendungen nutzen, schätzungsweise 30-40%. Das reicht von Fitness-Trackern bis hin zu Apps für chronische Krankheiten.
[redacted]	RQ2-1	Experiences and assessments of seniors regarding the acceptance	Besonders ältere Patienten zeigen vermehrt Interesse, unterstützt durch die Verbreitung von Smartphones und Empfehlungen von Familie und Ärzten.
[redacted]	RQ2-1	Experiences and assessments of seniors regarding the acceptance	Sie sehen das Internet als wertvolle Ergänzung zur klassischen medizinischen Versorgung, um aktiver an ihrer Gesundheit mitzuwirken.
[redacted]	RQ2-1	Experiences and assessments of seniors regarding the acceptance	Allerdings sind nicht alle gleich technikaffin, was eine individuelle Unterstützung notwendig macht.
[redacted]	RQ2-1	Experiences and assessments of seniors regarding the acceptance	Bedienbarkeit sind wichtige Punkte, und Unterstützung durch Familie und Freunde fördert die Akzeptanz
[redacted]	RQ2-1	Experiences and assessments of seniors regarding the acceptance	Es gibt Bedenken, dass die Nutzung digitaler Gesundheitsanwendungen für einige ältere Menschen herausfordernd sein kann. Vor allem, wenn sie dann auch noch nicht an digitale Geräte gewöhnt sind.
[redacted]	RQ2-1	Experiences and assessments of seniors regarding the acceptance	Es ist entscheidend, ältere Patienten beim Gebrauch von Apps sorgfältig zu überwachen und zu unterstützen
[redacted]	RQ2-1	Experiences and assessments of seniors regarding the acceptance	Dass nie alle Patienten erreicht werden können, sollte allen klar sein, aber das ist bei Medikamenten selbst auch nicht anders.
[redacted]	RQ2-1	Experiences and assessments of seniors regarding the acceptance	Es hilft die Daten übersichtlich vor sich zu haben und wenn ich sie dann in der App zusammenfassend anzeigen lassen kann, hilft das auch mir.
[redacted]	RQ2-2	Perceived Usefulness	Ich hab bemerkt, dass die Compliance, also die Zuverlässigkeit bei der Medikamenteneinnahme, sich verbessert hat, weil die Leute aktiver daran erinnert werden.

[redacted]	RQ2-2	Perceived Usefulness	Und auch das Selbstmanagement der Patienten mit chronischen Krankheiten wirkt souveräner, als hätten sie ständig eine helfende Hand dabei. Es stärkt quasi das Gesundheitsbewusstsein und die Aufklärung.
[redacted]	RQ2-2	Perceived Usefulness	Insgesamt kann die Compliance verbessert werden, da das Thema Krankheitsbehandlung nicht mehr nur noch im Krankenhaus stattfindet, sondern auch zuhause. Das führt dann auch zu Empowerment der Patienten, und einem besseren und selbstbestimmten Gesundheitsbewusstsein.
[redacted]	RQ2-2	Perceived Usefulness	echte Vorteile bei Sachen wie Medikamenteneinnahme oder Therapietreue
[redacted]	RQ2-2	Perceived Usefulness	Auch das schnelle Erkennen von Veränderungen bei den Patienten
[redacted]	RQ2-2	Perceived Usefulness	effektiveren Gestaltung der Arztkontakte, weil einfach mehr Daten vorhanden sind
[redacted]	RQ2-2	Perceived Usefulness	gibt es den Patienten ein Stück Autonomie zurück
[redacted]	RQ2-2	Perceived Usefulness	Sie nehmen die Bekämpfung ihrer Krankheit selbst in die Hand und haben ein Tool, das sie dabei unterstützt.
[redacted]	RQ2-2	Perceived Usefulness	man selbstbewusst und mit Nachdruck betont, dass es dem Patienten wirklich hilft. Wenn der Nutzen klar verstanden wird, dann werden auch andere Methoden gut aufgenommen
[redacted]	RQ2-2	Perceived Usefulness	Es bringt halt eine bessere Datenerfassung bzw eine regelmäßige Datenerfassung
[redacted]	RQ2-2	Perceived Usefulness	Wir sind in diesem Moment nur noch diejenigen, die die Patienten beraten und Feedback geben können, aber an sich können viele Patienten dadurch ihre Gesundheit selber sehr gut im Auge behalten.
[redacted]	RQ2-2	Perceived Usefulness	Oft dauert es eine Weile, bis eine Patient*in den Umgang mit seiner Krankheit durchblickt hat und versteht, welche Daten uns wichtig sind. Eine App ist ein großartiges Tool für den Patienten sich selbst und seine Krankheit zu verstehen und dann ins Arztgespräch die übrig gebliebenen Fragen und die wichtigen Daten mitzubringen.
[redacted]	RQ2-2	Perceived Usefulness	Ich habe das Gefühl, viele Patient*innen freuen sich über den Autonomiegewinn durch Apps.
[redacted]	RQ2-2	Perceived Usefulness	Überraschend oft werden Apps positiv aufgenommen und es wird sich immer über einen ärztlichen Therapievorschlag gefreut, der nicht - noch eine Tablette am Abendbedeutet.
[redacted]	RQ2-2	Perceived Usefulness	Sie stärken das Gesundheitsbewusstsein der Patienten, indem diese ihre Gesundheit aktiv mitverfolgen können.
[redacted]	RQ2-2	Perceived Usefulness	konstante Überwachung und somit eine bessere Kontrolle
[redacted]	RQ2-2	Perceived Usefulness	in der Prävention, indem sie zum Beispiel durch Bewegungserinnerungen oder Ernährungstipps einen gesünderen Lebensstil fördern
[redacted]	RQ2-2	Perceived Usefulness	Digitale Gesundheitsanwendungen bieten ein großes Potenzial, Patienten dabei zu unterstützen, ihre Therapiepläne genauer zu befolgen.
[redacted]	RQ2-2	Perceived Usefulness	Über solche Plattformen können Patienten auch einfacher und schneller Fragen stellen oder Rückmeldungen geben, ohne dafür extra in die Praxis kommen zu müssen.
[redacted]	RQ2-2	Perceived Usefulness	Telemedizin und Monitoring-Apps ermöglichen es, Gesundheitsdaten einfach zu übermitteln und halten so den Kontakt zum Arzt, ohne dass der Patient vor Ort sein muss.
[redacted]	RQ2-2	Perceived Usefulness	frühzeitig Probleme erkennen und die Kommunikation vereinfachen
[redacted]	RQ2-2	Perceived Usefulness	Die Patienten konnten ein größeres Bewusstsein für ihre Gesundheit entwickeln und wurden motiviert, aktiver an der Verwaltung ihrer Erkrankungen teilzunehmen.

[redacted]	RQ2-2	Perceived Usefulness	Viele berichteten von einer Verbesserung ihrer Lebensqualität und das Gefühl, auch selber etwas tun zu können.
[redacted]	RQ2-2	Perceived Usefulness	Verbesserung der Selbstmanagementfähigkeiten. Viele Apps bieten Werkzeuge und Ressourcen, die Patienten dabei unterstützen, ihre eigene Gesundheit aktiver zu managen.
[redacted]	RQ2-2	Perceived Usefulness	Sie können ihre Symptome besser tracken, es können teilweise Ernährungs- und Bewegungspläne gesehen werden. Manche nutzen sie wie einen Wecker, um an die Medikamenteneinnahme erinnert zu werden.
[redacted]	RQ2-2	Perceived Usefulness	Indem Patienten ein besseres Verständnis und mehr Kontrolle über ihre Gesundheitszustände erlangen, können sie aktiv zu ihrer Therapie und zum langfristigen Gesundheitserhalt beitragen.
[redacted]	RQ2-2	Perceived Usefulness	eine Erhöhung der Therapietreue
[redacted]	RQ2-2	Perceived Usefulness	regelmäßige Nutzung kann die Einhaltung von Therapieplänen fördern
[redacted]	RQ2-2	Perceived Usefulness	Erinnerungen und das Tracking von Gesundheitsdaten können sie besser bei ihrem vorgeschriebenen Therapieplan bleiben
[redacted]	RQ2-2	Perceived Usefulness	eine Frühzeitige Erkennung von Verschlechterungen
[redacted]	RQ2-2	Perceived Usefulness	Das kann rechtzeitige Anpassungen der Behandlung erlauben, bevor ernsthafte Probleme entstehen und können die individuelle Therapiegestaltung fördern
[redacted]	RQ2-2	Perceived Usefulness	Sie können die Lebensqualität verbessern, indem sie die Selbstständigkeit fördern und die soziale Einbindung unterstützen.
[redacted]	RQ2-2	Perceived Usefulness	Apps zu Gedächtnistraining, Sturzprävention oder zur Förderung sozialer Kontakte
[redacted]	RQ2-2	Perceived Usefulness	Eine verbesserte Patientenbindung könnte ein Vorteil sein
[redacted]	RQ2-2	Perceived Usefulness	hilft eine geduldige Kommunikation, unterstützt von Familie oder Pflegepersonal, Bedenken zu mindern
[redacted]	RQ2-2	Perceived Usefulness	Respekt, Vertrauen und klare Kommunikation sind entscheidend
[redacted]	RQ2-2	Perceived Usefulness	Es kann kommuniziert werden ohne, dass man vor Ort sich sehen muss
[redacted]	RQ2-2	Perceived Usefulness	Patienten bekommen Tools an die Hand, um ihren Gesundheitszustand zu überwachen und bei Bedarf direkt Kontakt aufzunehmen, was ihre Eigenverantwortung stärkt und uns die Möglichkeit bietet in medizinischen Notfällen rechtzeitig kontaktiert zu werden.
[redacted]	RQ2-2	Perceived Usefulness	Es hilft bei der kontinuierlichen Überwachung von Gesundheitsparametern und helfen ihnen, aktiver ihre Gesundheit zu managen, durch Apps für Ernährung, Bewegung und Medikamentenmanagement.
[redacted]	RQ2-3	Ease of use	Ich sehe das Problem tatsächlich eher darin, dass Senioren, die weit von der Technik entfernt sind, sich überfordert fühlen könnten, die Apps zu nutzen.
[redacted]	RQ2-3	Ease of use	Es ist auch sehr witzig zu sehen, wieviel Spaß einige daran haben, ständig ihre Werte am Smartphone sehen zu können.
[redacted]	RQ2-3	Ease of use	außerdem kann es für viele durch eine benutzerfreundliche Oberfläche auch einfach mehr Spaß machen Daten regelmäßig festzuhalten.
[redacted]	RQ2-3	Ease of use	Eine App ist natürlich auch viel schöner fürs Auge als ein Blatt Papier oder die trockenen Daten, die wir ihnen runterbeten können.

[redacted]	RQ2-3	Ease of use	Überraschend oft werden Apps positiv aufgenommen und es wird sich immer über einen ärztlichen Therapievorschlag gefreut, der nicht - noch eine Tablette am Abendbedeutet.
[redacted]	RQ2-3	Ease of use	Ebenso auf der anderen Seite das schnelle Vernachlässigen der App, da es einfach Mühe erfordert, regelmäßig dort die Daten einzugeben.
[redacted]	RQ2-3	Ease of use	die Anwendung sollte so gestaltet sein, dass auch Patienten, die nicht so oft am Smartphone hängen, sie problemlos nutzen können.
[redacted]	RQ2-3	Ease of use	einen wahren Kern, besonders wenn es um die Zugänglichkeit und Benutzerfreundlichkeit digitaler Gesundheitsanwendungen geht. Es stimmt, dass einige ältere Patienten Schwierigkeiten haben könnten, mit der Komplexität moderner Technologien umzugehen.
[redacted]	RQ2-3	Ease of use	Allerdings bedeutet dies nicht, dass digitale Gesundheitsanwendungen generell ungeeignet für ältere Menschen sind. Vielmehr zeigt es die Notwendigkeit, bei der Entwicklung dieser Technologien auf Einfachheit, intuitive Bedienbarkeit und klare Anleitungen zu achten.
[redacted]	RQ2-3	Ease of use	Wichtig ist dabei, diese Technologien so zu gestalten, dass sie auch für Technik-Neulinge einfach zu nutzen sind.
[redacted]	RQ2-3	Ease of use	Der Schlüssel für den Erfolg solcher Apps liegt in leichtem Zugang, klarer Kommunikation ihres Nutzens und der Unterstützung durch Ärzte.
[redacted]	RQ2-3	Ease of use	die Benutzeroberfläche intuitiv und auch für Technikunerfahrene einfach zu nutzen sein
[redacted]	RQ2-3	Ease of use	Die Benutzerfreundlichkeit und einfache Gestaltung von Apps sind hier entscheidend, um ihre effektive Nutzung zu gewährleisten.
[redacted]	RQ2-3	Ease of use	Es ist wichtig, dass Apps einfache Obereflächen und klare Anweisungen bieten, um Fehler zu minimieren.
[redacted]	RQ2-3	Ease of use	Es muss nicht immer alles notiert werden für den Arztbesuch und man hat nicht mal eben den Zettel mit den letzten Blutzuckerwerten auf dem Wohnzimmertisch liegen gelassen.
[redacted]	RQ2-4	Trust	Der Einfluss ist echt enorm, vor allem wenn man selbstbewusst auftritt.
[redacted]	RQ2-4	Trust	Wenn man selbstsicher auftritt, machen die Patienten meistens auch das, was man ihnen empfiehlt.
[redacted]	RQ2-4	Trust	Also die Empfehlung wird schon hoch geschätzt. Das nennen wir dann Compliance, wenn der Patient das macht, was man vorschlägt. Aber natürlich ist das nicht immer so. Es gibt auch genug Patienten, die komplett widersprechen und auch mal laut werden.
[redacted]	RQ2-4	Trust	wenn der leitende Arzt das für richtig hält, kommt eigentlich wenig Gegenwind
[redacted]	RQ2-4	Trust	Aber, und das ist mir wichtig zu betonen, das alles funktioniert nur mit guter Aufklärung der Patienten
[redacted]	RQ2-4	Trust	Der Einfluss einer medizinischen Empfehlung ist enorm, besonders bei älteren Patienten. Sie vertrauen in der Regel stark auf die Meinung ihrer Ärzte.
[redacted]	RQ2-4	Trust	Das Vertrauensverhältnis zwischen Patienten und Ärzten ist fundamental. Wenn dieses Vertrauen besteht, sind Patienten in der Regel offen dafür, neuen Behandlungsmethoden eine Chance zu geben, selbst wenn diese ihnen zunächst fremd erscheinen.
[redacted]	RQ2-4	Trust	Mehr Technik bedeutet für die Patienten weniger Kontakt mit dem Arzt selbst, mögliche Gespräche fallen flach wenn man sich nur noch auf technische Daten fokussiert.
[redacted]	RQ2-4	Trust	sozialem Umfeld und Erfahrungen mit dem Gesundheitssystem
[redacted]	RQ2-4	Trust	Empfehlung eines vertrauten Arztes und eine klare Kommunikation der Vorteile sind oft entscheidend

[redacted]	RQ2-4	Trust	Es zeigt sich, dass mit dem richtigen Ansatz und Unterstützung ältere Patienten neuen Methoden positiv gegenüberstehen.
[redacted]	RQ2-4	Trust	Ärzte haben einen großen Einfluss auf die Gesundheitsentscheidungen älterer Patienten, vor allem wegen des starken Vertrauensverhältnisses.
[redacted]	RQ2-4	Trust	Es ist eine andere Generation, in der Ärzte noch einen deutlich größeren Stellenwert hatten. Ältere Menschen schätzen traditionelle Werte wie Autorität und Expertise, wodurch ärztliche Empfehlungen besonders wirksam sind.
[redacted]	RQ2-4	Trust	Einfluss beruht auf langjährigem Vertrauen
[redacted]	RQ2-4	Trust	Klare Anweisungen und verständliche Erklärungen von Ärzten motivieren ältere Patienten oft, neuen Behandlungsmethoden zu folgen.
[redacted]	RQ2-4	Trust	Das Vertrauen zwischen Patienten und Ärzten ist tatsächlich fundamental für den Erfolg von Behandlungen.
[redacted]	RQ2-4	Trust	Aus meiner Erfahrung sehe ich, dass Patienten in der Regel den Ratschlägen ihrer Ärzte folgen, auch bei fehlgeschlagenen Methoden und Vorschlägen neuer Behandlungsmethoden.
[redacted]	RQ2-4	Trust	Wenn Patienten das Gefühl haben, dass ihre Ärzte wirklich ihr Bestes im Sinn haben, sind sie offener für deren Empfehlungen.
[redacted]	RQ2-4	Trust	Die Art und Weise, wie Ärzte neue Behandlungen erklären und auf Bedenken eingehen, ist entscheidend für die Akzeptanz.
[redacted]	RQ2-4	Trust	Ein partizipativer Entscheidungsprozess, bei dem Patienten aktiv einbezogen werden, stärkt ihr Vertrauensgefühl.
[redacted]	RQ2-4	Trust	Auch die Unterstützung durch Familie und Freunde spielt eine große Rolle.
[redacted]	RQ2-5	Personal attitudes	Wenn ich merke, dass die traditionellen Behandlungsmethoden nicht so richtig gefruchtet haben oder der Patient aufgeschlossen und technikbegeistert genug erscheint, es mal zu versuchen, dann schlage ich es vor. Und dann entscheiden wir gemeinsam.
[redacted]	RQ2-5	Personal attitudes	Ich denk, das kann echt dazu beitragen, dass die Motivation gestärkt wird bei den Patienten.
[redacted]	RQ2-5	Personal attitudes	In irgendeiner Form, ja, also auch Sachen wie Smartwatches zum Pulsmessen. Das sehe ich tatsächlich immer öfter, sogar bei älteren Leuten.
[redacted]	RQ2-5	Personal attitudes	Ich sehe ja auch eine Verbesserung im Gesundheitsbewusstsein der Patienten also was mit meinem Körper passiert und wie ich selbst aktiv dazu beitragen kann, meinen Zustand zu verbessern und so.
[redacted]	RQ2-5	Personal attitudes	Ich sehe auch, wie die Patienten durch diese Apps ein anderes Bewusstsein für ihre Krankheit entwickeln. Sie werden selbst zu Experten, da sie genau nachvollziehen können, wann und wie sich ihr Körper worauf verhält.
[redacted]	RQ2-5	Personal attitudes	Über eine Krankheit zu erfahren ist einem gewissen Sinne ein Kontrollverlust für jemanden. Durch diese Apps sind die Patient*innen nicht mehr so vollkommen dem Gesundheitssystem ausgeliefert, sondern kriegen das Gefühl, dass sie das selbst auch im Blick haben und etwas tun können.
[redacted]	RQ2-5	Personal attitudes	Einige Patienten sind neugierig und aufgeschlossen, während andere skeptisch bleiben.
[redacted]	RQ2-5	Personal attitudes	Ältere Patienten sind oft offener für neue Behandlungsmethoden und digitale Gesundheitsapps, als man denkt.
[redacted]	RQ2-5	Personal attitudes	Viele sind motiviert, ihre Gesundheit aktiv zu verbessern, aber Datenschutzbedenken und Skepsis gegenüber der Technik können eine Rolle spielen.
[redacted]	RQ2-5	Personal attitudes	Allerdings kann es Vorbehalte geben, bedingt durch Skepsis oder frühere Erfahrungen.

[redacted]	RQ2-5	Personal attitudes	Außerdem ist direktes Feedback über den Behandlungsfortschritt super motivierend und die verbesserte Kommunikation mit Ärzten durch das Teilen von Gesundheitsdaten ist auch ein großer Pluspunkt
[redacted]	RQ3-1	Usability	Definitiv sehe ich Vorteile in einer effektiveren Gestaltung der Arztkontakte, weil einfach mehr Daten vorhanden sind.
[redacted]	RQ3-1	Usability	Aber sobald ich ihnen die Vorteile erkläre, zum Beispiel wie es die Behandlung enger und sogar krankenhausübergreifend machen kann, sind eigentlich alle ziemlich offen und interessiert.
[redacted]	RQ3-1	Usability	Also, vom Feedback der Patienten kann ich berichten, dass sich einige über die Benutzeroberfläche der Apps beschwert haben, weil sie nicht so intuitiv zu bedienen sind, wie sie es von anderen Apps gewohnt sind, also beim Navigieren und so weiter.
[redacted]	RQ3-1	Usability	Ich sehe das Problem tatsächlich eher darin, dass Senioren, die weit von der Technik entfernt sind, sich überfordert fühlen könnten, die Apps zu nutzen
[redacted]	RQ3-1	Usability	Große Vorteile der Apps sehe ich daran, dass der Patient nicht mehr nur in der Klinik betreut wird.
[redacted]	RQ3-1	Usability	Das schafft sozusagen viel Transparenz und wir können gezielter agieren
[redacted]	RQ3-1	Usability	Die kontinuierliche Messung vom Blutzucker hilft uns enorm nachzuvollziehen, wann und weshalb die Werte steigen oder fallen.
[redacted]	RQ3-1	Usability	Gewisse Risiken gibt es auch, wenn zum Beispiel der Patient die App falsch verwendet oder absichtlich falsche Werte eingibt.
[redacted]	RQ3-1	Usability	Es bringt halt eine bessere Datenerfassung bzw eine regelmäßige Datenerfassung
[redacted]	RQ3-1	Usability	Wahrscheinlich ist nicht um Patientenschulungen drumrum zu kommen, damit die Patienten zum Beispiel wissen, was sie bei fehlerhaften Einträgen machen oder wie sie insgesamt die Apps verwenden können, aber was hier die bei Apps gegebenen Fehlerquellen darstellen, sind bei den manuell festgehaltenen Daten die mangelnde Ausführlichkeit und Regelmäßigkeit der Möglichkeit die Daten überhaupt festzuhalten.
[redacted]	RQ3-1	Usability	In manchen Fällen ist die Lesbarkeit auch leider nicht zu unterschätzen.
[redacted]	RQ3-1	Usability	Die größte Hürde besteht in der Nutzung der Apps selbst
[redacted]	RQ3-1	Usability	Überraschend oft werden Apps positiv aufgenommen und es wird sich immer über einen ärztlichen Therapievorschlag gefreut, der nicht - noch eine Tablette am Abendbedeutet.
[redacted]	RQ3-1	Usability	Es gibt ältere Menschen, die, wenn sie können, auf Arztbesuche verzichten und sich freuen autonom eine Übersicht über ihre medizinischen Parameter zu haben.
[redacted]	RQ3-1	Usability	Ebenso auf der anderen Seite das schnelle Vernachlässigen der App, da es einfach Mühe erfordert, regelmäßig dort die Daten einzugeben.
[redacted]	RQ3-1	Usability	Nicht alle Patienten haben die Mittel oder das Wissen, um mit diesen Technologien umzugehen, was zu einer ungleichen Versorgung führen kann.
[redacted]	RQ3-1	Usability	Zudem erlauben sie die frühzeitige Erkennung von Problemen, sodass schneller reagiert werden kann.
[redacted]	RQ3-1	Usability	können diese Apps eine konstante Überwachung und somit eine bessere Kontrolle ermöglichen
[redacted]	RQ3-1	Usability	durch Bewegungserinnerungen oder Ernährungstipps einen gesünderen Lebensstil fördern
[redacted]	RQ3-1	Usability	die Fortschritte der Patienten dokumentieren und die Einhaltung der Therapiepläne unterstützen

[redacted]	RQ3-1	Usability	Wichtig ist, dass die Anwendungen intuitiv und leicht zugänglich sind, um eine breite Akzeptanz und effektive Nutzung zu gewährleisten.
[redacted]	RQ3-1	Usability	Die Anwendung von digitale Gesundheitsanwendungen ist für viele ältere Patienten zu komplex, was zu fehlerhaften Gesundheitsdaten führt und im schlimmsten Fall Therapiefehler verursachen kann. Fr. Winter Diese Aussage hat einen wahren Kern, besonders wenn es um die Zugänglichkeit und Benutzerfreundlichkeit digitaler Gesundheitsanwendungen geht.
[redacted]	RQ3-1	Usability	Es stimmt, dass einige ältere Patienten Schwierigkeiten haben könnten, mit der Komplexität moderner Technologien umzugehen.
[redacted]	RQ3-1	Usability	Das Risiko von Fehlbedienungen und daraus resultierenden fehlerhaften Gesundheitsdaten ist nicht von der Hand zu weisen
[redacted]	RQ3-1	Usability	Vielmehr zeigt es die Notwendigkeit, bei der Entwicklung dieser Technologien auf Einfachheit, intuitive Bedienbarkeit und klare Anleitungen zu achten.
[redacted]	RQ3-1	Usability	Wichtig ist jedoch, dass die Anwendungen auf die individuellen Bedürfnisse der Patienten zugeschnitten sind.
[redacted]	RQ3-1	Usability	Über solche Plattformen können Patienten auch einfacher und schneller Fragen stellen oder Rückmeldungen geben, ohne dafür extra in die Praxis kommen zu müssen.
[redacted]	RQ3-1	Usability	diese Technologien so zu gestalten, dass sie auch für Technik-Neulinge einfach zu nutzen sind.
[redacted]	RQ3-1	Usability	Natürlich war es auch interessant für die Patienten mehr über ihre Krankheit zu erfahren
[redacted]	RQ3-1	Usability	Viele Apps bieten Werkzeuge und Ressourcen, die Patienten dabei unterstützen, ihre eigene Gesundheit aktiver zu managen.
[redacted]	RQ3-1	Usability	Einige Apps ermöglichen das kontinuierliche Monitoring von Gesundheitsparametern.
[redacted]	RQ3-1	Usability	Allerdings sind nicht alle gleich technikaffin, was eine individuelle Unterstützung notwendig macht.
[redacted]	RQ3-1	Usability	müssen Apps durch klinische Studien belegten medizinischen Nutzen bieten, wie Symptomkontrolle oder Förderung eines gesünderen Lebensstils.
[redacted]	RQ3-1	Usability	Schutz der Patientendaten durch höchste Datenschutzstandards unerlässlich
[redacted]	RQ3-1	Usability	sollte die Benutzeroberfläche intuitiv und auch für Technikunerfahrene einfach zu nutzen sein.
[redacted]	RQ3-2	Engagement	Ich denk, das kann echt dazu beitragen, dass die Motivation gestärkt wird bei den Patienten. Insgesamt kann die Compliance verbessert werden, da das Thema Krankheitsbehandlung nicht mehr nur noch im Krankenhaus stattfindet, sondern auch zuhause.
[redacted]	RQ3-2	Engagement	führt dann auch zu Empowerment der Patienten, und einem besseren und selbstbestimmten Gesundheitsbewusstsein.
[redacted]	RQ3-2	Engagement	Durch das ständige Erinnern und Nutzen der Apps werden auch Probleme wie Fehlmessungen reduziert.
[redacted]	RQ3-2	Engagement	Aber dann hab ich in den DiGA-Infomaterialien gelesen, dass man beim Erklären mehr auf die Vorteile eingehen sollte. Und als ich das Ganze dann anders angegangen bin und erklärt habe, was gebraucht wird und dass es eine gute Idee sein könnte, das über das Smartphone aufzuzeichnen, hat es überraschend gut funktioniert.
[redacted]	RQ3-2	Engagement	Außerdem sollten die Apps so gestaltet sein, dass sie keine unnötigen Gesundheitsängste schüren, zum Beispiel durch Vermeidung von Fehlinterpretationen durch die Patienten oder eine zu starke Fokussierung auf einzelne Vitalwerte.
[redacted]	RQ3-2	Engagement	Und ebenfalls haben die Patienten Vorteile, wie Wegfallen vom aufwändigen Stechen der Fingerkuppen.

[redacted]	RQ3-2	Engagement	Es ist auch sehr witzig zu sehen, wieviel Spaß einige daran haben, ständig ihre Werte am Smartphone sehen zu können.
[redacted]	RQ3-2	Engagement	dass einige Apps da auch nicht positiv beitragen, mit Gamification Elementen, Punktetabellen und bunten Bildern.
[redacted]	RQ3-2	Engagement	Eine App ist natürlich auch viel schöner fürs Auge als ein Blatt Papier oder die trockenen Daten, die wir ihnen runterbeten können.
[redacted]	RQ3-2	Engagement	Durch diese Apps sind die Patient*innen nicht mehr so vollkommen dem Gesundheitssystem ausgeliefert, sondern kriegen das Gefühl, dass sie das selbst auch im Blick haben und etwas tun können.
[redacted]	RQ3-2	Engagement	Überraschend oft werden Apps positiv aufgenommen und es wird sich immer über einen ärztlichen Therapievorschlag gefreut, der nicht - noch eine Tablette am Abendbedeutet.
[redacted]	RQ3-2	Engagement	Es gibt ältere Menschen, die, wenn sie können, auf Arztbesuche verzichten und sich freuen autonom eine Übersicht über ihre medizinischen Parameter zu haben.
[redacted]	RQ3-2	Engagement	Es gibt auch ein Risiko der Überinformation oder Fehlinformation.
[redacted]	RQ3-2	Engagement	Nicht alle Patienten haben die Mittel oder das Wissen, um mit diesen Technologien umzugehen, was zu einer ungleichen Versorgung führen kann.
[redacted]	RQ3-2	Engagement	Das führt zu besserer Therapietreue, was gerade bei langwierigen Krankheiten wichtig ist.
[redacted]	RQ3-2	Engagement	das alles funktioniert nur mit guter Aufklärung der Patienten
[redacted]	RQ3-2	Engagement	Wichtig ist, dass die Anwendungen intuitiv und leicht zugänglich sind, um eine breite Akzeptanz und effektive Nutzung zu gewährleisten.
[redacted]	RQ3-2	Engagement	Vielmehr zeigt es die Notwendigkeit, bei der Entwicklung dieser Technologien auf Einfachheit, intuitive Bedienbarkeit und klare Anleitungen zu achten.
[redacted]	RQ3-2	Engagement	Apps können beispielsweise Erinnerungen an die Medikamenteneinnahme senden, was besonders bei komplexen Behandlungsschemata hilfreich ist
[redacted]	RQ3-2	Engagement	diese Technologien so zu gestalten, dass sie auch für Technik-Neulinge einfach zu nutzen sind.
[redacted]	RQ3-2	Engagement	Mehr Technik bedeutet für die Patienten weniger Kontakt mit dem Arzt selbst
[redacted]	RQ3-2	Engagement	Ganz gut, um ehrlich zu sein. Die Patienten konnten ein größeres Bewusstsein für ihre Gesundheit entwickeln und wurden motiviert, aktiver an der Verwaltung ihrer Erkrankungen teilzunehmen.
[redacted]	RQ3-2	Engagement	Durch Erinnerungen und das Tracking von Gesundheitsdaten können sie besser bei ihrem vorgeschriebenen Therapieplan bleiben
[redacted]	RQ3-2	Engagement	Was auch dazukommt ist, dass nicht alle Patienten gleichermaßen Zugang haben oder sind vertraut mit digitalen Technologien.
[redacted]	RQ3-2	Engagement	Der Schlüssel für den Erfolg solcher Apps liegt in leichtem Zugang, klarer Kommunikation ihres Nutzens und der Unterstützung durch Ärzte.
[redacted]	RQ3-2	Engagement	Bereitschaft hängt von verschiedenen Faktoren ab, wie der Einstellung zu Technik, Gesundheitszustand, sozialem Umfeld
[redacted]	RQ3-3	Emotional response	Wenn ich merke, dass die traditionellen Behandlungsmethoden nicht so richtig gefruchtet haben oder der Patient aufgeschlossen und technikbegeistert genug erscheint, es mal zu versuchen, dann schlage ich es vor.

[redacted]	RQ3-3	Emotional response	Die Rückmeldung war eigentlich ziemlich positiv. Ich hab bemerkt, dass die Compliance, also die Zuverlässigkeit bei der Medikamenteneinnahme, sich verbessert hat, weil die Leute aktiver daran erinnert werden.
[redacted]	RQ3-3	Emotional response	Und auch das Selbstmanagement der Patienten mit chronischen Krankheiten wirkt souveräner, als hätten sie ständig eine helfende Hand dabei.
[redacted]	RQ3-3	Emotional response	Ich finde, es verringert einfach die Distanz zwischen Arzt und Patienten.
[redacted]	RQ3-3	Emotional response	Und wie schon gesagt, gibt es den Patienten ein Stück Autonomie zurück. Sie nehmen die Bekämpfung ihrer Krankheit selbst in die Hand und haben ein Tool, das sie dabei unterstützt.
[redacted]	RQ3-3	Emotional response	Der Schutz der persönlichen Daten ist so ein Thema. Was passiert mit den Daten, wer speichert sie und wofür werden sie genutzt?
[redacted]	RQ3-3	Emotional response	Meistens ist es für die Leute was ganz Neues und sie sind anfangs ein bisschen skeptisch, weil es vielleicht erstmal wie ein Spielzeug wirkt.
[redacted]	RQ3-3	Emotional response	Die ersten Patienten waren direkt skeptisch und eher ablehnend.
[redacted]	RQ3-3	Emotional response	nicht so selbstsicher wirken, wenn sie was anordnen. Dann werden die Patienten skeptisch und wollen eine zweite Meinung.
[redacted]	RQ3-3	Emotional response	Wenn man selbstsicher auftritt, machen die Patienten meistens auch das, was man ihnen empfiehlt.
[redacted]	RQ3-3	Emotional response	es wird vielleicht als Spielerei und nicht ernst zu nehmende Sache angesehen.
[redacted]	RQ3-3	Emotional response	Ich sehe auch, wie die Patienten durch diese Apps ein anderes Bewusstsein für ihre Krankheit entwickeln. Sie werden selbst zu Experten, da sie genau nachvollziehen können, wann und wie sich ihr Körper worauf verhält.
[redacted]	RQ3-3	Emotional response	Es ist auch sehr witzig zu sehen, wieviel Spaß einige daran haben, ständig ihre Werte am Smartphone sehen zu können.
[redacted]	RQ3-3	Emotional response	Also die Empfehlung wird schon hoch geschätzt.
[redacted]	RQ3-3	Emotional response	Ich könnte mir vorstellen, dass es viele noch als Gimmick sehen.
[redacted]	RQ3-3	Emotional response	außerdem kann es für viele durch eine benutzerfreundliche Oberfläche auch einfach mehr Spaß machen Daten regelmäßig festzuhalten.
[redacted]	RQ3-3	Emotional response	Oft dauert es eine Weile, bis eine Patient*in den Umgang mit seiner Krankheit durchblickt hat und versteht, welche Daten uns wichtig sind. Eine App ist ein großartiges Tool für den Patienten sich selbst und seine Krankheit zu verstehen und dann ins Arztgespräch die übrig gebliebenen Fragen und die wichtigen Daten mitzubringen.
[redacted]	RQ3-3	Emotional response	Ich habe das Gefühl, viele Patient*innen freuen sich über den Autonomiegewinn durch Apps.
[redacted]	RQ3-3	Emotional response	Es gibt natürlich auch älteren Patient*innen, für die solche Apps sehr neumodischer Kram sind, aber da können solche Apps auch von den Angehörigen für diese übernommen werden.
[redacted]	RQ3-3	Emotional response	Überraschend oft werden Apps positiv aufgenommen und es wird sich immer über einen ärztlichen Therapievorschlag gefreut, der nicht - noch eine Tablette am Abendbedeutet.
[redacted]	RQ3-3	Emotional response	Ebenso auf der anderen Seite das schnelle Vernachlässigen der App, da es einfach Mühe erfordert, regelmäßig dort die Daten einzugeben.
[redacted]	RQ3-3	Emotional response	Sie stärken das Gesundheitsbewusstsein der Patienten, indem diese ihre Gesundheit aktiv mitverfolgen können.

[redacted]	RQ3-3	Emotional response	icht alle Patienten würden gleich aufgeschlossen gegenüber digitalen Neuerungen sein.
[redacted]	RQ3-3	Emotional response	Eine gewisse Komplexität des Themas macht eben stutzig.
[redacted]	RQ3-3	Emotional response	Ganz gut, um ehrlich zu sein. Die Patienten konnten ein größeres Bewusstsein für ihre Gesundheit entwickeln und wurden motiviert, aktiver an der Verwaltung ihrer Erkrankungen teilzunehmen.
[redacted]	RQ3-3	Emotional response	Viele berichteten von einer Verbesserung ihrer Lebensqualität und das Gefühl, auch selber etwas tun zu können.
[redacted]	RQ3-3	Emotional response	Ebenfalls eine Überforderung der Patienten würden wir vermeiden wollen, was eben voraussetzt, dass man sehr viel aufklärt, erklärt, zeigt und bespricht.
[redacted]	RQ3-3	Emotional response	Besonders ältere Patienten zeigen vermehrt Interesse, unterstützt durch die Verbreitung von Smartphones und Empfehlungen von Familie
[redacted]	RQ3-3	Emotional response	Ältere Patienten sind oft offener für neue Behandlungsmethoden und digitale Gesundheitsapps, als man denkt.
[redacted]	RQ3-3	Emotional response	Es zeigt sich, dass mit dem richtigen Ansatz und Unterstützung ältere Patienten neuen Methoden positiv gegenüberstehen.
[redacted]	RQ4-1	Overcome technology use	Es ist auch sehr witzig zu sehen, wieviel Spaß einige daran haben, ständig ihre Werte am Smartphone sehen zu können.
[redacted]	RQ4-1	Overcome technology use	Es gibt natürlich auch älteren Patient*innen, für die solche Apps sehr neumodischer Kram sind, aber da können solche Apps auch von den Angehörigen für diese übernommen werden.
[redacted]	RQ4-1	Overcome technology use	Überraschend oft werden Apps positiv aufgenommen und es wird sich immer über einen ärztlichen Therapievorschlag gefreut, der nicht - noch eine Tablette am Abendbedeutet.
[redacted]	RQ4-1	Overcome technology use	Das erledige ich meist im Dialog und zeige die Optionen auf. Wenn Interesse besteht, eigenständig eine App auszuprobieren, unterstütze ich und bereite alles gemeinsam vor, sodass die Bürokratie auch mit den Krankenkassen reibungsfrei funktioniert
[redacted]	RQ4-1	Overcome technology use	Ihre Bereitschaft hängt von verschiedenen Faktoren ab, wie der Einstellung zu Technik, Gesundheitszustand, sozialem Umfeld
[redacted]	RQ4-1	Overcome technology use	Die Empfehlung eines vertrauten Arztes und eine klare Kommunikation der Vorteile sind oft entscheidend
[redacted]	RQ4-1	Overcome technology use	Technische Herausforderungen und Bedienbarkeit sind wichtige Punkte, und Unterstützung durch Familie und Freunde fördert die Akzeptanz.
[redacted]	RQ4-1	Overcome technology use	Klare Anweisungen und verständliche Erklärungen von Ärzten motivieren ältere Patienten
[redacted]	RQ4-1	Overcome technology use	In solchen Fällen hilft eine geduldige Kommunikation, unterstützt von Familie oder Pflegepersonal, Bedenken zu mindern.
[redacted]	RQ4-1	Overcome technology use	Respekt, Vertrauen und klare Kommunikation sind entscheidend, um den Einfluss von medizinischen Empfehlungen positiv zu nutzen.
[redacted]	RQ4-1	Overcome technology use	in partizipativer Entscheidungsprozess, bei dem Patienten aktiv einbezogen werden, stärkt ihr Vertrauensgefühl.
[redacted]	RQ4-1	Overcome technology use	Auch die Unterstützung durch Familie und Freunde spielt eine große Rolle.
[redacted]	RQ4-2	Enhance learning	meistens ergibt sich das im Laufe des Gesprächs.

[redacted]	RQ4-2	Enhance learning	Durch das ständige Erinnern und Nutzen der Apps werden auch Probleme wie Fehlmessungen reduziert.
[redacted]	RQ4-2	Enhance learning	Vieles basiert ja auf Gesprächen
[redacted]	RQ4-2	Enhance learning	Aber mit den Apps können die Patienten uns direkt zeigen, was sie gemacht haben und wie es ihnen hilft
[redacted]	RQ4-2	Enhance learning	Ich sehe auch, wie die Patienten durch diese Apps ein anderes Bewusstsein für ihre Krankheit entwickeln.
[redacted]	RQ4-2	Enhance learning	Wir müssen die Auswertungen der Apps lesen, die Patienten schulen und alles klären.
[redacted]	RQ4-2	Enhance learning	Wahrscheinlich ist nicht um Patientenschulungen drumrum zu kommen, damit die Patienten zum Beispiel wissen, was sie bei fehlerhaften Einträgen machen oder wie sie insgesamt die Apps verwenden können
[redacted]	RQ4-2	Enhance learning	Es zeigt sich, dass mit dem richtigen Ansatz und Unterstützung ältere Patienten neuen Methoden positiv gegenüberstehen.
[redacted]	RQ4-3	Ensuring realization of benefits	Vorteile bei Sachen wie Medikamenteneinnahme oder Therapietreue
[redacted]	RQ4-3	Ensuring realization of benefits	Wir müssen uns nicht mehr nur auf das Wort der Patienten verlassen und können viel gezielter eingreifen. Ich finde, es verringert einfach die Distanz zwischen Arzt und Patienten.
[redacted]	RQ4-3	Ensuring realization of benefits	Definitiv sehe ich Vorteile in einer effektiveren Gestaltung der Arztkontakte, weil einfach mehr Daten vorhanden sind.
[redacted]	RQ4-3	Ensuring realization of benefits	Und wie schon gesagt, gibt es den Patienten ein Stück Autonomie zurück. Sie nehmen die Bekämpfung ihrer Krankheit selbst in die Hand und haben ein Tool, das sie dabei unterstützt.
[redacted]	RQ4-3	Ensuring realization of benefits	Aber sobald ich ihnen die Vorteile erkläre, zum Beispiel wie es die Behandlung enger und sogar krankenhausübergreifend machen kann, sind eigentlich alle ziemlich offen und interessiert.
[redacted]	RQ4-3	Ensuring realization of benefits	in den DiGA-Infomaterialien gelesen, dass man beim Erklären mehr auf die Vorteile eingehen sollte. Und als ich das Ganze dann anders angegangen bin und erklärt habe, was gebraucht wird und dass es eine gute Idee sein könnte, das über das Smartphone aufzuzeichnen, hat es überraschend gut funktioniert.
[redacted]	RQ4-3	Ensuring realization of benefits	Große Vorteile der Apps sehe ich daran, dass der Patient nicht mehr nur in der Klinik betreut wird.
[redacted]	RQ4-3	Ensuring realization of benefits	Das schafft sozusagen viel Transparenz und wir können gezielter agieren.
[redacted]	RQ4-3	Ensuring realization of benefits	Ich habe bisher die besten Ergebnisse bei Diabetespatienten gesehen. Die kontinuierliche Messung vom Blutzucker hilft uns enorm nachzuvollziehen, wann und weshalb die Werte steigen oder fallen. Und ebenfalls haben die Patienten Vorteile, wie Wegfallen vom aufwändigen Stechen der Fingerkuppen.
[redacted]	RQ4-3	Ensuring realization of benefits	Wahrscheinlich ist nicht um Patientenschulungen drumrum zu kommen, damit die Patienten zum Beispiel wissen, was sie bei fehlerhaften Einträgen machen oder wie sie insgesamt die Apps verwenden können, aber was hier die bei Apps gegebenen Fehlerquellen darstellen, sind bei den manuell festgehaltenen Daten die mangelnde Ausführlichkeit und Regelmäßigkeit der Möglichkeit die Daten überhaupt festzuhalten.
[redacted]	RQ4-3	Ensuring realization of benefits	Eine App ist ein großartiges Tool für den Patienten sich selbst und seine Krankheit zu verstehen und dann ins Arztgespräch die übrig gebliebenen Fragen und die wichtigen Daten mitzubringen.
[redacted]	RQ4-3	Ensuring realization of benefits	Durch diese Apps sind die Patient*innen nicht mehr so vollkommen dem Gesundheitssystem ausgeliefert, sondern kriegen das Gefühl, dass sie das selbst auch im Blick haben und etwas tun können.
[redacted]	RQ4-3	Ensuring realization of benefits	Überraschend oft werden Apps positiv aufgenommen und es wird sich immer über einen ärztlichen Therapievorschlag gefreut, der nicht - noch eine Tablette am Abend bedeutet.

[redacted]	RQ4-3	Ensuring realization of benefits	Sie können die Lebensqualität verbessern, indem sie die Selbstständigkeit fördern und die soziale Einbindung unterstützen.
[redacted]	RQ4-3	Ensuring realization of benefits	esonders ältere Patienten zeigen vermehrt Interesse, unterstützt durch die Verbreitung von Smartphones und Empfehlungen von Familie
[redacted]	RQ4-3	Ensuring realization of benefits	Technische Herausforderungen und Bedienbarkeit sind wichtige Punkte, und Unterstützung durch Familie und Freunde fördert die Akzeptanz.
[redacted]	RQ4-3	Ensuring realization of benefits	In solchen Fällen hilft eine geduldige Kommunikation, unterstützt von Familie oder Pflegepersonal, Bedenken zu mindern.
[redacted]	RQ4-3	Ensuring realization of benefits	Apps können eine bessere Kommunikation für die Patienten bieten. Es kann kommuniziert werden ohne, dass man vor Ort sich sehen muss. Es muss nicht immer alles notiert werden für den Arztbesuch und man hat nicht mal eben den Zettel mit den letzten Blutzuckerwerten auf dem Wohnzimmertisch liegen gelassen.
[redacted]	RQ4-3	Ensuring realization of benefits	Es hilft die Daten übersichtlich vor sich zu haben und wenn ich sie dann in der App zusammenfassend anzeigen lassen kann
[redacted]	RQ4-3	Ensuring realization of benefits	Auch die Unterstützung durch Familie und Freunde spielt eine große Rolle.
[redacted]	RQ5-1	Seniors recognition	Durch das ständige Erinnern und Nutzen der Apps werden auch Probleme wie Fehlmessungen reduziert.
[redacted]	RQ5-1	Seniors recognition	Und wie schon gesagt, gibt es den Patienten ein Stück Autonomie zurück. Sie nehmen die Bekämpfung ihrer Krankheit selbst in die Hand und haben ein Tool, das sie dabei unterstützt.
[redacted]	RQ5-1	Seniors recognition	Aber sobald ich ihnen die Vorteile erkläre, zum Beispiel wie es die Behandlung enger und sogar krankenhausübergreifend machen kann, sind eigentlich alle ziemlich offen und interessiert.
[redacted]	RQ5-1	Seniors recognition	Wenn die Apps korrekt genutzt werden, könnten wir viel schneller auf Missbrauch oder Ähnliches reagieren und eingreifen.
[redacted]	RQ5-1	Seniors recognition	Wenn der Nutzen klar verstanden wird, dann werden auch andere Methoden gut aufgenommen
[redacted]	RQ5-1	Seniors recognition	Große Vorteile der Apps sehe ich daran, dass der Patient nicht mehr nur in der Klinik betreut wird. Oft ist es ja so, dass wir nur eine Momentaufnahme sehen, für die Zeit in der der Patient hier ist. Aber mit den Apps können wir schwarz auf weiß Daten einsehen, die zeigen was der Patient sonst tut.
[redacted]	RQ5-1	Seniors recognition	Ich sehe auch, wie die Patienten durch diese Apps ein anderes Bewusstsein für ihre Krankheit entwickeln. Sie werden selbst zu Experten, da sie genau nachvollziehen können, wann und wie sich ihr Körper worauf verhält.
[redacted]	RQ5-1	Seniors recognition	Es ist auch sehr witzig zu sehen, wieviel Spaß einige daran haben, ständig ihre Werte am Smartphone sehen zu können.
[redacted]	RQ5-1	Seniors recognition	Oft dauert es eine Weile, bis eine Patient*in den Umgang mit seiner Krankheit durchblickt hat und versteht, welche Daten uns wichtig sind.
[redacted]	RQ5-1	Seniors recognition	Eine App ist ein großartiges Tool für den Patienten sich selbst und seine Krankheit zu verstehen und dann ins Arztgespräch die übrig gebliebenen Fragen und die wichtigen Daten mitzubringen.
[redacted]	RQ5-1	Seniors recognition	Ich habe das Gefühl, viele Patient*innen freuen sich über den Autonomiegewinn durch Apps. Über eine Krankheit zu erfahren ist einem gewissen Sinne ein Kontrollverlust für jemanden. Durch diese Apps sind die Patient*innen nicht mehr so vollkommen dem Gesundheitssystem ausgeliefert, sondern kriegen das Gefühl, dass sie das selbst auch im Blick haben und etwas tun können.
[redacted]	RQ5-1	Seniors recognition	Es gibt ältere Menschen, die, wenn sie können, auf Arztbesuche verzichten und sich freuen autonom eine Übersicht über ihre medizinischen Parameter zu haben.
[redacted]	RQ5-1	Seniors recognition	Sie stärken das Gesundheitsbewusstsein der Patienten, indem diese ihre Gesundheit aktiv mitverfolgen können. Das führt zu besserer Therapietreue, was gerade bei langwierigen Krankheiten wichtig ist. Zudem erlauben sie die frühzeitige Erkennung von Problemen, sodass schneller reagiert werden kann.

[redacted]	RQ5-1	Seniors recognition	Um diese Bedenken zu adressieren, sind klare Richtlinien, fundierte Schulungen und eine transparente Kommunikation über den Nutzen und die Grenzen digitaler Gesundheitsanwendungen notwendig.
[redacted]	RQ5-1	Seniors recognition	Es bietet ja den Vorteil von mehr Autonomie bei den Patienten sich besser mit ihrer Krankheit auseinandersetzen zu können und für mich als Arzt einen Einblick in den Alltag, der außerhalb von dem stattfindet, was ich in der Praxis mitbekomme
[redacted]	RQ5-1	Seniors recognition	Natürlich war es auch interessant für die Patienten mehr über ihre Krankheit zu erfahren, auch ein Diabetes zeigt sich bei jedem Patienten individuell.
[redacted]	RQ5-1	Seniors recognition	Chronische Erkrankungen zum Beispiel, wo man enormen Mehrwert erhält. Oder bei der Rehabilitation und Genesung nach Operationen oder bei der Genesung von Verletzungen.
[redacted]	RQ5-1	Seniors recognition	Die Empfehlung eines vertrauten Arztes und eine klare Kommunikation der Vorteile sind oft entscheidend.
[redacted]	RQ5-1	Seniors recognition	personalisierte Erinnerungen für Medikamenteneinnahme und Termine, ermöglichen es Patienten, ihre Gesundheitsdaten selbst zu überwachen, und bieten Infos über Krankheiten und Behandlungsmöglichkeiten
[redacted]	RQ5-1	Seniors recognition	Es muss nicht immer alles notiert werden für den Arztbesuch und man hat nicht mal eben den Zettel mit den letzten Blutzuckerwerten auf dem Wohnzimmertisch liegen gelassen.
[redacted]	RQ5-2	Involvement by medical staff	Als Arzt hab ich natürlich die Verantwortung für die sensiblen Daten meiner Patienten
[redacted]	RQ5-2	Involvement by medical staff	Wenn genau aufgezeichnet wird, was gegessen wird oder wann Medikamente genommen wurden, hilft uns das enorm.
[redacted]	RQ5-2	Involvement by medical staff	Wir müssen uns nicht mehr nur auf das Wort der Patienten verlassen und können viel gezielter eingreifen. Ich finde, es verringert einfach die Distanz zwischen Arzt und Patienten.
[redacted]	RQ5-2	Involvement by medical staff	Definitiv sehe ich Vorteile in einer effektiveren Gestaltung der Arztkontakte, weil einfach mehr Daten vorhanden sind.
[redacted]	RQ5-2	Involvement by medical staff	Als Patient hat man da oft keinen genauen Überblick, und bei einer chronischen Krankheit ist man eher bereit, das zu akzeptieren, besonders wenn der Arzt es empfiehlt. Da müssen wir wirklich genauer hinschauen und für Aufklärung sorgen.
[redacted]	RQ5-2	Involvement by medical staff	Aber sobald ich ihnen die Vorteile erkläre, zum Beispiel wie es die Behandlung enger und sogar krankenhausübergreifend machen kann, sind eigentlich alle ziemlich offen und interessiert.
[redacted]	RQ5-2	Involvement by medical staff	ie schon gesagt, ist es einfach ein weiteres Werkzeug, das uns hilft zu verstehen, was mit den Patienten passiert, wenn sie unser Haus verlassen.
[redacted]	RQ5-2	Involvement by medical staff	Und da ist so eine App, die schwarz auf weiß festhält, was passiert und was gemacht wird, echt hilfreich.
[redacted]	RQ5-2	Involvement by medical staff	Wenn der Nutzen klar verstanden wird, dann werden auch andere Methoden gut aufgenommen
[redacted]	RQ5-2	Involvement by medical staff	Negativ belastet ist damit nur die Tatsache, dass wir mehr Arbeit haben.
[redacted]	RQ5-2	Involvement by medical staff	Wir müssen die Auswertungen der Apps lesen, die Patienten schulen und alles klären.
[redacted]	RQ5-2	Involvement by medical staff	Wahrscheinlich ist nicht um Patientenschulungen drumrum zu kommen, damit die Patienten zum Beispiel wissen, was sie bei fehlerhaften Einträgen machen oder wie sie insgesamt die Apps verwenden können
[redacted]	RQ5-2	Involvement by medical staff	Eine App ist ein großartiges Tool für den Patienten sich selbst und seine Krankheit zu verstehen und dann ins Arztgespräch die übrig gebliebenen Fragen und die wichtigen Daten mitzubringen.
[redacted]	RQ5-2	Involvement by medical staff	Die menschliche Komponente in der Pflege und medizinischen Versorgung bleibt unersetzlich. Digitale Anwendungen können unterstützen, aber nicht den Bedarf an qualifiziertem medizinischem Personal ersetzen

[redacted]	RQ5-2	Involvement by medical staff	Es bietet ja den Vorteil von mehr Autonomie bei den Patienten sich besser mit ihrer Krankheit auseinandersetzen zu können und für mich als Arzt einen Einblick in den Alltag, der außerhalb von dem stattfindet, was ich in der Praxis mitbekomme
[redacted]	RQ5-2	Involvement by medical staff	Eine gewisse Komplexität des Themas macht eben stutzig. Neue Verordnungsprozesse und die Frage, wie sich diese neuen Werkzeuge in die bestehenden Abläufe meiner Praxis integrieren lassen würden
[redacted]	RQ5-2	Involvement by medical staff	Ebenso darf das Ganze keine großen zusätzlichen administrativen Lasten mit sich bringen.
[redacted]	RQ5-2	Involvement by medical staff	Die Entscheidung, eine Apps zu verschreiben, treffe ich nach Bewertung der medizinischen Eignung. Also schaue ich sowohl die potenziellen Vorteile als auch mögliche Einschränkungen
[redacted]	RQ5-2	Involvement by medical staff	Die Empfehlung eines vertrauten Arztes und eine klare Kommunikation der Vorteile sind oft entscheidend.
[redacted]	RQ5-2	Involvement by medical staff	In solchen Fällen hilft eine geduldige Kommunikation, unterstützt von Familie oder Pflegepersonal, Bedenken zu mindern.
[redacted]	RQ5-2	Involvement by medical staff	Daher sollte es sehr gute Überprüfungsmechanismen geben und Patientenschulungen angeboten werden, um korrekte Nutzung zu fördern
[redacted]	RQ5-2	Involvement by medical staff	Es hilft die Daten übersichtlich vor sich zu haben und wenn ich sie dann in der App zusammenfassend anzeigen lassen kann
[redacted]	RQ5-2	Involvement by medical staff	Klar gibt es auch Herausforderungen wie technische Hürden oder Datenschutzbedenken, aber mit der richtigen Herangehensweise können Apps die Kommunikation zwischen Praxen und Patienten wirklich verbessern.
[redacted]	RQ5-2	Involvement by medical staff	Dieses Vertrauen baut sich über die Zeit auf, basierend auf positiven Erfahrungen und der Kompetenz des Arztes.
[redacted]	RQ6-1	Observed behaviours and self reported abilities	Durch das ständige Erinnern und Nutzen der Apps werden auch Probleme wie Fehlmessungen reduziert. Und wie schon gesagt, gibt es den Patienten ein Stück Autonomie zurück. Sie nehmen die Bekämpfung ihrer Krankheit selbst in die Hand und haben ein Tool, das sie dabei unterstützt.
[redacted]	RQ6-1	Observed behaviours and self reported abilities	Also, vom Feedback der Patienten kann ich berichten, dass sich einige über die Benutzeroberfläche der Apps beschwert haben, weil sie nicht so intuitiv zu bedienen sind, wie sie es von anderen Apps gewohnt sind, also beim Navigieren und so weiter.
[redacted]	RQ6-1	Observed behaviours and self reported abilities	sollten die Apps so gestaltet sein, dass sie keine unnötigen Gesundheitsängste schüren, zum Beispiel durch Vermeidung von Fehlinterpretationen durch die Patienten oder eine zu starke Fokussierung auf einzelne Vitalwerte.
[redacted]	RQ6-1	Observed behaviours and self reported abilities	Ich sehe das Problem tatsächlich eher darin, dass Senioren, die weit von der Technik entfernt sind, sich überfordert fühlen könnten, die Apps zu nutzen.
[redacted]	RQ6-1	Observed behaviours and self reported abilities	Ich sehe auch, wie die Patienten durch diese Apps ein anderes Bewusstsein für ihre Krankheit entwickeln. Sie werden selbst zu Experten, da sie genau nachvollziehen können, wann und wie sich ihr Körper worauf verhält.
[redacted]	RQ6-1	Observed behaviours and self reported abilities	Es ist auch sehr witzig zu sehen, wieviel Spaß einige daran haben, ständig ihre Werte am Smartphone sehen zu können.
[redacted]	RQ6-1	Observed behaviours and self reported abilities	Ich habe das Gefühl, viele Patient*innen freuen sich über den Autonomiegewinn durch Apps. Über eine Krankheit zu erfahren ist einem gewissen Sinne ein Kontrollverlust für jemanden. Durch diese Apps sind die Patient*innen nicht mehr so vollkommen dem Gesundheitssystem ausgeliefert, sondern kriegen das Gefühl, dass sie das selbst auch im Blick haben und etwas tun können.
[redacted]	RQ6-1	Observed behaviours and self reported abilities	Das spiegelt meine Erfahrungen recht gut wider. Das Vertrauensverhältnis zwischen Patienten und Ärzten ist fundamental. Wenn dieses Vertrauen besteht, sind Patienten in der Regel offen dafür, neuen Behandlungsmethoden eine Chance zu geben, selbst wenn diese ihnen zunächst fremd erscheinen.
[redacted]	RQ6-1	Observed behaviours and	Wichtig ist dabei, diese Technologien so zu gestalten, dass sie auch für Technik-Neulinge einfach zu nutzen sind.

		self reported abilities	
[redacted]	RQ6-1	Observed behaviours and self reported abilities	Es bietet ja den Vorteil von mehr Autonomie bei den Patienten sich besser mit ihrer Krankheit auseinandersetzen zu können
[redacted]	RQ6-1	Observed behaviours and self reported abilities	Mehr Technik bedeutet für die Patienten weniger Kontakt mit dem Arzt selbst, mögliche Gespräche fallen flach
[redacted]	RQ6-1	Observed behaviours and self reported abilities	Die Tatsache, dass diese Apps einer strengen Prüfung unterzogen werden, gibt mir als Arzt ein hohes Maß an Vertrauen in ihre Zuverlässigkeit und Sicherheit.
[redacted]	RQ6-1	Observed behaviours and self reported abilities	Auch für ältere Menschen gibt es sinnvolle Anwendungsfälle: Sie können die Lebensqualität verbessern, indem sie die Selbstständigkeit fördern
[redacted]	RQ6-1	Observed behaviours and self reported abilities	Allerdings sind nicht alle gleich technikaffin, was eine individuelle Unterstützung notwendig macht.
[redacted]	RQ6-1	Observed behaviours and self reported abilities	habe ich festgestellt, dass vor allem Patienten, die schon technikaffin sind, digitale Gesundheitsapps auf eigene Faust nutzen, egal welchen Alters.
[redacted]	RQ6-1	Observed behaviours and self reported abilities	Viele sind motiviert, ihre Gesundheit aktiv zu verbessern, aber Datenschutzbedenken und Skepsis gegenüber der Technik können eine Rolle spielen.
[redacted]	RQ6-1	Observed behaviours and self reported abilities	sollte die Benutzeroberfläche intuitiv und auch für Technikunerfahrene einfach zu nutzen sein.
[redacted]	RQ6-1	Observed behaviours and self reported abilities	Herausforderungen wie Benutzerfreundlichkeit für Technik-Ungeübte, Datenschutz und die Erhaltung des persönlichen Kontakts nie vergessen werden.
[redacted]	RQ7-1	Challenges	In irgendeiner Form, ja, also auch Sachen wie Smartwatches zum Pulsmessen. Das sehe ich tatsächlich immer öfter, sogar bei älteren Leuten.
[redacted]	RQ7-1	Challenges	Wahrscheinlich ist nicht um Patientenschulungen drumrum zu kommen, damit die Patienten zum Beispiel wissen, was sie bei fehlerhaften Einträgen machen oder wie sie insgesamt die Apps verwenden können, aber was hier die bei Apps gegebenen Fehlerquellen darstellen, sind bei den manuell festgehaltenen Daten die mangelnde Ausführlichkeit und Regelmäßigkeit der Möglichkeit die Daten überhaupt festzuhalten.
[redacted]	RQ7-1	Challenges	In manchen Fällen ist die Lesbarkeit auch leider nicht zu unterschätzen.
[redacted]	RQ7-1	Challenges	Es gibt natürlich auch älteren Patient*innen, für die solche Apps sehr neumodischer Kram sind, aber da können solche Apps auch von den Angehörigen für diese übernommen werden.
[redacted]	RQ7-1	Challenges	Neben den bereits genannten Bedenken hinsichtlich Datenschutz und Wirksamkeit sehe ich eine große Herausforderung in der digitalen Kluft. Nicht alle Patienten haben die Mittel oder das Wissen, um mit diesen Technologien umzugehen, was zu einer ungleichen Versorgung führen kann.
[redacted]	RQ7-1	Challenges	Es stimmt, dass einige ältere Patienten Schwierigkeiten haben könnten, mit der Komplexität moderner Technologien umzugehen.
[redacted]	RQ7-1	Challenges	Ein weiterer Grund, Apps weiter zu verschreiben, war das positive Feedback der Patienten selbst. Viele berichteten von einer Verbesserung ihrer Lebensqualität und das Gefühl, auch selber etwas tun zu können.
[redacted]	RQ7-1	Challenges	Besonders ältere Patienten zeigen vermehrt Interesse, unterstützt durch die Verbreitung von Smartphones und Empfehlungen von Familie und Ärzten.

[redacted]	RQ7-1	Challenges	Technische Herausforderungen und Bedienbarkeit sind wichtige Punkte, und Unterstützung durch Familie und Freunde fördert die Akzeptanz.
[redacted]	RQ7-1	Challenges	Ich sehe es als meine Aufgabe, Patienten über Apps aufzuklären, stehe aber manchmal vor der Herausforderung, auf spezifische Fragen, besonders zu technisch komplexen Apps, einzugehen.
[redacted]	RQ7-1	Challenges	Vor allem, wenn sie dann auch noch nicht an digitale Geräte gewöhnt sind. Die Benutzerfreundlichkeit und einfache Gestaltung von Apps sind hier entscheidend
[redacted]	RQ8-1	Age-specific Requirements	In manchen Fällen ist die Lesbarkeit auch leider nicht zu unterschätzen.
[redacted]	RQ8-1	Age-specific Requirements	Überraschend oft werden Apps positiv aufgenommen und es wird sich immer über einen ärztlichen Therapievorschlag gefreut, der nicht - noch eine Tablette am Abendbedeutet.
[redacted]	RQ8-1	Age-specific Requirements	Es gibt ältere Menschen, die, wenn sie können, auf Arztbesuche verzichten und sich freuen autonom eine Übersicht über ihre medizinischen Parameter zu haben.
[redacted]	RQ8-1	Age-specific Requirements	Natürlich gibt es eine gewisse Skepsis, vor allem bei neuen Technologien. Aber mit der richtigen Herangehensweise, Geduld und klaren Erklärungen, wie diese Methoden ihre Lebensqualität verbessern können, sind viele bereit, es zumindest zu versuchen
[redacted]	RQ8-1	Age-specific Requirements	Der Einfluss einer medizinischen Empfehlung ist enorm, besonders bei älteren Patienten. Sie vertrauen in der Regel stark auf die Meinung ihrer Ärzte.
[redacted]	RQ8-1	Age-specific Requirements	Es stimmt, dass einige ältere Patienten Schwierigkeiten haben könnten, mit der Komplexität moderner Technologien umzugehen.
[redacted]	RQ8-1	Age-specific Requirements	Das Risiko von Fehlbedienungen und daraus resultierenden fehlerhaften Gesundheitsdaten ist nicht von der Hand zu weisen.
[redacted]	RQ8-1	Age-specific Requirements	Vielmehr zeigt es die Notwendigkeit, bei der Entwicklung dieser Technologien auf Einfachheit, intuitive Bedienbarkeit und klare Anleitungen zu achten.
[redacted]	RQ8-1	Age-specific Requirements	Besonders ältere Patienten zeigen vermehrt Interesse, unterstützt durch die Verbreitung von Smartphones und Empfehlungen von Familie
[redacted]	RQ8-1	Age-specific Requirements	Es ist eine andere Generation, in der Ärzte noch einen deutlich größeren Stellenwert hatten.
[redacted]	RQ8-1	Age-specific Requirements	Ältere Menschen schätzen traditionelle Werte wie Autorität und Expertise, wodurch ärztliche Empfehlungen besonders wirksam sind.
[redacted]	RQ8-1	Age-specific Requirements	Klare Anweisungen und verständliche Erklärungen von Ärzten motivieren ältere Patienten
[redacted]	RQ8-1	Age-specific Requirements	Es gibt Bedenken, dass die Nutzung digitaler Gesundheitsanwendungen für einige ältere Menschen herausfordernd sein kann. Vor allem, wenn sie dann auch noch nicht an digitale Geräte gewöhnt sind.
[redacted]	RQ8-1	Age-specific Requirements	Die Benutzerfreundlichkeit und einfache Gestaltung von Apps sind hier entscheidend
[redacted]	RQ8-1	Age-specific Requirements	Es ist wichtig, dass Apps einfache Obereflächen und klare Anweisungen bieten, um Fehler zu minimieren
[redacted]	RQ8-1	Age-specific Requirements	Es ist entscheidend, ältere Patienten beim Gebrauch von Apps sorgfältig zu überwachen und zu unterstützen

Appendix for Methodology II: Empirical Quantitative Data Collection

German original version survey via microsoft forms A:

Nutzung und Akzeptanz von Digitalen Gesundheitsanwendungen durch Senioren A

Sehr geehrte Teilnehmerinnen und Teilnehmer,

im Rahmen meiner Masterarbeit an der Hochschule Neu-Ulm führe ich eine Studie zum Thema Digitalen Gesundheitsanwendungen durch. Ihr Beitrag ist von unschätzbarem Wert, um ein tieferes Verständnis über die Gesundheitsversorgung von morgen zu erlangen.
Die Umfrage umfasst 24 Fragen und wird voraussichtlich 6 Minuten Ihrer Zeit in Anspruch nehmen. Bitte beantworten Sie alle Fragen so ehrlich und genau wie möglich. Ihre Antworten werden anonym behandelt und ausschließlich für wissenschaftliche Zwecke verwendet.

Datenschutz und Anonymität:
Wir legen großen Wert auf den Schutz Ihrer Daten und Ihre Privatsphäre. Alle erhobenen Daten werden vertraulich behandelt, anonym ausgewertet und nicht an Dritte weitergegeben. Die Teilnahme an dieser Umfrage ist freiwillig, und Sie können diese jederzeit ohne Angabe von Gründen abbrechen.

Kontakt:
Sollten Sie Fragen zur Umfrage oder zur Studie haben, können Sie mich gerne unte[redacted]
kontaktieren.
Mit Ihrer Teilnahme an dieser Umfrage erklären Sie sich mit den oben genannten Bedingungen einverstanden und leisten einen wertvollen Beitrag zu meiner Forschung. Ich danke Ihnen im Voraus für Ihre Zeit und Ihre Unterstützung.

Mit freundlichen Grüßen,

[redacted]

Erforderlich

Demografische Daten

1. Wie alt sind Sie? *

- ◯ Unter 65
- ◯ 65-74
- ◯ 75-84
- ◯ 85 und älter

2. Welches Geschlecht haben Sie? *

- ◯ Weiblich
- ◯ Männlich
- ◯ Bevorzuge keine Angabe

3. Wie schätzen Sie ihr Wissen über ihre eigene Gesundheit ein? *

1	2	3	4	5

Sehr schlecht Sehr gut

4. Was ist Ihr höchster Bildungsabschluss? *

- ◯ Kein Schulabschluss
- ◯ Haupt-/Volksschulabschluss
- ◯ Mittlere Reife / Realschulabschluss
- ◯ (Fach-)Abitur
- ◯ Hochschulabschluss
- ◯ Sonstiges

Vorerfahrungen mit Technologie und Apps

5. Nutzen Sie ein Smartphone oder Tablet? *

- ◯ Ja
- ◯ Nein

6. Welche Art von Apps nutzen Sie? (Mehrere Antworten möglich)

- ☐ Gesundheitsapps
- ☐ Fitness-Apps
- ☐ Nachrichten-Apps
- ☐ Soziale Medien
- ☐ Spiele
- ☐ Telefonie
- ☐ Keine
- ☐ Sonstiges

7. Wie würden Sie Ihre Erfahrung mit Smartphones oder Tablets beschreiben? *

- ◯ Absoluter Anfänger/in (Ich habe kaum oder keine Erfahrung mit Smartphones oder Tablets.)
- ◯ Anfänger/in (Ich nutze grundlegende Funktionen, aber fühle mich noch unsicher.)
- ◯ Fortgeschrittene/r (Ich nutze regelmäßig verschiedene Funktionen und Apps, habe aber hin und wieder noch Fragen.)
- ◯ Erfahren (Ich bin vertraut mit den meisten Funktionen und Apps und kann Probleme selbst lösen.)
- ◯ Experte/in (Ich kenne mich ausgezeichnet aus und kann anderen Nutzern Hilfe und Tipps geben.)

8. Wie häufig verwenden Sie Gesundheits- oder Fitnessapps? *

- ◯ Nie
- ◯ Selten (1x im Monat)
- ◯ Eher Selten (paar Mal im Monat)
- ◯ Moderat (1x die Woche)
- ◯ Eher häufig (Mehrmals die Woche)
- ◯ Häufig (Täglich)

9. Welche Geräte nutzen Sie für ihre Gesundheit? (Mehrere Antworten möglich) *

- ☐ Keine Geräte - Ich nutze keine Geräte oder Hilfsmittel für meine Gesundheit.
- ☐ Basisgeräte - Ich nutze traditionelle Geräte wie Blutdruckmessgeräte oder Thermometer ohne digitale Anzeige.
- ☐ Digitale Basisgeräte - Ich verwende digitale Geräte wie elektronische Blutdruckmessgeräte oder digitale Thermometer.
- ☐ Wearables - Ich trage Geräte wie Fitness-Armbänder oder Smartwatches, die grundlegende Gesundheitsdaten erfassen.
- ☐ Mobile Gesundheits-Apps - Ich nutze Apps auf meinem Smartphone oder Tablet für die Gesundheitsüberwachung, wie z.B. Schrittzähler oder Ernährungsprotokolle.
- ☐ Vernetzte Gesundheitsgeräte - Ich verwende Geräte, die sich mit dem Internet verbinden lassen, wie z.B. smarte Waagen oder Blutzuckermessgeräte.
- ☐ Integrierte Gesundheitssysteme - Ich nutze fortgeschrittene Systeme wie Telemedizin-Plattformen oder vernetzte Geräte, die Daten automatisch an meinen Arzt oder ein Gesundheitsportal senden.
- ☐ Umfassende Gesundheitsmanagement-Plattformen - Ich verwende komplexe Systeme, die verschiedene Datenquellen integrieren, wie z.B. elektronische Gesundheitsakte (eGA) oder spezialisierte DiGA-Apps.

Wahrnehmung und Akzeptanz von digitalen Gesundheitsanwendungen

10. Haben Sie schon einmal von verschreibungspflichtigen Digitalen Gesundheitsanwendungen (DiGA oder auch App auf Rezept) gehört, die speziell für die Gesundheitsvorsorge entwickelt wurden? *

- ◯ Ja
- ◯ Nein

11. Würden Sie in Betracht ziehen, eine verschreibungspflichtige App zur Unterstützung Ihrer Gesundheit zu nutzen? *

- ◯ Ja, definitiv
- ◯ Wahrscheinlich
- ◯ Unentschlossen
- ◯ Unwahrscheinlich
- ◯ Nein, auf keinen Fall

12. Wie wichtig ist Ihnen die Empfehlung eines Arztes bei der Auswahl der Behandlungsmethode? *

- ◯ Überhaupt nicht wichtig
- ◯ Weniger wichtig
- ◯ Teils/teils
- ◯ Wichtig
- ◯ Sehr wichtig

13. Inwiefern beeinflussen Freunde und Familie Ihre Entscheidung zur Nutzung von neuen Produkten? *

- ◯ Gar nicht
- ◯ Kaum
- ◯ Teilweise
- ◯ Stark
- ◯ Sehr stark

Bewertung der Behandlungsmethode A

Bitte stellen Sie sich folgendes Szenario vor: Sie leiden seit einiger Zeit unter Einschlafproblemen, was Ihnen Unbehagen bereitet. Daraufhin beschließen Sie, Ihren Hausarzt zu konsultieren und ihm von Ihrem Anliegen zu berichten. Während Ihres Besuchs nimmt sich Ihr behandelnder Arzt ausreichend Zeit, hört Ihnen sorgfältig zu und stellt spezifische Fragen. Basierend auf Ihren Schilderungen vermutet er zunächst, dass Sie anfängliche Symptome einer Schlafstörung, bekannt als Insomnie, aufweisen könnten. Um Ihnen das Einschlafen zu erleichtern, verschreibt er Ihnen zunächst Beruhigungsmittel und bittet Sie, in der folgenden Woche für eine Nachkontrolle wiederzukommen, um den Erfolg der Behandlung zu beurteilen.

Wie bewerten Sie diese hypothetische Betreuung durch Ihren Arzt? Bewerten Sie pro Zahlenreihe ob Sie die Behandlung so eher dem Begriff links oder mit dem Begriff rechts zuordnen würden:

14. *

1	2	3	4	5

Behindernd — Unterstützend

15. *

1	2	3	4	5

Kompliziert — Einfach

16. *

1	2	3	4	5

Ineffizient — Effizient

17. *

1	2	3	4	5

Verwirrend — Übersichtlich

18. *

1	2	3	4	5

Langweilig — Spannend

19. *

1	2	3	4	5

Uninteressant — Interessant

20. *

1	2	3	4	5

Konventionell Originell

21. *

1	2	3	4	5

Herkömmlich Neuartig

Barrieren und Bedenken

22. Welche Bedenken haben Sie bei der Nutzung einer App? (Mehrere Antworten möglich) *

- [ ] Datenschutz und Sicherheit meiner Daten
- [ ] Schwierigkeiten bei der Bedienung
- [ ] Zu kleine Schrift
- [ ] Unklare Anweisungen
- [ ] Sinnhaftigkeit / Klaren Mehrwert erkennen
- [ ] Kein Interesse oder Bedarf
- [ ] Sonstiges

23. Welche der folgenden altersspezifischen Zugänglichkeitsprobleme würde Ihre Nutzung einer neuen Gesundheits-App beeinflussen? (Mehrere Antworten möglich) *

- [ ] Schriftgröße und Bildschirmaufbau nicht seniorengerecht
- [ ] Zu komplexe Navigation oder Menüführung
- [ ] Mangel an Anleitungen oder Erklärungen, die auf ältere Nutzer abgestimmt sind
- [ ] Fehlende Unterstützung durch Audio- oder Video-Anleitungen
- [ ] Nicht kommunizierter Nutzen
- [ ] Keine Bedenken; ich finde neue Apps allgemein gut zugänglich
- [ ] Sonstiges

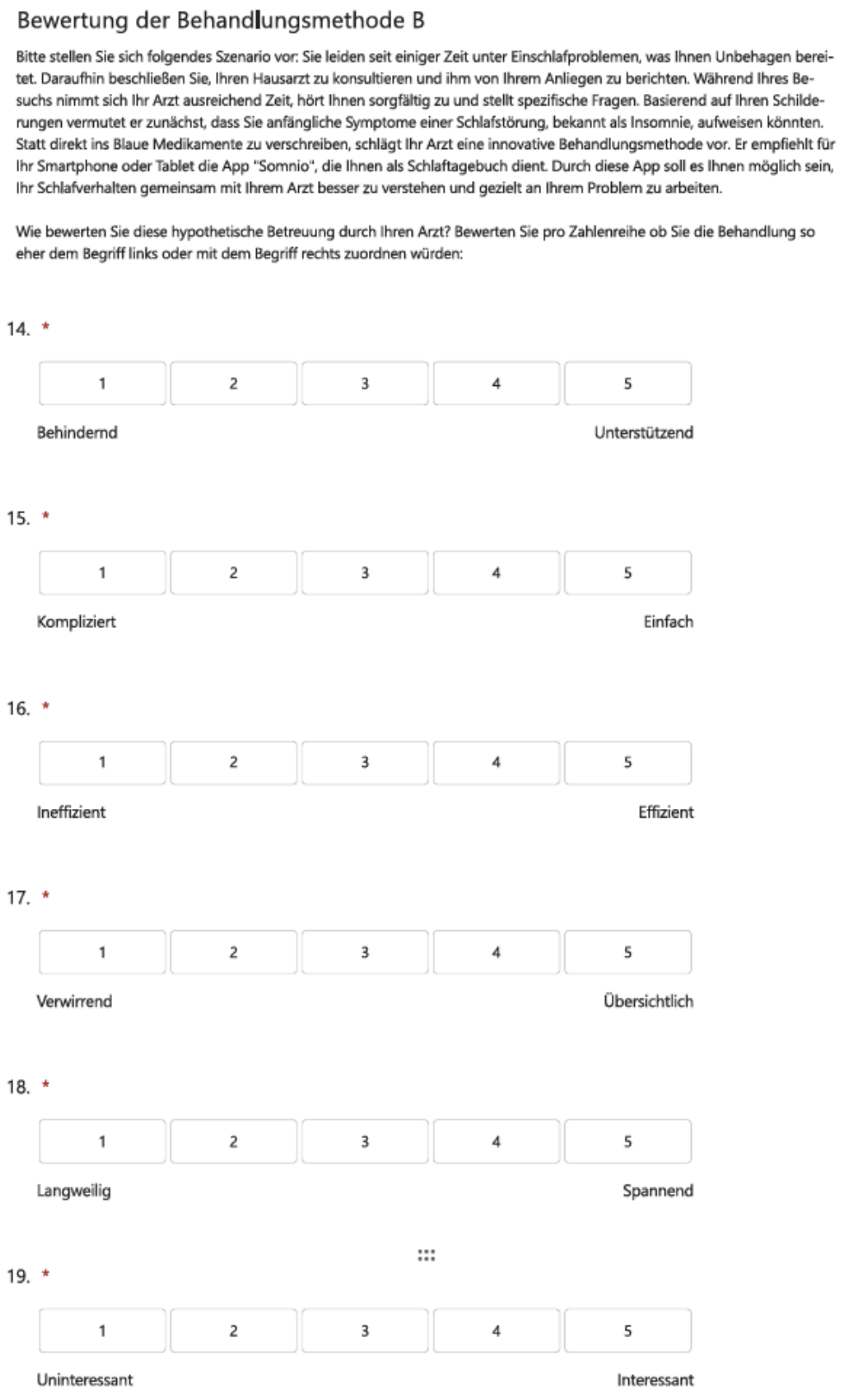
24. Würde Ihre Bereitschaft eine Gesundheits-App zu nutzen erhöht werden, vorab in einer persönlichen Schulung die App zu testen? *

- ◯ Ja, definitiv
- ◯ Wahrscheinlich ja
- ◯ Unsicher
- ◯ Wahrscheinlich nicht
- ◯ Nein, das würde keinen Unterschied machen

25. Gibt es weitere Anmerkungen, Vorschläge oder Bedenken, die Sie bezüglich der Nutzung von DiGA-Apps haben?

German original version survey via microsoft forms B:

Question 1-13 and 22-25 are exactly the same, difference is in 14-21:



Bewertung der Behandlungsmethode B

Bitte stellen Sie sich folgendes Szenario vor: Sie leiden seit einiger Zeit unter Einschlafproblemen, was Ihnen Unbehagen bereitet. Daraufhin beschließen Sie, Ihren Hausarzt zu konsultieren und ihm von Ihrem Anliegen zu berichten. Während Ihres Besuchs nimmt sich Ihr Arzt ausreichend Zeit, hört Ihnen sorgfältig zu und stellt spezifische Fragen. Basierend auf Ihren Schilderungen vermutet er zunächst, dass Sie anfängliche Symptome einer Schlafstörung, bekannt als Insomnie, aufweisen könnten. Statt direkt ins Blaue Medikamente zu verschreiben, schlägt Ihr Arzt eine innovative Behandlungsmethode vor. Er empfiehlt für Ihr Smartphone oder Tablet die App "Somnio", die Ihnen als Schlaftagebuch dient. Durch diese App soll es Ihnen möglich sein, Ihr Schlafverhalten gemeinsam mit Ihrem Arzt besser zu verstehen und gezielt an Ihrem Problem zu arbeiten.

Wie bewerten Sie diese hypothetische Betreuung durch Ihren Arzt? Bewerten Sie pro Zahlenreihe ob Sie die Behandlung so eher dem Begriff links oder mit dem Begriff rechts zuordnen würden:

14. *

1	2	3	4	5

Behindernd — Unterstützend

15. *

1	2	3	4	5

Kompliziert — Einfach

16. *

1	2	3	4	5

Ineffizient — Effizient

17. *

1	2	3	4	5

Verwirrend — Übersichtlich

18. *

1	2	3	4	5

Langweilig — Spannend

19. *

1	2	3	4	5

Uninteressant — Interessant

20. *

1	2	3	4	5

Konventionell Originell

21. *

1	2	3	4	5

Herkömmlich Neuartig

Appendix for Methodology III: Evaluation of existing DiGA apps

Extended MARS form:

Mobile Application Rating Scale (MARS)

App Classification

The Classification section is used to collect descriptive and technical information about the app. Please review the app description in iTunes / Google Play to access this information.

App Name: _____

Rating this version: _____ **Rating all versions:** _____

Developer: _____

N ratings this version: _____ **N ratings all versions:** _____

Version: _____ **Last update:** _____

Cost - basic version: _____ **Cost - upgrade version:** _____

Platform: ☐ iPhone ☐ iPad ☐ Android

Brief description: _____

_____

Focus: what the app targets (select all that apply)

- ☐ Increase Happiness/Well-being
- ☐ Mindfulness/Meditation/Relaxation
- ☐ Reduce negative emotions
- ☐ Depression
- ☐ Anxiety/Stress
- ☐ Anger
- ☐ Behaviour Change
- ☐ Alcohol /Substance Use
- ☐ Goal Setting
- ☐ Entertainment
- ☐ Relationships
- ☐ Physical health
- ☐ Other _____

Theoretical background/Strategies (all that apply)

- ☐ Assessment
- ☐ Feedback
- ☐ Information/Education
- ☐ Monitoring/Tracking
- ☐ Goal setting
- ☐ Advice /Tips /Strategies /Skills training
- ☐ CBT - Behavioural (positive events)
- ☐ CBT – Cognitive (thought challenging)
- ☐ ACT - Acceptance commitment therapy
- ☐ Mindfulness/Meditation
- ☐ Relaxation
- ☐ Gratitude
- ☐ Strengths based
- ☐ Other _____

Affiliations:

☐ Unknown ☐ Commercial ☐ Government ☐ NGO ☐ University

Age group (all that apply)

- ☐ Children (under 12)
- ☐ Adolescents (13-17)
- ☐ Young Adults (18-25)
- ☐ Adults
- ☐ General

Technical aspects of app (all that apply)

- ☐ Allows sharing (Facebook, Twitter, etc.)
- ☐ Has an app community
- ☐ Allows password-protection
- ☐ Requires login
- ☐ Sends reminders
- ☐ Needs web access to function

QUT Queensland University of Technology

YOUNGANDWELL Cooperative Research Centre

App Quality Ratings

The Rating scale assesses app quality on four dimensions. All items are rated on a 5-point scale from "1.Inadequate" to "5.Excellent". Circle the number that most accurately represents the quality of the app component you are rating. Please use the descriptors provided for each response category.

SECTION A

Engagement – fun, interesting, customisable, interactive (e.g. sends alerts, messages, reminders, feedback, enables sharing), well-targeted to audience

1. **Entertainment: Is the app fun/entertaining to use? Does it use any strategies to increase engagement through entertainment (e.g. through gamification)?**

    1 Dull, not fun or entertaining at all
    2 Mostly boring
    3 OK, fun enough to entertain user for a brief time (< 5 minutes)
    4 Moderately fun and entertaining, would entertain user for some time (5-10 minutes total)
    5 Highly entertaining and fun, would stimulate repeat use

2. **Interest: Is the app interesting to use? Does it use any strategies to increase engagement by presenting its content in an interesting way?**

    1 Not interesting at all
    2 Mostly uninteresting
    3 OK, neither interesting nor uninteresting; would engage user for a brief time (< 5 minutes)
    4 Moderately interesting; would engage user for some time (5-10 minutes total)
    5 Very interesting, would engage user in repeat use

3. **Customisation: Does it provide/retain all necessary settings/preferences for apps features (e.g. sound, content, notifications, etc.)?**

    1 Does not allow any customisation or requires setting to be input every time
    2 Allows insufficient customisation limiting functions
    3 Allows basic customisation to function adequately
    4 Allows numerous options for customisation
    5 Allows complete tailoring to the individual's characteristics/preferences, retains all settings

4. **Interactivity: Does it allow user input, provide feedback, contain prompts (reminders, sharing options, notifications, etc.)? Note: these functions need to be customisable and not overwhelming in order to be perfect.**

    1 No interactive features and/or no response to user interaction
    2 Insufficient interactivity, or feedback, or user input options, limiting functions
    3 Basic interactive features to function adequately
    4 Offers a variety of interactive features/feedback/user input options
    5 Very high level of responsiveness through interactive features/feedback/user input options

5. **Target group: Is the app content (visual information, language, design) appropriate for your target audience?**

    1 Completely inappropriate/unclear/confusing
    2 Mostly inappropriate/unclear/confusing
    3 Acceptable but not targeted. May be inappropriate/unclear/confusing
    4 Well-targeted, with negligible issues
    5 Perfectly targeted, no issues found

A. Engagement mean score = _____

SECTION B

Functionality – app functioning, easy to learn, navigation, flow logic, and gestural design of app

6. **Performance: How accurately/fast do the app features (functions) and components (buttons/menus) work?**

    1 App is broken; no/insufficient/inaccurate response (e.g. crashes/bugs/broken features, etc.)
    2 Some functions work, but lagging or contains major technical problems
    3 App works overall. Some technical problems need fixing/Slow at times
    4 Mostly functional with minor/negligible problems
    5 Perfect/timely response; no technical bugs found/contains a 'loading time left' indicator

7. **Ease of use: How easy is it to learn how to use the app; how clear are the menu labels/icons and instructions?**

    1 No/limited instructions; menu labels/icons are confusing; complicated
    2 Useable after a lot of time/effort
    3 Useable after some time/effort
    4 Easy to learn how to use the app (or has clear instructions)
    5 Able to use app immediately; intuitive; simple

8. **Navigation: Is moving between screens logical/accurate/appropriate/ uninterrupted; are all necessary screen links present?**

    1 Different sections within the app seem logically disconnected and random/confusing/navigation is difficult
    2 Usable after a lot of time/effort
    3 Usable after some time/effort
    4 Easy to use or missing a negligible link
    5 Perfectly logical, easy, clear and intuitive screen flow throughout, or offers shortcuts

9. **Gestural design: Are interactions (taps/swipes/pinches/scrolls) consistent and intuitive across all components/screens?**

    1 Completely inconsistent/confusing
    2 Often inconsistent/confusing
    3 OK with some inconsistencies/confusing elements
    4 Mostly consistent/intuitive with negligible problems
    5 Perfectly consistent and intuitive

B. Functionality mean score = _____

SECTION C

Aesthetics – graphic design, overall visual appeal, colour scheme, and stylistic consistency

10. **Layout: Is arrangement and size of buttons/icons/menus/content on the screen appropriate or zoomable if needed?**

    1 Very bad design, cluttered, some options impossible to select/locate/see/read device display not optimised
    2 Bad design, random, unclear, some options difficult to select/locate/see/read
    3 Satisfactory, few problems with selecting/locating/seeing/reading items or with minor screen-size problems
    4 Mostly clear, able to select/locate/see/read items
    5 Professional, simple, clear, orderly, logically organised, device display optimised. Every design component has a purpose

11. **Graphics: How high is the quality/resolution of graphics used for buttons/icons/menus/content?**

    1 Graphics appear amateur, very poor visual design - disproportionate, completely stylistically inconsistent
    2 Low quality/low resolution graphics; low quality visual design – disproportionate, stylistically inconsistent
    3 Moderate quality graphics and visual design (generally consistent in style)
    4 High quality/resolution graphics and visual design – mostly proportionate, stylistically consistent
    5 Very high quality/resolution graphics and visual design - proportionate, stylistically consistent throughout

12. **Visual appeal: How good does the app look?**

    1 No visual appeal, unpleasant to look at, poorly designed, clashing/mismatched colours
    2 Little visual appeal – poorly designed, bad use of colour, visually boring
    3 Some visual appeal – average, neither pleasant, nor unpleasant
    4 High level of visual appeal – seamless graphics – consistent and professionally designed
    5 As above + very attractive, memorable, stands out; use of colour enhances app features/menus

C. Aesthetics mean score = _____

SECTION D

Information – Contains high quality information (e.g. text, feedback, measures, references) from a credible source. Select N/A if the app component is irrelevant.

13. **Accuracy of app description (in app store): Does app contain what is described?**

    1 Misleading. App does not contain the described components/functions. Or has no description
    2 Inaccurate. App contains very few of the described components/functions
    3 OK. App contains some of the described components/functions
    4 Accurate. App contains most of the described components/functions
    5 Highly accurate description of the app components/functions

14. **Goals: Does app have specific, measurable and achievable goals (specified in app store description or within the app itself)?**

    N/A Description does not list goals, or app goals are irrelevant to research goal (e.g. using a game for educational purposes)
    1 App has no chance of achieving its stated goals
    2 Description lists some goals, but app has very little chance of achieving them
    3 OK. App has clear goals, which may be achievable.
    4 App has clearly specified goals, which are measurable and achievable
    5 App has specific and measurable goals, which are highly likely to be achieved

15. **Quality of information: Is app content correct, well written, and relevant to the goal/topic of the app?**

    N/A There is no information within the app
    1 Irrelevant/inappropriate/incoherent/incorrect
    2 Poor. Barely relevant/appropriate/coherent/may be incorrect
    3 Moderately relevant/appropriate/coherent/and appears correct
    4 Relevant/appropriate/coherent/correct
    5 Highly relevant, appropriate, coherent, and correct

16. **Quantity of information: Is the extent coverage within the scope of the app; and comprehensive but concise?**

    N/A There is no information within the app
    1 Minimal or overwhelming
    2 Insufficient or possibly overwhelming
    3 OK but not comprehensive or concise
    4 Offers a broad range of information, has some gaps or unnecessary detail; or has no links to more information and resources
    5 Comprehensive and concise; contains links to more information and resources

17. **Visual information: Is visual explanation of concepts – through charts/graphs/images/videos, etc. – clear, logical, correct?**

    N/A There is no visual information within the app (e.g. it only contains audio, or text)
    1 Completely unclear/confusing/wrong or necessary but missing
    2 Mostly unclear/confusing/wrong
    3 OK but often unclear/confusing/wrong
    4 Mostly clear/logical/correct with negligible issues
    5 Perfectly clear/logical/correct

18. **Credibility: Does the app come from a legitimate source (specified in app store description or within the app itself)?**

    1 Source identified but legitimacy/trustworthiness of source is questionable (e.g. commercial business with vested interest)
    2 Appears to come from a legitimate source, but it cannot be verified (e.g. has no webpage)
    3 Developed by small NGO/institution (hospital/centre, etc.) /specialised commercial business, funding body
    4 Developed by government, university or as above but larger in scale
    5 Developed using nationally competitive government or research funding (e.g. Australian Research Council, NHMRC)

19. **Evidence base: Has the app been trialled/tested; must be verified by evidence (in published scientific literature)?**

    N/A The app has not been trialled/tested
    1 The evidence suggests the app does not work
    2 App has been trialled (e.g., acceptability, usability, satisfaction ratings) and has partially positive outcomes in studies that are not randomised controlled trials (RCTs), or there is little or no contradictory evidence.
    3 App has been trialled (e.g., acceptability, usability, satisfaction ratings) and has positive outcomes in studies that are not RCTs, and there is no contradictory evidence.
    4 App has been trialled and outcome tested in 1-2 RCTs indicating positive results
    5 App has been trialled and outcome tested in $\geq$ 3 high quality RCTs indicating positive results

D. Information mean score = _____ *

* Exclude questions rated as "N/A" from the mean score calculation.

App subjective quality

SECTION E

20. Would you recommend this app to people who might benefit from it?

1	**Not at all**	I would not recommend this app to anyone
2		There are very few people I would recommend this app to
3	**Maybe**	There are several people whom I would recommend it to
4		There are many people I would recommend this app to
5	**Definitely**	I would recommend this app to everyone

21. How many times do you think you would use this app in the next 12 months if it was relevant to you?

1 **None**
2 1-2
3 3-10
4 10-50
5 >50

22. Would you pay for this app?

1 No
3 Maybe
5 Yes

23. What is your overall star rating of the app?

1	★	One of the worst apps I've used
2	★★	
3	★★★	Average
4	★★★★	
5	★★★★★	One of the best apps I've used

Scoring

App quality scores for

SECTION

A: Engagement Mean Score = _____

B: Functionality Mean Score = _____

C: Aesthetics Mean Score = _____

D: Information Mean Score = _____

App quality mean Score = _____

App subjective quality Score = _____

App-specific

These added items can be adjusted and used to assess the perceived impact of the app on the user's knowledge, attitudes, intentions to change as well as the likelihood of actual change in the target health behaviour.

SECTION F

1. **Awareness: This app is likely to increase awareness of the importance of addressing [insert target health behaviour]**

   Strongly disagree — Strongly Agree

   1 2 3 4 5

2. **Knowledge: This app is likely to increase knowledge/understanding of [insert target health behaviour]**

   Strongly disagree — Strongly Agree

   1 2 3 4 5

3. **Attitudes: This app is likely to change attitudes toward improving [insert target health behaviour]**

   Strongly disagree — Strongly Agree

   1 2 3 4 5

4. **Intention to change: This app is likely to increase intentions/motivation to address [insert target health behaviour]**

   Strongly disagree — Strongly Agree

   1 2 3 4 5

5. **Help seeking: Use of this app is likely to encourage further help seeking for [insert target health behaviour] (if it's required)**

   Strongly disagree — Strongly Agree

   1 2 3 4 5

6. **Behaviour change: Use of this app is likely increase/decrease [insert target health behaviour]**

   Strongly disagree — Strongly Agree

   1 2 3 4 5

SECTION G

1. How much and how easily can materials related to the app's use be found?

   1 2 3 4 5

2. How quickly and specifically can a real person be reached who can assist with problems?

   1 2 3 4 5

3. How is the secure handling of sensitive data communicated and transparently presented? And how well is it comunicated to its users?

   1 2 3 4 5

4. How openly are training opportunities communicated or even directly offered on the website, in the app or otherwise?

   1 2 3 4 5