Christine Schets

Addressing Organizational Factors for Telemedicine Adoption in Low-Resource Settings

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By

Christine Schets

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Thesis committee:	Dr. S. Hinrichs-Krapels	TU Delft
	Dr.M.L.C. de Bruijne	TU Delft
	C. Adlung	TU Delft

TU Delft

Executive Summary

Telemedicine has the potential to serve as an alternative or associated service to complement healthcare services. By reducing the influence of geographical, temporal, and financial constraints, it allows for more affordable healthcare, increased accessibility, enhanced accountability, and improved comprehension among stakeholders. Telemedicine's potential as a solution to different healthcare challenges has been recognized, particularly for Low Resource Settings (LRS). The impact of the COVID-19 pandemic increased adoption of telemedicine, however, adoption rates of telemedicine remain low, and many initiatives fail in LRS. In these contexts, delivering healthcare to the population presents many challenges. The potential benefits of telemedicine offer great promise to these healthcare settings. Despite advancements in mobile technology, telemedicine has not been widely adopted in LRS, indicating a need to examine the factors influencing this adoption. This study addresses the gap by exploring the organizational factors in telemedicine adoption in LRS, using adoption frameworks to better understand these dynamics.

The aim of this study is thus to explore the telemedicine adoption in LRS, since the low adoption rates of telemedicine suggests for research focusing on adoption factors for telemedicine in these settings. Given that successful adoption is linked to user acceptance, understanding the acceptance of healthcare professionals is crucial. Therefore, this study will address the following main research question:

How to address organizational adoption factors for telemedicine in LRS?

This is an exploratory study designed to gather insights and knowledge on organizational adoption factors for telemedicine adoption in LRS. Data has been aquired and coded using qualitative research methods: literature review and interviews. The purpose of qualitative research is to give a realistic understanding of adoption factors within the context. Adoption factors in this study include barriers, facilitators, and approaches to overcome. By the synthesis of data from literature and interviews, with a focus on real-world context and personal experiences adoption factors have been identified.

For this study has been examined which adoption framework is most suitable for identifying the organizational adoption factors for telemedicine in LRS. Based on the insights from the literature review has been determined to focus on the Unified Theory of Acceptance and Use of Technology (UTAUT) as the theoretical framework for this study. The idea in this study has been to modify the framework according to the organizational adoption factors identified by the research methods. Thereby focusing on adoption factors and adoption frameworks. This study revealed various identified barriers, followed by facilitators and approaches to overcome on the discussed telemedicine use cases. Frequently highlighted barriers include the lack of geographic and infrastructure resources, financial constraints, issues on connectivity, lack of policy, guidelines, and regulation and the lack of data protection (for privacy). Accessibility to mobile technology infrastructure appeared as a key facilitator from both research methods. The approaches to overcome have been discussed in interviews and revealed key findings on adoption factors. These concepts are interrelated, highlighting the complexities of telemedicine adoption. This research addresses the connection between adoption and implementation. findings suggest that a new type of term is needed to better reflect this process, which current terminology does not fully capture. Overall, the identified barriers, facilitators, and approaches to overcome have been aligned against the UTAUT construct to explore emerging themes. This comparison has been aimed to identify emerging themes for telemedicine adoption in LRS. Secondly to reflect on how the UTAUT model could be refined to better address these emerging themes. These emerging themes resulted in framework adaptations, and a consideration when applying the UTAUT model for this study. Figure 1 presents the modified

UTAUT framework according to framework adaptations. Two constructs were identified: Patient attitude aligning with the other constructs, and organizational conditions adding a new dimension to the construct of facilitating conditions. This interaction is visualized by broken lines and an arrow in both directions, highlighting interconnectedness and recognizing complexity of this interaction. For applying this framework in the context of this study, intrinsic cultural values require consideration.

Concluding, the applicability of the UTAUT framework for this use case has been questioned. Reflecting on its use in specifically this study it appeared that this framework has constraints in addressing broader adoption factors. It can be concluded that the UTAUT framework is more individually oriented and therefore has limited relevance when considering adoption from a broader perspective. As described the identified adoption factors cannot be entirely covered by the construct of facilitating conditions of the UTAUT. Furthermore, from the identified emerging themes resulted that focusing on one construct of the UTAUT is not adequate for addressing organizational adoption factors. Overall, for addressing the organizational adoption factors for telemedicine adoption by healthcare professionals in LRS UTAUT is not fully applicable. As a result, it has been concluded that to address organizational adoption factors for telemedicine the modified framework is suitable, however validation of the framework is necessary. The findings of this study contributed to understanding the context-dependency and interrelated nature of barriers, facilitators, and approaches to overcome. And by proposing the modified framework and discussing considerations, this study intends to provide new insights on how to address telemedicine adoption among healthcare professionals in LRS.

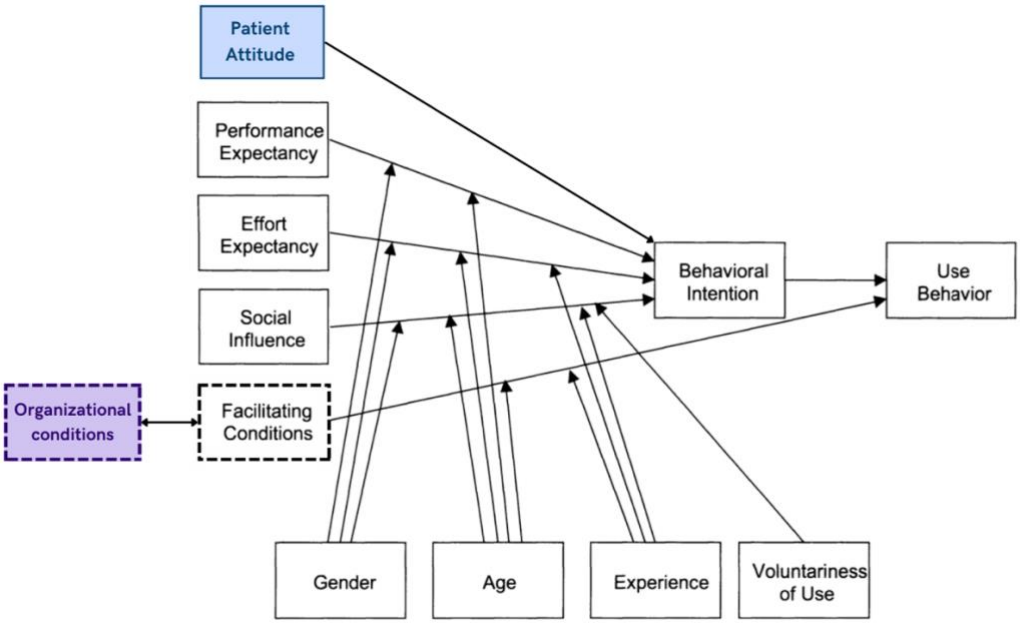

Figure 1. Modified UTAUT framework for addressing organizational adoption factors for telemedicine in LRS

Key words:
Telemedicine, LRS, Organizational Factors, Healthcare Professionals, Adoption Framework, UTAUT.

List of Abbreviations

LRS	Low Resource Settings
UTAUT	The Unified Theory of Acceptance and Use of Technology
TAM	Technology Acceptance Model
DoI	Diffusion of Innovation
PRISMA	Preferred Reporting Items for Systematic review and Meta-Analyses
MDE	Medical Device Equipment

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1 Introduction

1.1 Introduction

Telemedicine is a valuable tool for achieving the United Nations Sustainable Development Goals, SDG No.3, “ensure healthy lives and promote well-being for all, at all ages”. The introduction of telemedicine has the potential to serve as an alternative or associated service to complement healthcare services, by reducing the influence of geographical, temporal, and financial constraints, it facilitates more affordable healthcare, increased accessibility, enhanced accountability, and improved comprehension among stakeholders (Chowdhury et al., 2021; Lawal et al., 2022). With COVID-19, the adoption of telemedicine has increased, leading healthcare systems to use it more due to isolation restrictions (Lawal et al., 2022; Mensah et al., 2023; Owolabi et al., 2022). Since, telemedicine provides a solution to access medical services without direct physical contact, therefore following social distancing measures (Alboraie et al., 2022; Mensah et al., 2023; Owolabi et al., 2022; Tiwari et al., 2023). This tool aims to improve access to care regardless of location and reduces the number of face-to-face visits. The ability for physical and social distance are an important reason for adoption of telemedicine (Garavand et al., 2022).

Developed countries are better at implementing telemedicine as compared to Low-Resource Setting (LRS) (Kiberu et al., 2018). Telemedicine services have seen slow progress in LRS with little to no evidence of the effectiveness of programs (Tiwari et al., 2023). The COVID-19 pandemic underscored the vulnerabilities of healthcare systems worldwide, especially where the resources are limited (Ye et al., 2023). Despite its potential, telemedicine has not been widely adopted by healthcare professionals in these contexts (Addotey-Delove et al., 2023; Tiwari et al., 2023).

This research investigates the organizational adoption factors of telemedicine adoption in LRS. To provide clarity in this study, the key concepts of adoption, telemedicine, and LRS have been established.

Adoption: This study focuses on adoption rather than implementation. Adoption is the original dependent variable in innovation research and can be defined as the decision to make full use of an innovation by individuals or organizations as the best course of action available, while rejection is the decision not to adopt (Eveland, 1979; Sparling et al., 2007). Adoption is a complex process in which beliefs and attitudes evolve over time and lead to a final decision about whether to adopt a technology (Liu & Miguel-Cruz, 2022). For this research theoretical adoption frameworks have been examined, this will be elaborated on in the Problem Statement in 1.3. Furthermore, in this study adoption factors include both barriers (factors that hinder adoption), facilitators (factors that promote adoption), as well as approaches to overcome barriers and enhance facilitators. The focus is specifically on organizational adoption factors defined as ‘the degree that the individual believes that an organizational and technical infrastructure exists to support the use of the system’, the choice for this focus will be elaborated in Chapter 3 (Venkatesh et al., 2003).

Telemedicine: Telemedicine is used interchangeably with similar concepts of e-health, m-health, telehealth and digital health in this study, this approach thereby also recognizes the varied terminology used in different studies. Literature reveals that these terms are often used interchangeably in different disciplines. Due to differing perspectives among academia, scientific institutions, industry, and individuals there is a lack of comprehensive understanding on the definition (Takuwa et al., 2023). From different studies, to increase the specificity of the research topic and methods, the studies concentrated on one term, while also excluding

comparable concepts (Grace et al., 2021; Kissi et al., 2023). Therefore, to avoid complexity, has been chosen to focus on the term telemedicine interchangeably with similar terms. According to the WHO telemedicine refers to the delivery of health-care services over distance (WHO, 2022). Telemedicine is an integration of technology and medicine, and normally consists of a communication device with software to support sharing of information as well as a secure network channel for communication (Mahdi et al., 2022; Tchao et al., 2019). The use of technology to facilitate exchange of health information and providing healthcare services remotely across geographic, time, social, cultural, and political barriers (Kiberu et al., 2018; Leochico et al., 2020; Ndlovu et al., 2017; Tchao et al., 2019). Subsets of telemedicine include among others: telerehabilitation: electronic means in remotely conducting evaluation, consultation, therapy and monitoring and teleradiology: the electronic transmission of radiological images (Mahdi et al., 2022; Leochico et al., 2020; Rackimuthu et al., 2022).

Low-Resource Settings (LRS): In this study the term Low-Resource Setting (LRS) is used interchangeably with the term Low- and Middle-Income Country (LMIC). For the definition can be referred to the definition from 2024, defined with a GNI per capita of $1,135 or less and a GNI per capita between $1,136 and $4,465 (The World Bank, 2024).

The data and insights presented in this Chapter 1 are derived from the literature review, this will be further detailed in the Chapter 3 of this study. The next paragraphs, will go further into the background of the topics addressed in this Chapter.

1.2 Background

1.2.1 History Overview of Telemedicine

Humans have been able to communicate health-related information over long distances long before modern technologies were available. The telegraph was the first device used in providing distant medical care (Lawal et al., 2022). In the 19th century, during the American civil war, it was used for soldiers to communicate with their doctors via telegraphs and phones, by the transmission of reports about wounded soldiers to stand-by medical teams (Alboraie et al., 2022; Lawal et al., 2022). In 1959, a microwave link was used for telepsychiatry consultations between the Nebraska Psychiatric Institute in Omaha and the state mental hospital 112 miles away (Mahdi et al., 2022). The availability of low-cost computing and digital telecommunication in the 1980s made telehealth practicable (Kissi et al., 2023). Over time, advancements in communication technologies, with the popularization of the radio, telephone, and television in the 20th century, these devices were employed for medical education and consultations. From literature it has been stated that there is a relation between advances in communication technology and the evolution of telemedicine (Lawal et al., 2022). Replacement of the traditional face-to-face communication methods with the computer-based ones, with the fast decline in the costs of ICTs, has enabled different healthcare institutions to adopt new and structured methods of presenting care to patients (Alboraie et al., 2022). Telemedicine is said to have gone through three generations: the first generation was reactive telemedicine systems which focused mainly on social alarms. The second generation was proactive telemedicine systems that automated responses based on sensor information. And the third generation is an integrated telemedicine system that uses virtual communities to enhance patients' quality of life (Kissi et al., 2023). The mobile health field has had a major influence on the current growth of telemedicine. Today, telemedicine involves the use of telecommunications systems to enable real-time communication between healthcare professionals and patients in different locations (Lawal et al., 2022).

1.2.2 Potential of Telemedicine

Numerous potentials have been highlighted in literature, where telemedicine emerges as a multifaceted solution to various healthcare challenges (Getachew et al., 2022; Lawal et al., 2022; Mahdi et al., 2022; Owolabi et al. 2022; Pagaling et al., 2021; Tahir et al., 2022; Tchao et al., 2019). The use of ICT and other digital healthcare interventions have the potential to reduce inequalities in LRS (Mengesha & Garfield, 2018). Telemedicine holds the promise of being able to connect patients in the remotest of regions to qualified doctors in urban areas (Mahdi et al., 2022). It also offers a cost-effective solution to healthcare delivery, reducing unnecessary referrals and patient expenses while improving treatment outcomes. So this would avoid patient travel and reduce out of pocket travel expenses, may also reduce patient transfer, re-hospitalisation and length of in hospital stay, and it saves both healthcare professionals and patients time and costs (Kiberu et al., 2018; Tahir et al., 2022). Furthermore, the quality of healthcare delivery also stands out on health information, diagnosis, treatment and management of patients (Kiberu et al., 2018; Lawal et al., 2022; Mensah et al., 2023; Tahir et al., 2022; Tchao et al., 2019). And the potential to reduce disease morbidity, and improve treatment (Kiberu et al., 2018; Ndlovu et al., 2017; Ye et al., 2023). For the perspective of healthcare professionals engaging in telemedicine they could develop knowledge and skills because of interactions with medical specialists (Ndlovu et al., 2017; Mahdi et al., 2022). In addition, telemedicine can also reduce the effect of global shortage of healthcare professionals (Tchao et al., 2019). And with the context of COVID-19 in mind, a safe support system for healthcare facilities during infectious outbreaks (Lawal et al., 2022; Tahir et al., 2022). Overall, telemedicine could solve logistical barriers, gives support to weak health systems, and helps to establish worldwide networks of healthcare professionals (Mahdi et al., 2022).

1.2.3 Context: Healthcare in LRS

LRS face many challenges providing healthcare to the populations (Hui et al., 2022). In most countries, access to healthcare remains a challenge due to various factors such as shortage of healthcare professionals, burden of disease, poverty, lack of government, cost of connectivity, computer literacy, lack of infrastructure, civil unrest, poorly funded healthcare provision, inadequate facilities, and the high costs of medical consultation (Kiberu et al., 2018; Mengesha & Garfield, 2018; Ncube et al., 2023). In these contexts, the distribution of health infrastructures is concentrated in urban areas, leaving rural regions underserved and forcing patients to travel long distances for care (Mensah et al., 2023; Tchao et al., 2019). Furthermore, the specialists are mostly centered at the urban areas, so cases which cannot be handled in the rural areas have to be referred to the urban areas. This urban-rural disparity is increased by a shortage of healthcare professionals, and by limited educational facilities and resources. Looking at Sub-Saharan Africa, for example the low intake of students into medical schools due to inadequacy of facilities to train students (Tchao et al., 2019).

Different articles discussed the impact of the COVID-19 pandemic on healthcare and societal systems (Tiwari et al., 2023). The COVID-19 pandemic underscored the vulnerabilities of healthcare systems particularly in LRS, where resources are limited (Mahmoud et al., 2022; Ye et al., 2023). More specifically the pandemic brought focus on the fragility of healthcare systems in LRS (Singh, 2022). In almost all LRS the healthcare system is structured in the customary model of in-person or face-to-face model of care. Given this fragile health system, the economic impacts of COVID-19 were worse in these contexts and caused socioeconomic challenges (Shiferaw et al., 2021; Tahir et al., 2022). Since the COVID-19, there has been an urgent need for a rapid and adequate reaction to the pandemic's disruption of healthcare systems (Mahmoud et al., 2022). Despite slow progress in telemedicine services in LRS and limited evidence of the costs and effectiveness of programs publications and research indicate a growing interest in telemedicine (Mahmoud et al., 2022; Tiwari et al., 2023). There were nearly as many publications in the first 4 months of 2021, as in the entire year of 2020, suggesting that interest in telemedicine has surged in LRS during COVID-19 (Mahmoud et al.,

2022). And from some article's telemedicine access expanded in LRS during the pandemic to maintain essential health services (Hoffer-Hawlik et al., 2020; Singh, 2022). So, despite the COVID-19 disruption of healthcare systems in low resource settings, the interest in telemedicine has increased. This rising interest has extended to advanced technologies like 3D telemedicine, which addresses the limitations of traditional 2D telemedicine in replacing the authenticity of in-person consultations (Mcdonald & Shirk, 2023; Lo et al., 2023). A study by Lo et al. (2024) performed a proof-of-concept study on 3D consultation by a real-time 3D Telemedicine system leveraging Microsoft's Holoportation communication technology enabled by an international multidisciplinary team meeting (MDT) to consult with complex reconstructive patients before, during, and after an overseas surgical collaboration in Ghana. Although the infancy of this system, this technology has the potential to enhance the delivery of surgical visits over distance to LRS, potentially making 3D remote consultations as effective as in-person visits (Mcdonald & Shirk, 2023; Lo et al., 2023; Lu et al., 2022).

1.3 Problem Statement

Telemedicine has been in use for some time in the context of LRS, but on a relatively smaller scale compared to developed countries (Mengesha & Garfield, 2018; Tchao et al., 2019). Telemedicine adoption in LRS, specifically sub-Saharan Africa has been slow or underutilized (Ncube et al., 2023). More than 75% of telemedicine system projects failed without significant contributions to the health system globally. However developed countries are better at implementing telemedicine as compared with LRS, for example 76% of United States of America health institutions fully function the system. 75% of Norway's health institutions successfully implement telemedicine systems, But, in LRS only 10% of their health institutions provide health service through telemedicine (Kiberu et al., 2018). Digital health is still a new trend in LRS, where there is limited evidence for interventions that have been implemented, most do not grow beyond the pilot or project phase or fail (Kiberu et al., 2018; Takuwa et al., 2023; Ye et al., 2023).

Even in LRS, mobile phones and mobile technologies are rapidly advancing. For example mobile phone use in sub-Saharan Africa has increased rapidly, rising from 16% in the late 1990s to more than 90% in 2011 (Takuwa et al., 2023). Even though internet connectivity is only 15%, the progress is encouraging to consider incorporating information and communications technology (ICT) for healthcare delivery. Also, innovations and technological advancements have made internet communication cheaper, providing a unique opportunity for integrating telemedicine into healthcare practices, especially LRS (Mensah et al., 2023). Many LRS are investing more in mobile telecommunication infrastructure than in road transport and electric power generation. Despite this, telemedicine has not seen widespread adoption by healthcare professionals in LRS (Addotey-Delove et al., 2023).

Literature defines that the success rate of adoption is linked to user acceptance (Pagaling et al., 2021). Currently, to understand the cause of users' accepting or rejecting any new technology has become an integral task in many information systems' lifecycle (Venkatesh et al., 2003). There are different theoretical frameworks that exits to help contextualize the factors that influence adoption of technology (Janssen et al., 2021). The Unified Theory of Acceptance and Use of Technology (UTAUT), which integrates key factors for adoption provides a theoretical framework that has proven applicable in understanding the adoption of telemedicine technologies in various contexts (Venkatesh et al., 2003; Grace et al., 2021). From this framework adoption is discussed in the context of user intention and/or usage of information technology. In Chapter 3, the identification of this adoption framework will be elaborated. A study by Wubante et al. (2022) identified a gap in evaluation of telemedicine readiness, the state of being prepared for adoption, highlighting the need for future research to encompass various dimensions such as organizational, technological, and societal adoption (Wubante et

al., 2022). Given this observed gap in evaluating telemedicine adoption, there is a need to examine the adoption of telemedicine in LRS, with a focus on factors such as organizational. Understanding organizational adoption factors is important, since research indicates that introducing technology is often met with problems at the organizational level. (Grace et al., 2021).

From literature, the use of telemedicine has been highlighted with potential to improve healthcare delivery, particularly evident during the COVID-19 pandemic. Overall, despite these telemedicine potentials, there remains an uneven adoption across several LRS (Owolabi et al., 2022). The potential benefits offer great promise for healthcare (Kiberu et al., 2018). Many countries do have some form of ICT, but telemedicine is not an embedded focus on an existing strategy (Ncube et al., 2023). In these settings incorporating telemedicine into the healthcare system could enhance exchanging health information for practicing medicine for the diagnosis, treatment, and prevention of diseases (Wubante et al., 2022). LRS face different challenges in providing health care to populations and the concentration of healthcare services is in the urban areas, leaving the rural areas underserved (Hui et al., 2022; Mensah et al., 2023; Tchao et al., 2019). As described, there is a disparity between the successful adoption of telemedicine in developed countries compared to LRS, where adoption remains slow and often fails to progress beyond pilot projects. Overall, there is a need to examine telemedicine adoption in LRS. Research suggests that organizational factors play a role in the success rate of adoption, and there is a gap in evaluating telemedicine adoption in LRS. To address this gap, it is essential to explore telemedicine adoption in LRS using adoption frameworks to understand and contextualize the factors influencing its adoption in this setting. The following research question has been stated.

1.4 Research Questions

For this research has been determined to focus on the organizational adoption factors, the choice for this focus will be elaborated on in Chapter 4. In this Chapter, the research will explore adoption theories, to clarify the emphasis on organizational adoption factors. Furthermore, this study focuses on the perspective from the healthcare professionals, the main research question and sub questions are presented below. The first sub-question addresses the theory, the second explores organizational adoption in practice, and the third synthesizes findings to answer the main research question.

How to address organizational adoption factors for telemedicine in LRS?

SQ1. How can the adoption of telemedicine in LRS be examined?
SQ2. What are organizational adoption factors of telemedicine in LRS?
SQ3. How might existing frameworks be refined to better align with the identified organizational adoption factors for telemedicine in LRS?

1.5 Societal and Managerial Relevance

The societal impact of this thesis lies in addressing the critical challenge of healthcare accessibility in LRS by exploring the adoption of using telemedicine among healthcare professionals. By identifying organizational adoption factors, this study's goal is to contribute to the development of a theoretical adoption framework for telemedicine adoption in LRS adapted to the challenges in that context. By advancing theoretical understanding, it aims to guide future research and possibly policy initiatives aimed at integration of telemedicine into healthcare systems. Finally, through exploring the adoption of innovative technologies like

telemedicine, this research aims to focus on reducing health disparities and improving health outcomes in LRS.

1.6 Link with CoSEM Perspective

This study recognizes the necessity of identification for the adoption factors of telemedicine, as a technology, considering socio technical elements that recognize the interaction between healthcare and technology advancements. The approach proposes the identification of adoption factors and to bridge existing gaps in understanding and addressing adoption. For this study several COSEM methodologies and tools have been applied to create and evaluate the impact of technical solutions when dealing with complex issues, considering technology acceptance theories and qualitative methods. Furthermore, considering the larger social and ethical issues within the socio technical healthcare system in LRS, and taking values from different perspectives into account.

1.7 Thesis Outline

In Figure 2, the structure of this thesis is visualised in the research flow diagram. The first Chapters provides the research background of this study by data following from the literature review. Chapter 2 describes the study's methodology. For the data collection and analysis, Chapter 3, 4 and 5 address the sub questions of this research, and the conclusion of each Chapter is relevant to answering the following sub questions. Chapter 6 discusses the outcomes of the sub questions, with limitations on this study in Chapter 7. Chapter 8 concludes by answering the main research question, including a limitation to this conclusion.

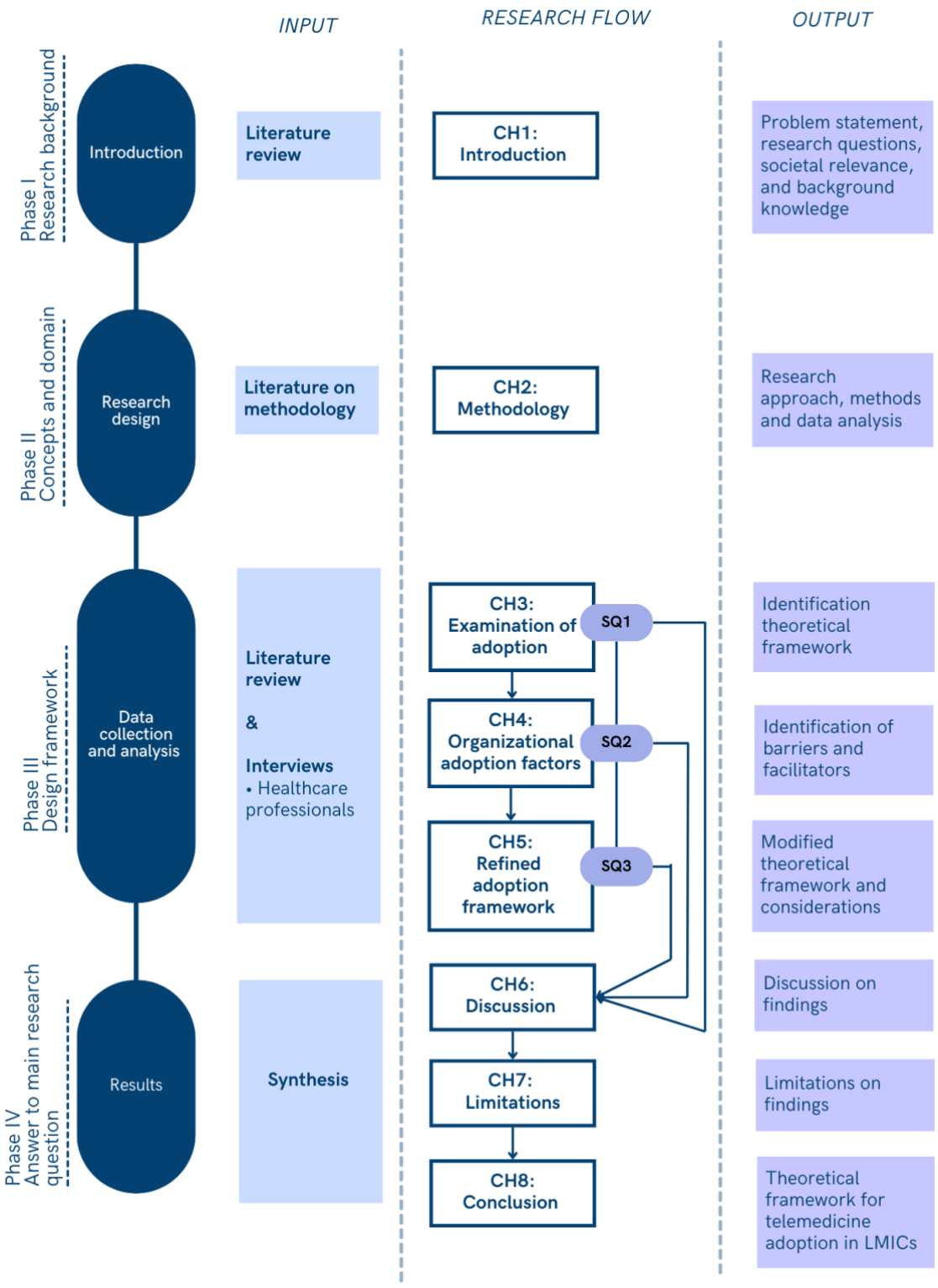

Figure 2. Overview of Thesis Outline

2 Methodology

2.1 Introduction

This Chapter outlines the research methodology for this study. By integrating qualitative research methods, including semi-structured interviews and a literature review, this study aims to identify organizational adoption factors against the adoption framework of the UTAUT by Venkatesh et al. (2003). The goal is to develop a contribution towards the framework for addressing telemedicine adoption by healthcare professionals in LRS. Data from the literature review have been analyzed manually, the interview data has been coded and analyzed using Atlas.ti. This Chapter provides a detailed description of the research approach, research methods, data analysis procedures and measures taken to ensure validity and reliability of the study. Figure 3 illustrates the research methods for each sub question and corresponding Chapters. It also outlines the data analysis process and how the data will be synthesized to answer the third sub-question.

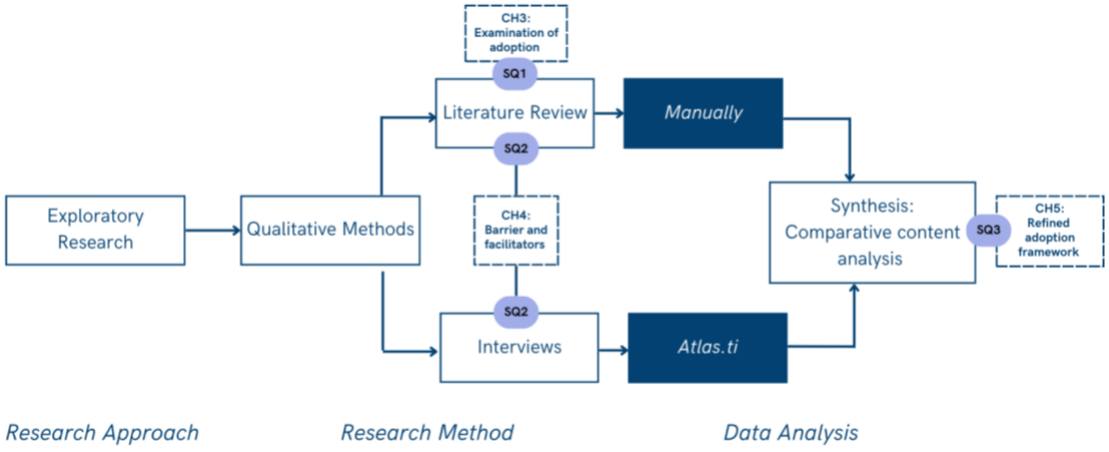

Figure 3. Research design

2.2 Research Approach

In this study, an exploratory research approach has been used to gather insights and knowledge on the adoption of telemedicine in LRS. This approach is effective for investigating phenomena that are not yet well-understood and for addressing problems that have not been clearly defined (Mbaka & Isiramen, 2021), which aligns with the focus of this study. Since this study aims to identify organizational adoption factors that are not yet well-understood. According to Stebbins (2001) the goal of exploratory research is to identify potential generalizations that may be developed into future hypotheses and eventually theories that emerge from the data (Casula et al., 2020; Stebbins, 2001). The flexibility and adaptability of exploratory research makes this approach appropriate, and it may be useful in establishing a framework for future research.
The primary methods of conducting exploratory research include a literature review and interviews with ‘experts’ on the subject. Through observation and interpretation, an in-depth understanding of human behavior, experience, attitudes, intentions, and motivations can be gained. This exploratory research collects qualitative, open-ended data, by collection of in-

depth semi-structured interviews to find out what is happening and seek new insights, observations, and documents (Makri & Neely, 2021; Mbaka & Isiramen, 2021). Data will be analyzed by qualitative analysis methods. Despite the effectiveness of this approach, it is important to acknowledge several drawbacks, such as the inclusive nature of research findings, which might not capture the complete range of perspectives on the topic. Additionally, there is the possibility of bias in qualitative information and interpretation which is related to limited generalizability of results due to small sample sizes (Saunders et al., 2019). Given this study's dependence on qualitative data and the limited sample size of interviewees, the generalizability of the results will be considered.

2.3 Research Methods

For this study qualitative research methods will be used for data collection. Qualitative research provides flexible ways of collecting, analyzing, and interpreting data and information and the use of primary and unstructured data gives qualitative research a descriptive capability (Mbaka & Isiramen, 2021). The choice for qualitative research for this study is driven by the ability to provide a realistic understanding of the adoption factors to telemedicine adoption in LRS. Qualitative research treats knowledge that is context-dependent, dealing with real-life context (Cibangu, 2012). Furthermore, qualitative methods are used to comprehend and describe personal experiences of phenomena, allowing for a description of how the phenomena are embedded in local contexts (Casula et al., 2020). Telemedicine is the phenomenon investigated in this study, and LRS refer to the local context. For this study qualitative data will be collected by literature and interviews. This research method is criticized as biased, small scale, anecdotal and lacking rigor, however, when it is carried out properly it is unbiased, in depth, valid, reliable, credible and rigorous (Anderson, 2010).

Qualitative methodologies are preferred for adaptability to new insights and changes in the research setting (Casula et al., 2020). This qualitative research method focuses on "the creation of emergent understanding". For this method, data collection, coding, analysis and theoretical sampling are effective tools for generating theory (Casula et al., 2020; Cibangu, 2012). This qualitative methodology combines both inductive and deductive activities. By focusing on real-world contexts and personal experiences, the qualitative research will provide an understanding of telemedicine adoption in LRS.

2.3.1 Literature Review

The purpose of the literature review is to examine the existing literature on organizational adoption factors for LRS. The methodology of a literature review has been chosen to find out which data already exists on this topic in order to compare this with data from interviews. This methodology has been applied for Chapter 3 and 4, for the synthesis of these Chapters in Chapter 5. In this paragraph, the literature reviews and systematic analysis of documents will be discussed, highlighting the process of search strategy, criteria for study selection, quality of evidence, data extraction and analysis. followed by the results of selected articles and visualization by PRISMA flow diagram, in Figure 4.

I. Search Strategy

In the process of searching and selecting literature, the database of Scopus has been searched to gather articles for the literature review. The search string employed focused on key concepts in this research, namely adoption, telemedicine, and LRS, which have been defined in the Introduction. To ensure comprehensive coverage, various keywords and synonyms were utilized for each concept. This search string resulted in a total of 568 articles.

(TITLE-ABS-KEY (adoption OR implementation OR viability OR scale-up OR feasibility) AND TITLE-ABS-KEY ("telemedicine" OR "electronic consultation" OR "teleconsultation" OR telemonitoring OR "health monitoring" OR "remote healthcare" OR "remote health care" OR "remote medical diagnosis" OR "remote patient monitoring" OR telecare OR telehealth OR telehealthcare OR "virtual medicine") AND TITLE-ABS-KEY ("lower-middle-income country" OR "LRS" OR "low-income country" OR "developing country" OR "less developed country" OR "underdeveloped nation" OR "resource-poor country" OR "economically challenged country" OR "impoverished nation" OR "socioeconomically varied country" OR "mixed-income country") AND NOT TITLE-ABS-KEY (print*)) AND PUBYEAR > 2013 AND PUBYEAR < 2025

Subsequently, data extraction into an Excel document was conducted on the articles, on Authors, Author full names, Author(s) ID, Title, Year, Link, Abstract, Author Keywords and Index Keywords. This structured approach facilitated the analysis of literature.

To refine the search strategy, multiple iterations of search strings were explored, as detailed in see Appendix I. for the chosen concepts, search string, results and why excluded. While using different search terms, it became evident that the data was limited. This iterative process allowed for the optimization of search parameters and the identification of relevant literature. A benefit of this research method is that data already exists but on the other hand data may also be limited (Office of Research & Doctoral Services, 2015). Finally, all search strings included the concept not to focus on print*, as many articles appeared on printing when including. Furthermore, has been searched for articles between > 2013, and < 2025. For the final search string, the concepts of 2D and 3D have been neglected, the objective was to focus on these concepts while screening the articles, this will be further addressed in II. Criteria for study selection.

II. Criteria for study selection

The screening of articles occurred in different phases, aimed to filter, and assess the relevance of each article to this study. Initially, this study aimed to focus on the 2D/3D telemedicine technologies. However, the literature review and analysis revealed that this focus was not prominently addressed or discussed in literature. As a result, it has been determined to exclude this focus from this study. However, 3D aspects of telemedicine technology will be explored in interviews to gather insights and practical perspectives on this advanced technology that is not extensively covered in the literature. This will be addressed in the interview paragraph.

Phase I. First study selection

The first screening phase involved the initial evaluation of the 568 articles based on Title and Abstract. During this phase specific eligibility criteria were applied to ensure the selection of articles aligning with the research objectives. This resulted in 56 relevant articles. These eligibility criteria were focused on:

The articles were screened on title and abstract. The following eligibility criteria were used to select the articles in this first phase:

[1] Geographical scope: Only studies conducted or focused on LRS were considered eligible. This criterion aimed to contextualize the findings.

[2] Telemedicine: The selected articles needed to either discuss general telemedicine concepts or explore specific use cases on telemedicine applications, ensuring that the literature review directly assessed telemedicine adoption.

[4] Language: Articles written in English were eligible for inclusion.

[5] Publication type: Only journal articles, for the rigor of the literature review.

Phase II. Second study selection
The 56 relevant articles have been obtained in full text. Subsequently, the articles have been reviewed according to additional criteria and categorized using a color-coded method. This method employed red, orange and green labels. Where green denoted “include”, orange indicated articles “requiring further consideration”, and red signified articles “not included”. The orange color-coded articles were reviewed several times before deciding to color-code them green or red when not useful for the study’s objectives. This resulted in 31 articles.

Several eligibility criteria have been applied to refine the selection process of the articles for this second screening phase:
[1] Full-text availability: Articles were eligible for inclusion if they had no full-text availability due to access issues, and access could not be requested.
[2] Perspective of healthcare professionals: Articles providing insights from the perspective of healthcare professionals were included referring to: physicians, healthcare workers, healthcare providers and clinicians. Specifically, articles discussing the perspective of the patient were excluded. Healthcare delivery perspective and health systems and policy perspective had not been excluded.
[3] Telemedicine adoption: Studies were required to focus on the adoption of telemedicine, ensuring relevance to adoption factors.

In addition to the articles retrieved to the literature search on Scopus, supplementary resources were also utilized for the literature review by snowballing and articles from experts. These supplementary resources have been used to gather broader insights from different sources.

III. Quality of evidence

Quality of evidence from this literature review followed from the search strategy and selection process of literature. By utilizing Scopus as the primary database, the search string and the exclusion criteria this resulted in 31 articles. Through external sources overall, 65, articles have been analyzed. This methodological approach of the literature review ensures relevance of the gathered evidence.

IV. Data extraction and analysis

To facilitate systematic data extraction, the 65 selected articles have been saved to an excel sheet. Data extraction on: Article, Author, Telemedicine use case (or general telemedicine), Identified barriers, Identified facilitators, Country of research, Taxonomy term used for telemedicine, UTAUT construct (if discussed). Furthermore, these articles have been analyzed manually, with an emphasis on identifying adoption factors of telemedicine. Specifically, adoption factors were identified, grouped, and categorized according to the focused construct of the UTAUT framework, or classified separately if not applicable to UTAUT. Furthermore, the analysis covered various aspects, including history and potential of telemedicine, adoption frameworks and theories, and the definition of telemedicine on the broad taxonomy. In addition, the papers were color-coded in the excel sheet to indicate if interviews were utilized in the research, the UTAUT framework was applied, or a particular study on telemedicine adoption factors was performed.

V. Visualization systematic review by PRISMA

PRISMA (Preferred Reporting Items for Systematic review and Meta-Analyses) is used for reporting on systematic reviews and meta-analyses (Moher et al., 2009). For this study PRISMA has been applied to ensure that the literature review was systematic and transparent. The PRISMA four-phase flow diagram covers the identification of articles, the screening by eligibility criteria and the included articles for literature review (Moher et al., 2009). This study’s flow diagram has been visualized in Figure 4. In this Figure ‘n’ presents the number of articles, which have been identified, screened, or selected for analysis in the literature review. The

selected articles follow from three different search methods, either articles through database search in Scopus from the search strings, by snowballing or one article has been obtained from an expert. See Appendix II and III for the selected articles for the literature review.

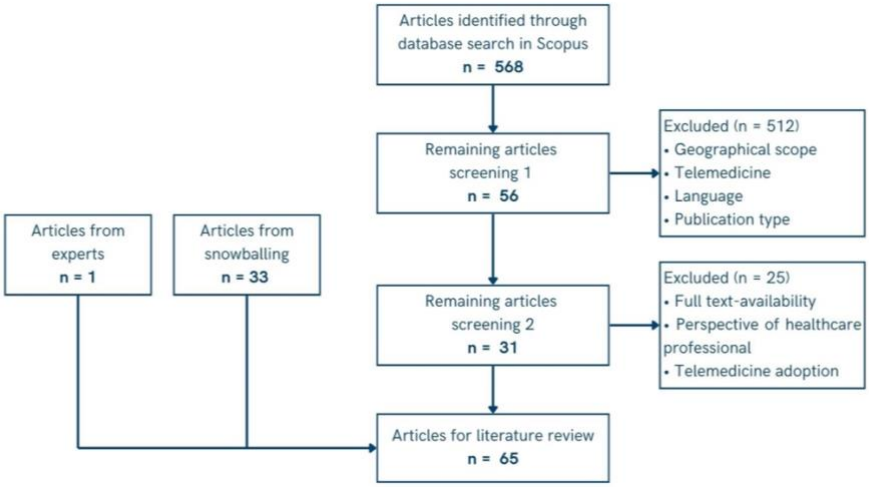

Figure 4. PRISMA flow diagram

2.3.2 Interviews

Interviews have been chosen to provide insights in the context of LRS, and to gain a realistic understanding from experts, healthcare professionals. The interviews focused on the identification of the organizational adoption factors for telemedicine adoption in this context. Furthermore, interviews contribute to understanding individual experiences, providing in-depth information, and allowing for flexibility (Office of Research & Doctoral Services, 2015). However, interviews have several drawbacks, such as the fact that they take a lot of time, it can be challenging to analyze and compare data and may be influenced by personal bias (Office of Research & Doctoral Services, 2015). These drawbacks will be addressed by the methodology on how the interviews are performed. For the qualitative method of interviews in this study, the form of semi structured in-depth interviews have been applied. The data from the interviews has been relevant for identifying adoption factors in Chapter 4, and for the synthesis in Chapter 5 In this paragraph the structured approach for performing the interviews will be covered including participant selection, interview design and questions, conducting in-depth interviews, ethical considerations and data extraction and analysis. The interview design is visualized in Figure 5, from participant selection to the data collection and data analysis. The lines to this state the activities performed.

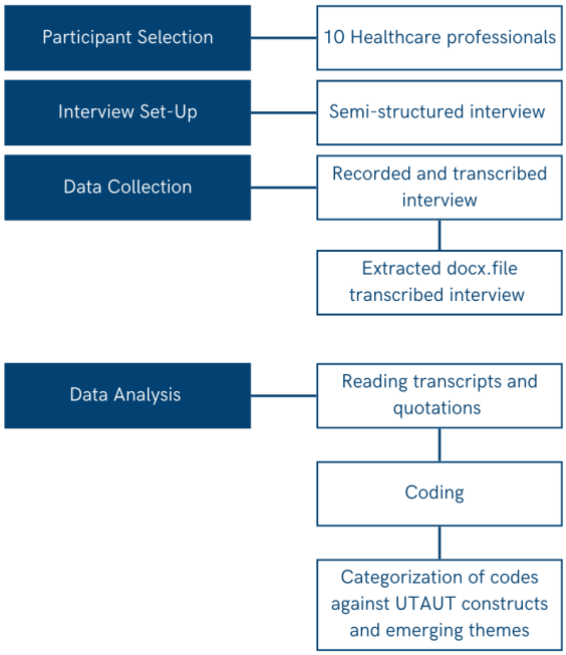

Figure 5. Interview design

I. Participant selection

The target audience for participant selection has been defined as healthcare professionals with experience with telemedicine in the context of low resource settings. This allowed for the inclusion of perspectives from experts who have been involved in the adoption of telemedicine in these settings, their experience with challenges and successes could provide insights into the organizational adoption factors. This includes individuals who either currently reside and practice in LRS or have previous experience working in these contexts. For participant recruitment contacts have been referred to from C.Adlung, the advisor of this study. Other participants have been recruited through connecting to authors of interesting publications, referrals from performed interviewees or own expert relationships. This approach enabled experts actively engaged in telemedicine in LRS, and ensured diverse perspectives and experiences. The three different perspectives are: medical, medical/organizational or academic/organizational, depending on job title and experience the interviewees have been grouped in the different perspectives, see Appendix IV. The medical perspective for interviewees working in healthcare settings with direct experience with telemedicine, the medical/organizational perspective for interviewees with experience in healthcare settings and working on their own telemedicine company, and the academic/organizational perspectives for healthcare professionals with academic positions as well as backgrounds in organizational roles. For this study 10 healthcare professionals have been interviewed. See Appendix IV for an overview of interviewees: Job title, perspective, country of telemedicine experience, country of base and discussed telemedicine use case.

II. Interview set up

For the interview design as described, a semi-structured interview guide has been developed, with open-ended questions aimed at exploring the organizational adoption factors of telemedicine adoption. Open-ended questions are frequently used for exploratory research (Saunders et al., 2019). By following the participant's leads during the discussions, open-ended questions can uncover elements not previously considered. Thereby mitigating the barrier of bias during the interviews, to encourage interviewees to express their perspectives and experiences and not be influenced by personal bias. Literature suggested using a predefined set of questions that have already been tested in other studies, but only used as a guide (Makri & Neely, 2021). Therefore, the interview questions have been defined according

to articles that performed interviews based on the UTAUT construct of facilitating conditions (Rouidi et al., 2022; Rouidi et al., 2023), and the article of (Venkatesh et al., 2003). In this study, the sub constructs of the UTAUT have been assigned to specific colors. Furthermore, item labels have been developed for these sub constructs aligned with both the UTAUT items from Venkatesh et al. (2003) and the interview questions adapted from Rouidi et al., (2023). Each interview question corresponds to a specific sub-construct of the UTAUT, allowing for clarity in coding and data analysis. Appendix V presents a Table that lists the main construct, sub-constructs and defined item labels, and corresponding color codes. This structure and use of colors has been applied throughout this entire study.

From literature, participants do not always state the truth, but may say what they think the interviewer wishes to hear (Anderson, 2010). As a result, a set of questions has been developed that do not steer the interviewee's response. For these questions, main questions have been defined, along with some follow-up questions. Depending on interviewees' perspectives, a distinct set of interviewee questions has been formed, see Appendix VI and VII for the interview design and questions. This approach aimed at gathering genuine responses rather than responses according to expectations.

As previously indicated, the interviewees have been introduced to a 3D telemedicine system. The interviewees were presented to the mock-up version of this 3D telemedicine system and discussed this relating to the use case discussed in the interview, see Appendix VIII and IX for the design of the mock-up. Using the case of the proof-of-concept study by (Lo et al., 2024), on consultation by a real-time 3D telemedicine system leveraging Microsoft's Holoportation communication technology to consult with complex reconstructive patients before, during, and after an overseas surgical collaboration in Ghana. The adoption of this 3D system has been compared with the discussed use case, providing insights into the adoption factors of such advanced telemedicine technologies.

III. Conducting in-depth interviews

Interviews were performed using MS TEAMS between April 2024 and May 2024. Each interview took 45 to 60 minutes and was recorded and transcribed using Teams. The interviews have been recorded to mitigate the limitations of interviews, as recording facilitates focused interviewing and the transcripts enable easy analysis and comparison of the data (Jamshed, 2014).

The selection of interview questions has been tailored based on the background of the interviewees as described. During the interview, the use case of telemedicine was determined: either by personal experience or by introducing the interviewee to a specific use case: Teleconsultation. Interview questions served as a guide for discussion, supplemented by additional questions to reveal emerging themes (Makri & Neely, 2021). This methodology has been consistently applied throughout the interviews to explore these emerging themes.

IV. Ethical considerations

Ethical approval has been obtained prior to conducting the interviews. Participants have been informed on the study's purpose, their rights, and confidentiality on their responses. Written informed consent has been obtained from all participants, see Appendix X. Furthermore, the Human Research Ethics Committee (HREC) has approved performing this study involving data obtained from Human Research Subjects at the 17th of April 2024, with the application number 4320.

V. Data extraction and analysis

The transcripts have been downloaded from MS TEAMS in docx files and imported to the software of Atlas.ti for the coding process. The following steps described are visualized in Figure 6 by the coding process.

First, the transcripts have been read and relevant text has been quoted. These quotations have been coded and grouped to the code groups, according to the UTAUT model. The construct of facilitating conditions from the UTAUT model formed the main code group of the qualitative analysis. The code groups have been made following the UTAUT model sub constructs, and colored as described above and presented in Appendix V During the coding process a difference between barriers, facilitators, and approaches to overcome have been made. Furthermore, codes that did not directly correspond to the UTAUT constructs as described in Appendix V, thus pre-existing codes, but still influenced adoption were also included in the analysis, by assigning new codes, grouped under 'Emerging'. In this study 'Emerging' refers to new or novel aspects that develop from exploring the adoption factors by the UTAUT framework, exposing previously unrecognized themes.

Second, after assigning the text to codes and organizing them into code groups and categories, the next step involved counting the frequency of code occurrences and the number of interviewees who mentioned each code at least ones. By analyzing both these frequencies, patterns emerged regarding which adoption factors were most cited in and by the interviewees. This frequency analysis provided valuable insights into the factors influencing the adoption of telemedicine, as it highlighted the most mentioned barriers, facilitators, and approaches to overcome mentioned by the healthcare professionals.

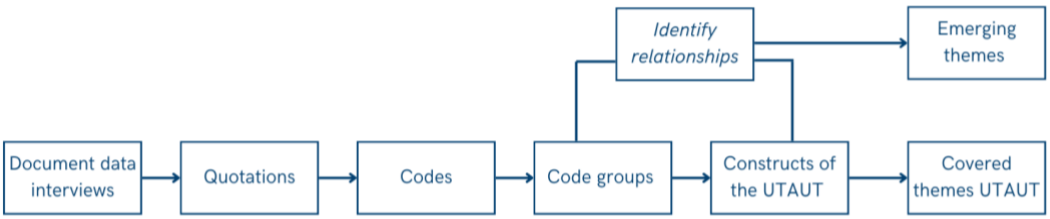

Figure 6. Coding process

Third, as described in the participant selection, all selected participants are healthcare professionals, but with different perspectives. For the data analysis has been examined how these different perspectives influence the study's findings. To visualize these insights, Sankey diagrams were generated using Atlas.ti. The Sankey diagrams illustrated the flow of data between the interviewees and the code categories, allowing to see relationships based on the width of the paths. For the analysis of the influence of the different perspectives form the interviewees in this study on the findings, three different analyses have been performed. The first analysis performed manually, where conclusions have been drawn reflecting on which perspectives addressed which adoption factors. For this analysis the adoption factors have been analyzed individually. The second analysis has been performed on single code occurrences, where the adoption factors have been examined collaboratively. The third analyses focused on multiple code occurrences and analyzed the Sankey Diagrams following from Atlas.ti. The findings from the three analyses have been compared to conclude on the influence of different perspectives in this study. For the calculations see Appendix XI and XII.

During the coding process, the coding was collaboratively reviewed with the supervisor and another student during a coding session on the 4th of June 2024. This student also uses the UTAUT framework for and focuses research on telemedicine adoption. This collaborative approach involved examining and discussing the initial codes to ensure their accuracy and relevance. Through these discussions, diverse perspectives and insights were incorporated,

leading to refined coding strategies. This process resulted in a more nuanced understanding of the data, thereby enhancing the depth of the analysis.

2.4 Data Analysis

Atlas.ti has been used as a qualitative method tool, to present data graphically. The transcribed interviews have been analyzed using thematic analysis to identify common themes and patterns relating to the research context, by grouping and ordering. Both inductive and deductive coding have been applied to categorize data and to draw insights. According to Strauss and Corbin there are three main sources to derive names for categories: terms emerging from data, based on terms used by participants, or derived terms used in existing theory and literature (Saunders et al., 2019). Data analysis has been performed to identify themes emerging from the interviews. Deductively against the facilitating conditions construct of the UTAUT, so terms derived from existing theory and literature. Inductively, by identification of categories that may fall outside the facilitating conditions construct of the UTAUT, so terms emerging from data and terms used by participants. In this study the sub constructs of the construct facilitating conditions have been colored as presented in Appendix V perceived behavioral control (green), facilitating conditions (orange), compatibility (purple) and emerging themes (blue). Data categories have been made and looked at how they align with the UTAUT construct. For categories that may fall outside that construct has been looked at the whole UTAUT framework if these categories are captured in other constructs. In Chapter 6, the findings have also been reflected in the study by Rouidi et al. (2022) and Rouidi et al. (2023).

Based on the categories that may fall outside the constructs, also has been looked at if these organizational adoption factors are also reflected in literature. Allowing for a comparison between the findings from literature and interviews, this will be covered in Chapter 5. So, the emerging themes following from interviews have been reflected with the literature, to see overlapping concepts. Through this comparative analysis, the alignment of identified organizational adoption factors with the UTAUT framework's facilitating conditions construct and other constructs has been evaluated, and adaptations have been proposed to capture the organizational adoption factors relevant to telemedicine adoption for healthcare professionals in low resource settings.

Initially this study intended to apply the adoption framework within a specific setting to get more information out of it, as described particularly through the introduction of the 3D telemedicine system to the interviewees as described. However, by reflection based on gathered experience, it became clear that this does not really contributes and aligns with the goal and findings of this study. Therefore, the concept of the 3D telemedicine system has been excluded from the data analysis and has been included in Appendix XIII. In Chapter 6, the discussion will be reflected on this advanced telemedicine system.

2.5 Ensuring Validity and Reliability

Validity ensures that the data collected truly represents what's being studied, and reliability ensures reproducibility and stability of the data (Anderson, 2010). For this study validity is enhanced by using different sources, literature review and interviews, and methods for analysis and discussion towards findings. Careful and transparent data collection and analysis ensures reliability, this refers to this methodology where the search strings, the interview design and how the analysis of data has been performed are presented. Through the comparative analysis of data from literature and interviews, this treats the data as a whole rather than as a fragment, according to Anderson (2010), this approach ensures validity and reliability.

2.6 Reflection on the Use of AI Tools

For this study, AI tool (ChatGPT) has been used for support for feedback on the structure of this thesis. More clearly, feedback on the ideas for the structure of sub-headers in a Chapter. Used to clarify own thinking, and support to make this thesis well-structured and presented. To ensure academic integrity, ChatGPT has only been used for these purposes, the findings and content in this research are created by the researcher.

3 Adoption Frameworks for Telemedicine Adoption

3.1 Introduction

This Chapter identifies how to examine the adoption of telemedicine in LRS, answering sub question 1. The data for this Chapter has been drawn from the literature review as described in Chapter 1. This research method is relevant for the examination of telemedicine adoption to determine the theoretical framework of this study and assess the existing data on adoption of telemedicine in LRS. Different adoption theories have been examined based on developed criteria which will be discussed in this Chapter, resulting in the selection of a framework for this study. Furthermore, by the analysis of the selected adoption framework the importance of focusing on organizational adoption factors and choosing healthcare professionals' perspectives will be outlined by research.

3.2 Adoption Theories

A number of theoretical frameworks exist to help contextualize the factors that influence uptake of technology by end users (Janssen et al., 2021). The evolution of technology acceptance theories and models have been initiated since the beginning of the 20th century and is still evolving. This evolution took place in different theoretical perspectives, such as: cognitive, affective, motivational, and behavioral intentions and the reactions of individuals (Venkatesh et al., 2003). As a part of the software quality activities in the software engineering field, information systems adoption, acceptance and usage behavior have started to attract attention since the 1970s as an initial step for technologies' utilization and realization. Currently, to understand the cause of users' accepting or rejecting any new technology has become an integral task in many information systems' lifecycle (Venkatesh et al., 2003). Technology must be aligned with complex technical artifacts and institutional norms to effectively use the technology in a sustainable and scalable manner (Getachew et al., 2022). Due to the variety of models and behavioral (individual) factors, in each country, technology and context, many studies have been conducted with different models of acceptance of telemedicine among physicians, each one of them introducing specific factors and models (Garavand et al., 2022). Furthermore, technology acceptance models are open for modification and extension due to the evolving nature of human behavior, practice, and technology and the need for contextualizing constructs to a target population (Shiferaw et al., 2021).

Two relevant studies identified applied adoption frameworks for telemedicine adoption. Study by Adlung et al. (2024) identified the most often underpinning frameworks used for the adoption of Medical Devices and Equipment (MDE). According to the U.S Food & Drug Administration (2020), telemedicine, as part of the broad scope of digital health, involves the use of various medical devices and equipment to provide remote services to patients. As a result, it is assumed that the findings of this article on frameworks are applicable to the context of telemedicine. Garavand et al. (2022) argued that the most underpinning frameworks are: Diffusion of Innovation Framework (DoI), Technology Acceptance Model (TAM), Consolidated Framework for Implementation (CFIR), Promoting Action on Research Implementation in Health Services Framework (i-PARIHS), Task Technology Fit Framework (TTF), Unified Theory of Acceptance and Use of Technology (UTAUT), Unified Theory of Acceptance and Use of Technology 2 (UTAUT2). Study by Garavand et al. (2022), identified behavioral factors

influencing the acceptance of telemedicine technology among physicians in different contexts by a literature review. This was the first study to assess the models and factors affecting the acceptance of telemedicine from the perspective of physicians as key users of the system, to provide an overview and theory of behavioral models and factors performed in different types of telemedicine technology. Results from this study show that half of the studies on telemedicine acceptance used the original TAM model, or extended TAM or TAM2 models. Followed by Theory of Planned Behavior (TPB), DoI models and combinations of these models. From this study the UTAUT model also followed as being performed among physicians (Garavand et al., 2022).

Looking at the research of Adlung et al. (2024) and Garavand et al. (2022) it has been analyzed which frameworks were presented in both studies: TAM, UTAUT and DoI models, and have therefore been chosen to focus on. From literature it follows that in the health context, the TAM and UTAUT are among the widely used models to predict acceptance behavior (Rouidi et al., 2022). Specifically focusing on telemedicine, different efforts have been made to analyze the acceptance and use of telemedicine, TAM and UTAUT are the most widely used models to understand adoption of technology in healthcare (Rouidi et al., 2023). The TAM and UTAUT frameworks have been applied in the articles following from the search string, the DoI framework did not appear throughout all articles. However, as from research by Adlung et al. (2024) and Garavand et al. (2022) DoI is assumed to be an interesting framework for telemedicine adoption, therefore this framework has been analyzed. Furthermore, several articles use combinations of theoretical models, for this study the framework designed by Roudi et al, modified version of the UTAUT has also been analyzed. For these four frameworks, TAM, UTAUT, DoI and combination of models a background and introduction will be discussed followed by an analysis of a variety of criteria to determine the most suited framework for this study. The order of discussion for these four frameworks, starts with the TAM followed by the UTAUT, since they have been presented in both studies by of Adlung et al. (2024) and Garavand et al. (2022) and the search string, followed by DoI framework that did not appear from the search string. Fourth, the discussion of these frameworks provides background for the introduction of the combination of models.

3.2.1 Background and Introduction TAM

Technology Acceptance Model (TAM) is among the most popular theories to study the adoption of technology (Rouidi et al., 2023). The theory argues that a person's intention to use and usage behavior of a technology can be predicted by a person's perceptions of the specific technology's usefulness and ease of use, see Appendix XIV. TAM, an information technology framework for understanding user's adoption and use of emerging technologies, was developed and introduced by Davis in 1985 (Davis, 1985). Davis (1985) developed this theoretical model according to two objectives. Firstly, to improve understanding of user acceptance processes, providing new theoretical insights into successful design and implementation of information systems. And secondly, to provide the theoretical basis for a practical "user acceptance testing" methodology to evaluate new systems prior to implementation. According to the model, a potential user's overall attitude toward using a given system is hypothesized to be a major determinant to actually use it. Followed by two beliefs: perceived usefulness and perceived ease of use (Davis, 1985). Perceived usefulness is defined as the extent to which a person believes that using the system will enhance his or her job performance. Perceived ease of use is defined as the extent to which a person believes that using the system will be free of effort. According to TAM the effects of external variables on intention to use are mediated by perceived usefulness and perceived ease of use (Venkatesh & Davis, 2000). This model has been shown to be one of the most effective models in the information systems literature for predicting user acceptability and behavior (Venkatesh & Davis, 1996). The approach to TAM can be quantitative or qualitative. Quantitative approaches based on TAM are most common in this research; however, according to research

by Vogelsang et al. (2013) the qualitative approach on TAM allows for a theory building process. According to researchers, due to its simplicity this model is a powerful tool, TAM has been shown to be effective in predicting and explaining usage across a variety of new technologies. TAM has been subject to improvements and adaptations, with a new version called TAM2 and TAM3 (Rouidi et al., 2022; Rouidi et al., 2023).

3.2.2 Background and Introduction UTAUT

According to Venkatesh et al. (2003) researchers were confronted with a choice of multiple models and ignored the contributions from alternative models, therefore there was a need for a review and synthesis in order to progress towards a unified view of user acceptance Venkatesh et al. (2003) formulated different objectives: to review the existent user acceptance models, to empirically compare the eight models, to formulate the UTAUT and to empirically validate the UTAUT (Venkatesh et al., 2003). See Appendix XV for visualization of UTAUT. In 2003 the following eight model of technology acceptance have been reviewed in that study: Theory of Reasoned Action (TRA), Theory of Planned Behavior (TPB), Technology Acceptance Model (TAM), the combination form of TAM and TPB (C-TAM-TPB), Model of PC Utilization (MPCU), Innovation Diffusion Theory (IDT), Motivation Model (MM), and the Social Cognitive Theory (SCT) (Venkatesh et al., 2003). The chronological evolution and development stages have been outlined by Momani & Jamous (2017), visualized in Appendix XVI. This Figure illustrates the timeline of models reviewed for the UTAUT, showing this models' broad coverage. By consolidating and improving models of information technology acceptance, the model is based on the conceptual and empirical similarities of the eight models (Rouidi et al., 2023). The developed unified model, UTAUT, was formulated with four core determinants of intention and usage: performance expectancy, effort expectancy, social influence and facilitating conditions, and four moderators of key relationships: gender, age, experience and voluntariness of use (Venkatesh et al., 2003). The UTAUT model has become one of the most integrated and developed technology acceptance theories by adopting the most advantageous constructs from other theories and models (Momani & Jamous, 2017; Venkatesh et al., 2003).

3.2.3 Background and Introduction Diffusion of Innovation (DoI)

Rogers (1983), investigated how the properties of an innovation affect its rate of adoption, which can be of great value to change agents seeking to predict the reactions of their clients to an innovation, see Appendix XVII for the Diffusion of Innovation (DoI). The rate of adoption refers to the relative speed with which an innovation is adopted by members of a social system (Rogers, 1983). According to this theory, innovation is an idea, process, or a technology that is perceived as new or unfamiliar to individuals within a particular area or social system (Zhang et al., 2015). He described five different attributes of innovations to work towards a comprehensive set of characteristics of innovation that are as mutually exclusive and as universally relevant as possible, serving as the general framework: Relative advantage, compatibility, complexity, trialability and observability (Rogers, 1983). The DoI by Rogers (1985) also argues that there are five adopter categories to innovativeness. In which innovativeness is the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than other members of a societal system. These five adopter categories are: Innovations, Early adopters, Early majority, Late majority, and Laggards. Where diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system (Rogers, 1983). After this development, Rogers reworked this theory in 1995, and 2003 (Hassani et al., 2017). Roger's DoI is one of the most popular theories for studying adoption of information technologies and diffusion of innovation theory has been used to study individuals' adoption of new healthcare information technologies (Zhang et al., 2015).

3.2.4 Background and Introduction to Combination of Adoption Models

Findings from study by AlQudah et al., (2021) discussed that several studies discussed integrated models, to explain explanatory power. In the field of telemedicine technology, several studies have looked to utilize TAM and UTAUT to analyze healthcare professionals' attitudes regarding these new technologies, using the original TAM model and the original UTAUT model and modified versions of these models. The study of Roudi et al. (2022) and Roudi et al. (2023) aimed to use a modified version of the UTAUT theoretical model, to understand the factors that may influence the acceptance of telemedicine technology by healthcare professionals. It could be argued that this model is relevant to this study's aim, however, the research in 2022 has not been conducted particularly for the context of LRS, as that is the focused context of this study. The study of Roudi et al. (2023) on the other hand focused on the research context of Morocco, a LRS. Therefore, this model will be reflected according to the criteria established.

Appendix XVIII, presents the modified version of the UTAUT model from Rouidi et al. (2023) to explain and understand the factors influencing healthcare professionals' intention to accept telemedicine technology. The model summarizes six research hypotheses and integrates the original UTAUT model with factors important for this adoption behavior. For the original UTAUT the variable of ‘social influence’ has been excluded, but using the variables performance expectancy, effort expectancy, facilitating conditions and behavioral intention. This model extended with the variables perceived incentive, compatibility and level of IT use. Furthermore, this model includes three dimensions as from other related studies on the three different contexts: individual context, technological context and organizational context (Rouidi et al., 2023).

3.3 Criteria for Selection

To evaluate TAM, UTAUT, DoI and combination of adoption models, several criteria have been established based on key aspects of this study such as adoption, particularly in the context of LRS, organizational adoption factors, qualitative research methods and two other relevant study characteristics. The criteria used for analyzing the introduced frameworks and relevance are explained below.

Criteria 1: Comprehensive factors for adoption
Description: Since this research is focused on adoption, therefore it is important that the framework reflects adoption factors. The aim of this study is to identify organizational adoption factors against a framework and to explore emerging themes within this construct. Therefore, it is interesting that the framework addresses comprehensive adoption factors, allowing for comparison.

Criteria 2: Applicability to different contexts
Description: This study focuses on the context of LRS, it is relevant for the selected framework to be usable in a variety of contexts, to be applicable for use in LRS.

Criteria 3: Includes organizational focused construct
Description: The aim of this study is to identify organizational adoption factors. An organizational focused construct is thus required.

Criteria 4: Suitability for qualitative research
Description: Given that this study employs qualitative research methods, the framework must support these methods. Frameworks solely focused on quantitative methods will not be suitable.

Criteria 5: Flexibility and adaptability
Description: To contribute towards a theoretical framework addressing telemedicine adoption by healthcare professionals in LRS, emphasis on flexibility and adaptability are interesting since these attributes allow the framework to be adjusted and refined based on emerging insights.

Criteria 6: Temporal alignment and study period
Description: Reflecting on this criterion is important since considering the temporal alignment and study period helps identify the limitations of the framework which can be considered when selecting.

3.4 Analysis of Adoption Frameworks

For the established criteria the four selected adoption frameworks have been evaluated. An overview of the findings is presented in Table 1 and below the criteria have been elaborated.

Framework	Criteria 1	Criteria 2	Criteria 3	Criteria 4	Criteria 5	Criteria 6
TAM	Perceived ease of use and perceived usefulness	Applicable in contexts, with challenges	No organizational focused construct	Primarily quantitative	Rigid structure	1985
UTAUT	Performance expectancy, effort expectancy, social influence and facilitating conditions	Applied in different contexts	Facilitating conditions	Both qualitative and quantitative	Flexibility, to customize	2003
DoI	For diffusion but not for adoption	-	-	-	-	-
Combination of models (Modified UTAUT)	Perceived incentive, level of IT use, performance expectancy, effort expectancy, compatibility and facilitating conditions	First study applied to different contexts, second study only 1 country scope	Dimension organizational construct: facilitating conditions and compatibility	Qualitative	Modified framework	2023

Table 1. Analyzed frameworks for adoption of telemedicine in LRS based on criteria

3.4.1 Analysis of Criteria

Criteria 1: Comprehensive factors including adoption
As from Table 1, TAM focuses on two main factors. The UTAUT extends the TAM by incorporating additional factors on performance expectancy, effort expectancy, social influence

and facilitating conditions. Furthermore, the UTAUT also includes moderators like age, gender, experience, and voluntariness, enhancing the ability to explain user behavior (Venkatesh et al., 2003). A systematic review on TAM and UTAUT argued that UTAUT has shown 20-30% better explanatory power than the TAM model, and the UTAUT has the capability to explain the intention to use specific technology can reach 70%, especially when including facilitating conditions and social influence factors (Rouidi et al., 2023). For the combined model, this model synthesizes research on the acceptance and use of technology by grouping together several variables with a significant effect on user behavior (Rouidi et al., 2022). However, this model does not take into account the moderators as in the UTAUT model, therefore not as comprehensive as the original UTAUT model. For the DoI framework the five attributes of innovation and five adopter categories, addressing not only the factors that affect adoption but also the entire process, as described in the five stages (Frei-Landau et al., 2022). Therefore, it could be argued that this framework covers comprehensive factors, however not for the purpose of adoption. From Rogers, diffusion of innovation theory provides steps necessary to promote the adoption of new ideas (Mohammadi et al., 2017). For this study the purpose is to focus on adoption and not diffusion. From literature these concepts are related but have a different definition. Diffusion is the communication process through which an innovation travels or spreads through certain channels, and adoption is the decision (acceptance or rejection) and subsequent implementation by an individual or an organization (Dearing, 2008; Kee, 2017). The study by Dearing (2008) visualized adoption and diffusion in a graph from which follows these are related but not comparable concepts, see Appendix XIX. Following this first criteria, this criteria is not matched and shows that this research will not choose for this theoretical framework, the additional criteria are therefore not researched as this criteria is overarching for the decision not to use the DoI framework for this study.

To conclude, UTAUT demonstrates explanatory power over TAM and the combination of adoption models. The DoI framework is insufficient due to the focus on diffusion rather than adoption, and therefore does not aligns with the focus of this study.

Criteria 2: Applicability to different contexts
According to Davis (1985), TAM is a general model, capable of being applied across a wide range of end-user systems contexts. Unfortunately, the benefit, or product, of using a system would appear to vary widely across system characteristics (Davis, 1985). Furthermore, although the TAM has been widely accepted in IT and information systems technology acceptance research, the original TAM model has been challenged for different reasons and within different contexts (Miller & Khera, 2010). The UTAUT model has been widely used to explore adoption across diverse domains, geographical locations, and industries, both in organizational or non-organizational settings (Biloš & Budimir, 2024). The framework of Rouidi et al. (2022) can be adapted to different contexts. This study reviewed 13 articles in different contexts, covering 11 different countries, from which 1 country is LRS, Nigeria (Rouidi et al., 2022). The study of Rouidi et al. (2023), focused on the research context of Morocco, a LRS, but on the other hand this is only in one specific LRS context.

To conclude, the TAM is introduced for capability in different contexts but varies widely, the UTAUT has been widely applicable across different contexts and the studies by Rouidi et al. (2022) only to a few settings, and the study by Rouidi et al. (2023) only in one specific setting.

Criteria 3: Includes organizational focused construct
The TAM does not focus on an organizational focused construct. From the analysis of adoption models by Venkatesh et al. (2003), argued that the studies technologies have been simple, individual-oriented as opposed to more complex and sophisticated organizational technologies. Furthermore, Davis (1985) argued the inability of TAM to measure actual organizational acceptance of systems.

As discussed from Table 1, the UTAUT covers a specific construct focused on organizational factors, facilitating conditions construct. The combined model of Rouidi et al. (2022) and Rouidi et al. (2023) specifically included a dimension on the organizational context covering the variables compatibility and facilitating conditions. Both organizational constructs and dimensions have been further analyzed to compare and identify overlapping elements. In Table 2 and 3, the constructs have been compared based on definitions and items/questions by the articles. The color codes for the sub constructs as described in Chapter 2 can be seen here. For clarity in the following paragraph the framework by Venkatesh et al. (2003) is referred to as the original UTAUT framework, and the framework by Rouidi et al. (2022) and Rouidi et al. (2023) is referred to as the modified UTAUT framework. The content of Tables 2 and 3 is elaborated as follows.

First, looking at the definitions of the constructs, the definition of facilitating conditions by Rouidi et al. (2022) and Rouidi et al. (2023) is the definition of the overall construct of facilitating conditions by Venkatesh et al. (2003). As this definition from the original UTAUT reflects, facilitating conditions are defined as 'the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system'. Furthermore, Venkatesh et al. (2003) describes that this definition captures concepts embodied by three different constructs: perceived behavioral control, facilitating conditions and compatibility. The definition of the concepts by the original UTAUT framework on perceived behavioral control, and facilitating conditions are not covered by the modified UTAUT framework. Looking at the definition of compatibility by the original UTAUT framework and the modified UTAUT framework these definitions capture the same. According to Rouidi et al. (2022) and Rouidi et al. (2023), compatibility construct is added to the framework of the original UTAUT, however looking into the concepts of the original UTAUT, this concept has already been covered. Diving into the items discussed by the two frameworks in Table 3. The items discussed by the modified UTAUT framework are also included in the original UTAUT framework, only separated over the construct of perceived behavioral control, and facilitating conditions. And the article of the original UTAUT framework extends with additional items. On the concept of compatibility from the modified UTAUT framework, the items following from the two frameworks reflect the same. Overall, this comparative analysis of the organizational construct/dimension by from the two frameworks highlights that the framework of Rouidi et al. (2022) and Rouidi et al. (2023) builds upon the foundational elements of UTAUT, it largely reiterates the construct items already addressed by Venkatesh et al. (2003), therefore reaffirming the foundational principles established by the UTAUT.

Construct	Definition by Venkatesh et al. (2003)	Definition by Rouidi et al. (2022) and Rouidi et al. (2023
Perceived Behavioral Control	Reflects perceptions of internal and external constraints on behavior and encompasses self-efficacy, resource facilitating conditions, and technology facilitating conditions.	Not applied in this model
Facilitating Conditions	Objective factors in the environment that observers agree make an act easy to do, including the provision of computer support.	Degree to which an individual believes that an organizational and technical infrastructure exists to support the use of the information system.
Compatibility	The degree to which an innovation is perceived as being consistent with existing values, needs, and experiences of potential adopters.	Degree of correspondence between innovation and existing values, past experiences, and the needs of potential users.

Table 2. Comparison on definitions constructs of original UTAUT (Venkatesh et al., 2003 and modified UTAUT (Rouidi et al., 2022; Rouidi et al., 2023).

Construct	Definition items by Venkatesh et al. (2003)	Definition items by Rouidi et al. (2022) and Rouidi et al. (2023
Perceived Behavioral Control	- I have control over using the system - I have the resources necessary to use the system - I have the knowledge necessary to use the system - Given the resources, opportunities and knowledge it takes to use the system, it would be easy for me to use the system - The system is not compatible with other systems I use	Not applied in this model
Facilitating Conditions	- Guidance was available to me in the selection of the system - Specialized instruction concerning the system was available to me - A specific person (or group) is available for assistance with system difficulties	- Do you think you will have all the resources you need to use telemedicine? - Do you think you will have all the knowledge you need to use telemedicine? - Do you think you will have people to assist you if you have difficulties using telemedicine?
Compatibility	- Using the system is compatible with all aspects of my work - I think that using the system fits well with the way I like to work - Using the system fits into my work style	- How do you rate the impact of telemedicine's compatibility with aspects of your job on your intention to accept this technology? - How do you judge the impact of telemedicine's compatibility with the way you work on your intention to accept this technology? - How do you judge the impact of telemedicine's integration with your work style on your intention to accept this technology?

Table 3. Comparison on items of original UTAUT (Venkatesh et al., 2003) and modified UTAUT (Rouidi et al., 2022; Rouidi et al., 2023).

In conclusion, TAM lacks an organizational focus, UTAUT addresses this with the construct of facilitating conditions, further developed in the modified UTAUT frameworks of Rouidi et al. (2022) and Rouidi et al. (2023), which have been built upon and reiterates the construct of facilitating conditions by Venkatesh et al. (2003).

Criteria 4: Suitability for qualitative research

Quantitative approaches based on TAM are most prevalent in this research stream; however, according to Vogelsang et al. (2013) research the qualitative approach on TAM allows for a theory building process. The UTAUT is suitable for qualitative and quantitative designs,

qualitative studies have been performed in various research for telemedicine and health-care services (Dockweiler et al., 2015; Pagaling et al., 2021; Virtanen et al., 2023). The first study of Rouidi et al. (2022) performed a literature review. The study in 2023 performed a qualitative study with semi-structured interviews and qualitative analysis, this framework is suitable for qualitative research (Rouidi et al., 2023).

To conclude, TAM mostly utilizes quantitative approaches, the UTAUT has adaptability to both quantitative and qualitative approaches, and the combination of adoption models includes qualitative research methods.

Criteria 5: Flexibility and adaptability

The TAM and UTAUT are robust theories to understand the acceptance of various technologies through different users, for both frameworks there is the availability to integrate various technology acceptance models or add other factors to produce more robust and valid acceptance models (Rouidi et al., 2023). Technology acceptance models are open for modification and extension due to the evolving nature of human behavior, practice, and technology and the need for contextualizing constructs to a target population. From the article of Venkatesh et al. (2003), it has been argued that further research should investigate other potential constructs. This relates to the flexibility and adaptability of the framework. Furthermore, several studies adapted or changed the TAM and frameworks for example the study by (Campbell et al., 2017; Janssen et al., 2021; Soroush et al., 2010; Schmitz et al., 2022). These frameworks' flexibility and adaptability may also be shown from the study of Rouidi et al. (2022) and Rouidi et al. (2023), who designed a modified version of the UTAUT.

In conclusion, TAM and UTAUT provide robust frameworks for understanding technology adoption, offering flexibility to integrate additional factors to the frameworks, this is demonstrated by the studies of Rouidi et al. (2022) and Rouidi et al. (2023).

Criteria 6: Temporal alignment and study period

Looking at temporal alignment and study period, the UTAUT was proposed by Venkatesh in 2003 and the TAM was developed by Davis in 1985. It could be argued that the evolution of technology, technological advancements since then may challenge the relevance of these frameworks in the current digital environment. On the other hand, the UTAUT already synthesizes several years of research on the acceptance of new technologies by combining several variables with a significant effect on usage behavior (Rouidi et al., 2023). For the study of Rouidi et al. (2023) it has been designed and applied during COVID-19. As discussed, adoption of telemedicine since the COVID-19 pandemic has massively increased because telemedicine provides a means to access medical services without direct physical contact, where there was an urgent need for a rapid and adequate reaction to the pandemic's disruption of healthcare systems. This rapid adoption of technologies in everyday life on a global scale is unprecedented (Liu & Miguel-Cruz, 2022). The article by Liu & Miguel-Cruz (2022) argued that the adoption process is not a single event, but instead a complex process in which an individual's beliefs and attitudes evolve over time and lead to a final decision about whether to adopt a technology. Given the rapid adoption during COVID-19, this could have affected the study results of Rouidi et al. (2023),and may not capture the evolving nature of technology adoption process as described in literature.

Overall, the temporal alignment of the TAM and UTAUT raise questions on their relevance for current technological advancements. Though the study of Rouidi et al. (2023) has been performed during COVID-19, highlighting the complexity and evolving nature of technology adoption.

3.4.2 Selected Framework

First, the focus of the DoI framework by Rogers has been eliminated from this study due to its focus on diffusion rather than adoption. Although diffusion and adoption are interrelated concepts, and Rogers' framework looks at adoption through diffusion, for this study the focus is specifically on adoption. Therefore, the DoI framework is not relevant for the objective of this research.

The Technology Acceptance Model (TAM) is not appropriate for this study for a variety of reasons. TAM focuses mostly on perceived utility and ease of use, lacking comprehensive factors. Second, while TAM is applicable in different contexts, it faces challenges. Furthermore, it does not address an organizational construct, which limits its usefulness. and TAM's quantitative nature limits its adaptability. Although this framework has been modified in various studies, indicating considerable flexibility, it was created in 1985 and may not be compatible with recent technological developments such as telemedicine. As a result, TAM is not preferred for this study.

Both the original UTAUT and the modified UTAUT framework by Rouidi et al. (2022) and Rouidi et al. (2023) are considered suitable for this research. The modified UTAUT framework closely aligns with this study's goal but has several limitations. Both theories provide comprehensive adoption factors and have been used in a variety of contexts, the second study of Rouidi et al. (2023) only within the scope of one country. A comparative analysis revealed that the modified UTAUT framework overlaps with the constructs of the original UTAUT framework by Venkatesh et al. (2003), particularly the construct of facilitating conditions and compatibility. Both frameworks support qualitative research methodologies and show adaptability and flexibility. However, both have limitations: UTAUT original framework's relevance may be questioned in terms of technological evolution, whereas the modified UTAUT framework during the rapid adoption phase of COVID-19 may fail to capture the nuanced process of technology adoption influenced by evolving individual beliefs and attitudes.

For this study, the original UTAUT framework by Venkatesh et al. (2003) has been chosen for exploring technology adoption, this framework is presented in Figure 7 This framework has been chosen over the modified UTAUT framework due to different reasons. First, the modified UTAUT framework by by Rouidi et al. (2022) and Rouidi et al. (2023) has substantial overlap with original UTAUT components, notably in organizational dimensions, however Venkatesh et al. (2003) includes additional items and definitions. Furthermore, the robustness and expensive validation provide a solid foundation for understanding organizational factors that influence technology acceptance (Venkatesh et al., 2003). Extensive citation (52,909) and empirical validation of the original UTAUT framework indicate reliability and applicability across diverse contexts. As opposed to Rouidi et al. (2022), only cited 37 times and Rouidi et al. (2023) 5 times, and only applied in two LRSs. Additionally, this study will also focus on different telemedicine applications and include additional perspectives of healthcare professionals.

This study will critically reflect on the organizational construct of the original UTAUT framework by Venkatesh et al. (2003). As described, since the framework of Rouidi et al. (2022) and Rouidi et al. (2023) is a modified version of UTAUT and the organizational constructs are comparable, the findings will reflect that study too. The results of this study will thus also complement the work of Rouidi et al. (2022) and Rouidi et al. (2023), this will be reflected in Chapter 6. By integrating UTAUT's established constructs this study seeks to contribute to theoretical understanding on the adoption of telemedicine from the perspective of healthcare professionals.

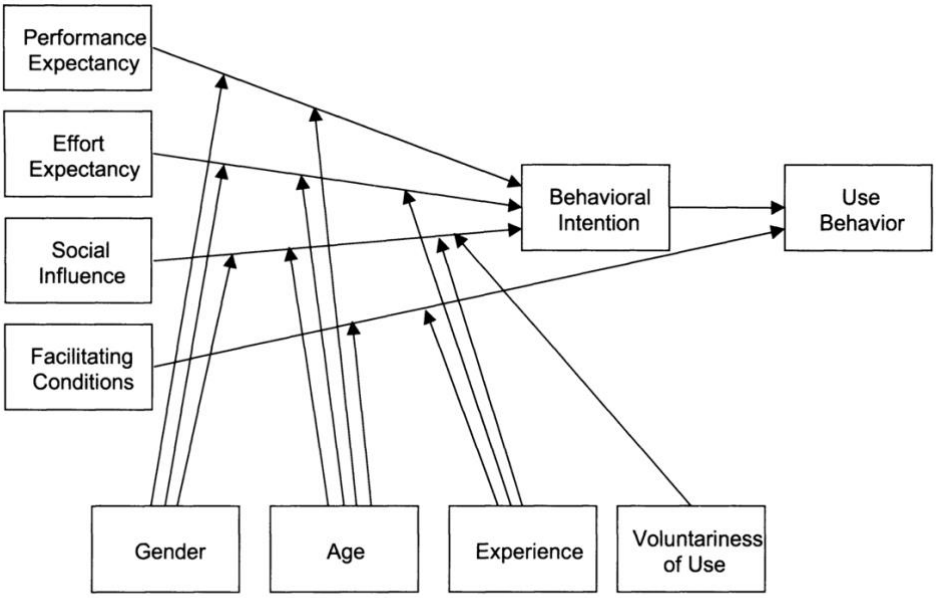

Figure 7. UTAUT Framework (Venkatesh et al., 2003)

3.5 Analysis of Selected Framework

For the selected UTAUT framework for this study, additional analysis on the constructs demonstrates the importance of organizational aspects in the adoption of telemedicine. The UTAUT model gives valuable insights on how organizational factors, by the facilitating conditions construct, influence telemedicine adoption. Focusing on healthcare professionals' perspective is essential for adoption. The next paragraphs will cover the UTAUT framework for telemedicine adoption, the facilitating conditions construct, and healthcare professionals' perspectives.

3.5.1 UTAUT for Telemedicine Adoption

Studies have been conducted using widely accepted technology acceptance and use theories to explain the underutilization of telemedicine (Getachew et al., 2022). The UTAUT model has been successfully applied for studying the acceptance and use of several telemedicine services (Pagaling et al., 2021; Virtanen et al., 2023). To contextualize the factors that influence acceptance of technology by end users this theoretical framework has been applicable (Janssen et al., 2021). For example, in studies of among other teleneurology, or in the context of digital health, to predict factors influencing healthcare professional and individual intention to adopt EMRs (Janssen et al., 2021; Pagaling et al., 2021). For instance, a study on a telemedicine device used the UTAUT model to explain healthcare professionals' behavior and health facility use (Grace et al., 2021). The UTAUT model has also been adapted to identify benefits, barriers, and facilitators on the attitude of mental healthcare professionals regarding internet-delivered interventions (Sander et al., 2021). Thus, the UTAUT model has been applied in different telemedicine scenarios, indicating its usefulness for understanding adoption factors.

3.5.2 Focused UTAUT Construct

UTAUT is predominantly composed of psychosocial and limited organization-related constructs (Getachew et al., 2022). The success rate on the adoption is linked to user acceptance, as described, driven by the constructs of the UTAUT: Performance expectancy, effort expectancy, social influence, and facilitating conditions by Pagaling et al. (2021). Introducing novel technology is often met with problems in its adoption both at the individual and organizational level. An innovation is considered successful only if it is absorbed and integrated into the organization and individuals continue to use it over a period of time (Grace et al., 2021). As discussed, this research aims to identify the factors that influence organizational adoption factors of telemedicine. The literature review shows a need for more studies on these organizational aspects. As Wubante et al. (2022) identified a gap in evaluation of telemedicine readiness highlighting the need for future research to encompass various dimensions such as organizational, technological, and societal readiness And another study by Rouidi et al., (2023) addressed the importance of organizations as for the context of LRS, telemedicine systems are strategic instruments to reduce health inequalities in LRS if they are properly designed, developed, and implemented in accordance with the organizational context of these countries. More focused on the UTAUT constructs, the study by Grace et al. (2021) examined and explained factors for adoption of a telemedicine device in health centers across the Philippines concluded that facilitating conditions, referring to the training and continuous technical support, and compatibility with clinical workflow, job demands, and social factors were the most important related to the intent-to-use (Grace et al., 2021). Other studies indicated that both infrastructural and organizational issues are important variables to be considered in the process of adoption, therefore hypothesizing that facilitating conditions have an influence on the user's attitude and intention to use the system (Shiferaw et al., 2021). The study by Getachew et al. (2022) on telemedicine adoption in Ethiopia, argued for facilitating conditions as the most important construct in the model. Elaborated by the idea of that organizational support that is put in place to lead to its use (Getachew et al., 2022). Given the observed gap in evaluating telemedicine readiness, particularly the importance of organizational support highlighted in the literature, focusing on facilitating conditions will allow to address adoption factors for the use of telemedicine in LRS. Therefore, in this study, the focus of the UTAUT framework will be on the construct of facilitating conditions. As discussed, facilitating conditions refers to' the degree that the individual believes that an organizational and technical infrastructure exists to support the use of the system', see Figure 8, for the construct of facilitating conditions by Venkatesh et al. (2003). This approach is thus focused on identifying organizational adoption factors.

Table 12. Facilitating Conditions: Root Constructs, Definitions, and Scales		
Construct	**Definition**	**Items**
Perceived Behavioral Control (Ajzen 1991; Taylor and Todd 1995a, 1995b)	Reflects perceptions of internal and external constraints on behavior and encompasses self-efficacy, resource facilitating conditions, and technology facilitating conditions.	1. I have control over using the system. 2. I have the resources necessary to use the system. 3. I have the knowledge necessary to use the system. 4. Given the resources, opportunities and knowledge it takes to use the system, it would be easy for me to use the system. 5. The system is not compatible with other systems I use.
Facilitating Conditions (Thompson et al. 1991)	Objective factors in the environment that observers agree make an act easy to do, including the provision of computer support.	1. Guidance was available to me in the selection of the system. 2. Specialized instruction concerning the system was available to me. 3. A specific person (or group) is available for assistance with system difficulties.
Compatibility (Moore and Benbasat 1991)	The degree to which an innovation is perceived as being consistent with existing values, needs, and experiences of potential adopters.	1. Using the system is compatible with all aspects of my work. 2. I think that using the system fits well with the way I like to work. 3. Using the system fits into my work style.

Figure 8. Construct of facilitating conditions UTAUT (Venkatesh et al., 2003)

3.5.3 Adoption Perspective

The decision to focus on the perspective of healthcare professionals in this study is supported by insights from existing literature. According to the article of Rouidi et al., (2022), one reason telemedicine systems have failed in the past is the lack of adoption by healthcare professionals. The slow uptake of telemedicine in LRS is failure to access health facility readiness before implementation. The introduction of telemedicine is a two-way process: it transforms the way organizations work and allows users to shape the future evolution of technology. Therefore, success can only be guaranteed if it is supported by future end users (Mensah et al., 2023; Rouidi et al., 2022). To adopt a new technology, healthcare professionals need to conduct readiness assessments of health institutions, providing guidelines to address potential challenges after implementation (Ye et al., 2023). The adoption of telemedicine depends on the readiness of organizations, people, and governments (Kiberu et al., 2018; Wubante et al., 2022; Ye et al., 2023). Studies have confirmed that healthcare professional readiness is a crucial stage that must not be underestimated before adopting evidence-based practices (Kiberu et al., 2018). Therefore, assessing the readiness of health facilities and professionals is essential before implementing telemedicine (Mensah et al., 2023). Readiness can be defined as “the state of being fully prepared for something” or “willingness to do something” (Kiberu et al., 2018).

Telemedicine acceptance and the adoption process by healthcare professionals is thus an important area to explore. Healthcare professionals are the principal users of telemedicine systems, and their acceptance is crucial, as there is a trust relationship between clinicians and

patients. They are the gatekeepers of health care delivery and the integration of digital health technologies such as telemedicine into routine clinical practice (Sander et al., 2021). Acceptance of technology is directly related to patients and must be addressed to ensure successful implementation (Adenuga et al., 2017; Rouidi et al., 2023). Therefore, the perspective of this study is focused on the healthcare professionals.

Relating this perspective to the focused UTAUT construct of this study, findings have shown that health professionals' attitude toward using telemedicine was influenced by among others the construct facilitating conditions (Pagaling et al., 2021; Shiferaw et al., 2021). Study of Pagaling et al. (2021) discussed that for facilitating conditions healthcare professionals were motivated to practice telemedicine when they had the adequate infrastructural and organizational support. A study also elaborated on additional factors threatening telemedicine adoption, such as human and organizational support factors, should be explored to further understand the perception of clinicians towards this useful technological innovation (Nguyen et al., 2022). Additionally, it is crucial to explore healthcare professionals' opinions through qualitative studies and extend the research to diverse implementation settings (Wubante et al., 2022). While previous studies utilizing the UTAUT model have provided valuable quantitative insights, it is recommended to focus on qualitative research to capture individual experiences in the practice of telemedicine (Pagaling et al., 2021). This need for qualitative studies has also been addressed, as it is useful to qualitatively, systematically structure the experiences of potential adopters (Virtanen et al., 2023). As described in the methodology, this qualitative approach will offer an understanding of the adoption factors of telemedicine, focusing on healthcare professionals' experience on the facilitating conditions construct.

3.6 Conclusion

In conclusion, the adoption of telemedicine in LRS can be examined using the UTAUT framework by Venkatesh et al. (2003), as determined after examining various adoption frameworks. UTAUT's focus on adoption, applicability across diverse contexts and the focus on an organizational construct makes it particularly suitable. Literature emphasized from using the UTAUT model for adoption of telemedicine that organizational adoption factors are crucial for successful adoption. Organizational adoption factors are important variables to be considered in the adoption process, suggesting that facilitating conditions influence users' attitude and intention to use a technology. These organizational adoption factors are thus assumed to be covered by the construct of facilitating conditions. Overall, this study highlights the importance of this construct from the UTAUT and healthcare professionals' perspectives in shaping attitudes towards telemedicine adoption, particularly in LRS.

4 Organizational Barriers and Facilitators

4.1 Introduction

This Chapter integrates the literature review with interview findings to identify organizational adoption factors to telemedicine adoption. The purpose of integrating these research methods is to gather information from current literature and expert opinions, compare these insights and reflect on existing theories with actual experiences in order to gain new insights. The identified barriers and facilitators have been linked to the focused construct of the UTAUT and additionally, emerging themes have been discovered. Consistent terminology on barriers and facilitators has been used in both research methods to allow for easy comparison of the results. Both the literature and interviews emphasized the importance of overcoming organizational barriers, which have been described briefly. Furthermore, the influence of interviewees' perspectives on the findings has also been examined. In Appendix XX, it has been evaluated how these different perspectives influence the identified adoption factors and concluded that the impact is limited.

SQ2. What are organizational barriers adoption factors of telemedicine in LRS?

4.2 Identified Barriers and Facilitators

See Figure 9, for an overview of the identified barriers and facilitators from the literature review and interviews. The structure in this Figure is based on the sub constructs from the UTAUT by Venkatesh et al. (2003), as described in Appendix V, with the same color-coding applied to the sub-constructs here. The upper part of the fishbone diagram presents the barriers, categorized according to the UTAUT sub-constructs, with additional barriers placed under emerging themes. The adoption factors that fall outside the scope of the sub-constructs have been covered under emerging themes, these emerging themes will be elaborated on in Chapter 5. The facilitators are presented at the lower part of the diagram, following the same structure. Barriers and facilitators mentioned in both research methods are bolded, those discussed only in literature are in italics, and those only from interviews are in regular text. Additionally, these adoption factors positioned farther from the fishbone are mentioned more frequently compared to those closer to the bone It can directly be observed that the number of mentioned barriers is higher than the facilitators.

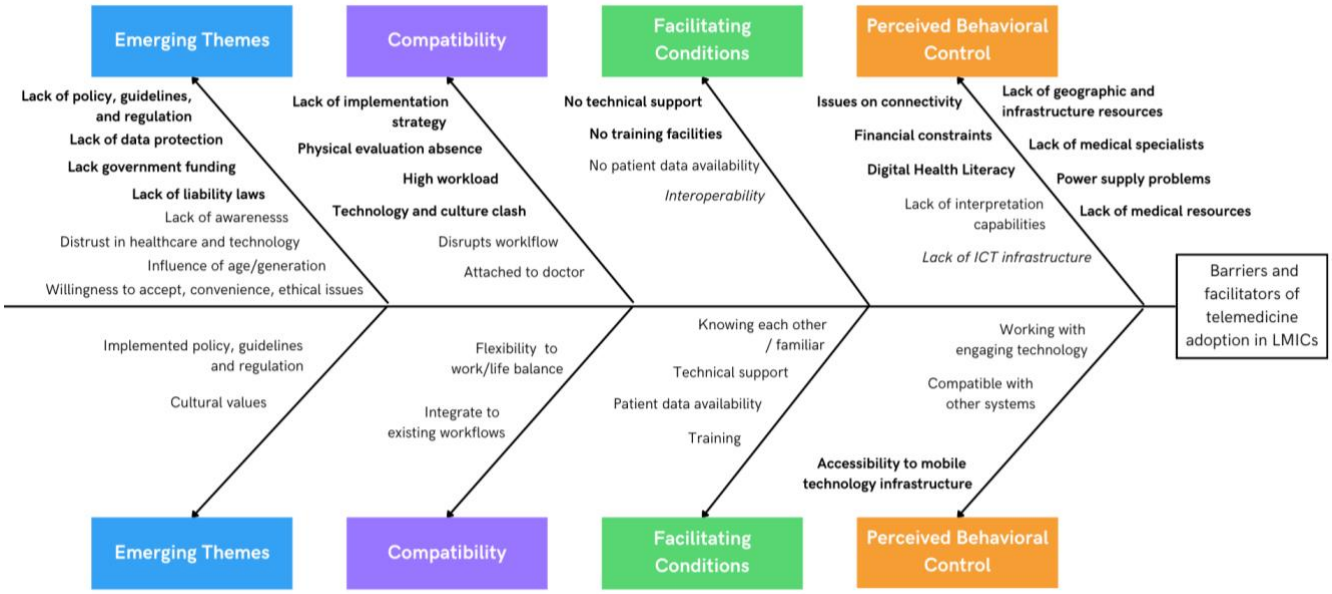

Figure 9. Overview of barriers and facilitators from literature review and interviews

4.2.1 Barriers and Facilitators from Literature Review and Interviews

For the literature review and interviews the identified barriers and facilitators have been summarized in Table 4 and Table 5. **L** refers to the number of articles from the literature review that discussed that specific barrier or facilitator, **C** denotes the frequency of coding occurrences in Atlas.ti from the interview transcripts, and **I** represent the number of interviewees that did mention the barrier or facilitator at least once. The identified barriers and facilitators have been linked to the sub constructs of the UTAUT construct: perceived behavioral control, facilitating conditions or compatibility. Furthermore, in this study item labels have been defined which relate to the items in the construct of facilitating conditions by Venkatesh et al. (2003) in Appendix V. Any barriers or facilitators not aligned with UTAUT have been classified as 'Emerging', referring to new or novel aspects of barriers and facilitators that cannot be covered by the existing UTAUT construct of facilitating conditions.

	Barrier	**L**	**C**	**I**	**Construct**	**Item label**
1	Lack of geographic and infrastructure resources	20	31	10	Perceived Behavioral Control	Resources
2	Issues on connectivity	24	35	9	Perceived Behavioral Control	Resources
3	Financial constraints	20	34	7	Perceived Behavioral Control	Resources
4	Power supply problems	8	11	3	Perceived Behavioral Control	Resources
5	Lack of medical resources	7	8	3	Perceived Behavioral Control	Resources

6	Lack of medical specialists	14	5	3	Perceived Behavioral Control	Resources
7	Lack of ICT infrastructure	3			Perceived Behavioral Control	Resource
8	Lack of interpretation knowledge capabilities		9	4	Perceived Behavioral Control	Knowledge
9	Digital health literacy	13	8	4	Perceived Behavioral Control	Knowledge
10	No patient data availability		4	2	Facilitating Conditions	Support
11	Interoperability	5			Facilitating Conditions	Support
12	No technical support	14	6	1	Facilitating Conditions	Assistance
13	No training facilities	13	6	5	Facilitating Conditions	Guidance
14	Technology and culture clash	5	3	2	Compatibility	Compatibility
15	Physical evaluation absence	6	31	7	Compatibility	Alignment
16	High workload	6	11	5	Compatibility	Alignment
17	Attached to doctor		3	2	Compatibility	Alignment
18	Disrupts workflow		15	3	Compatibility	Integration
19	Lack of implementation strategy	14	8	3	Compatibility	Integration
20	Lack of policy, guidelines, and regulation	19	27	10	*Emerging*	
21	Lack of government funding	8	20	7	*Emerging*	
22	Lack of data protection (for privacy)	14	26	7	*Emerging*	
23	Lack of liability laws	3	15	4	*Emerging*	
24	Lack of awareness		27	8	*Emerging*	*Patient centric*
25	Distrust in healthcare and technology		11	5	*Emerging*	*Patient centric*
26	Influence of age/generation		12	5	*Emerging*	*Patient centric*
27	Willingness to accept		13	3	*Emerging*	*Patient centric*

28	Influence of convenience		5	2	*Emerging*	*Patient centric*
29	Ethical issues		7	2	*Emerging*	*Patient centric*

Table 4. Barriers from literature review and interviews (L: number of articles from literature review, C: number of coding occurrences, I: mentioned by number of different interviewees)

	Facilitator	**L**	**C**	**I**	**Construct**	**Item label**
1	Accessibility to mobile technology infrastructure	6	25	9	Perceived Behavioral Control	Resources
2	Compatible with other systems		13	4	Perceived Behavioral Control	Resources
3	Working with an engaging technology / system		11	4	Perceived Behavioral Control	Knowledge
4	Knowing each other / familiar		3	1	Facilitating Conditions	Support
5	Patient data availability		10	2	Facilitating Conditions	Support
6	Technical support		7	1	Facilitating Conditions	Assistance
7	Training		5	4	Facilitating Conditions	Guidance
8	Flexibility to work/life balance		6	2	Compatibility	Alignment
9	Integrate to existing workflows		12	4	Compatibility	Integration
10	Cultural values		6	3	*Emerging*	
11	Implemented policy, guidelines, regulation		3	2	*Emerging*	

Table 5. Facilitators from literature review and interviews (L: number of articles from literature review, C: number of coding occurrences, I: mentioned by number of different interviewees)

4.2.2 Comparison Identified Barriers

Barriers found in 14 or more articles, and barriers from interviews cited by 7 out of 10 more interviews have been compared. This number 14 guarantees that only widely recognized barriers are considered. For the interviews, the choice of this numbers is related to the sample size of interviewees, making it important to only consider barriers mentioned by a majority (almost 75%) to ensure the barriers are relevant. Lack of geographic and infrastructure resources, financial constraints, issues on connectivity, lack of policy, guidelines, and regulation and the lack of data protection (for privacy), both data analysis highlighted these barriers frequently. Commonalities suggest that these barriers are recognized from both practical and academic perspectives. The barriers most cited from literature focus more on technical aspects, while the interviews highlight more practical concerns.

Frequently mentioned barriers from interviews on physical evaluation absence, lack of government funding and lack of awareness have not shown frequently from the literature review. Lack of awareness emerged only from interviews and has not been considered an organizational factor, which was the primary focus of the literature. Other patient centric emerging themes were only derived from interviews, indicating that healthcare professionals talk about the patient perspective, without being asked to do so. The barriers addressed by literature on the lack of medical specialists, lack of technical assistance, lack of implementation strategy have been mentioned by the interviews, but not extensively. The common and frequent barriers will be briefly discussed in the following paragraphs.

Barrier: **Lack of geographic and infrastructure resources**
The main challenge is the inaccessibility to telemedicine itself and infrastructure issues limit implementation in LRS (Addotey-Delove et al., 2023; Alboraie et al., 2022; Mahdi et al., 2022; Mensah et al., 2023; Tiwari et al., 2023). Geographical barriers refer to the inconvenient travel to telemedicine centers, and the distribution of pharmacies, clinics and hospitals is concentrated in urban areas (Mensah et al., 2023; Pagaling et al., 2021). Geographical limitations to telemedicine furthermore increase the exclusion of certain populations, particularly those in rural areas (Getachew et al., 2022; Hoffer-Hawlik et al., 2020; Mahmoud et al., 2022).

From interviews telemedicine has been highlighted as a potential solution to geographical barriers, however when people are in need of healthcare, long distances (up to 100 km from health facilities), and transportation issues are challenging: *"The infrastructure is still lacking and it makes it very difficult to have confidence in time and consultation, because if someone is in pain or someone needs healthcare services it makes it very challenging to rely on connectivity.".* Furthermore, financial and transportation costs were also noted as significant barriers, also transportation in rural areas is more expensive than in urban areas. Additionally, the lack of infrastructure might affect the usability and durability of telemedicine equipment: *"You need durable equipment for the rural areas, because some of the roads are rough roads".*

Barrier: **Financial constraints**
Financial constraints have been mentioned as the most significant barrier to the adoption of telemedicine from several articles (Addotey-Delove et al., 2023; Adenuga et al., 2016; Akhlaq et al., 2016; Sagaro et al., 2020). These relate to the limited financial resources and high initial costs for the implementation including infrastructure, training, telemedicine technology set up and management issues (Alboraie et al., 2022; Hoffer-Hawlik et al., 2020; Lawal et al., 2022; Mensah et al., 2023; Ye et al., 2023). This is among others due to the high costs of internet and mobile services, for example the expenses for transferring medical images from remote areas to bigger cities (Addotey-Delove et al., 2023; Hui et al., 2022; Rackimuthu et al., 2022).

From interviews it has been observed that costs are also critical, as expressed by one interviewee: *"The whole thing it is all about all these things is that at the end of the day, it is all boiled down to costs".* The interviewees expressed their concern about where the financial resources would come from, questioning who would pay, and the high costs of using the internet for telemedicine services. It was remarkable that the interviewees also discussed the perspectives of the patients, specifically not imagining how individuals will pay for these services because they do not have the money. One interviewee addressed the point that patients currently also do not have the money to visit healthcare facilities: *"If they can't afford to pay for transportation, can they afford Internet service?".* These findings show that financial constraints are not only a systemic issue, but also impose a burden on patients in low resource settings.

Barrier: **Issues on connectivity**
Telemedicine systems often lack internet access or are not integrated into local networks. High-speed internet is needed for communication and uploading high-resolution images, but many regions face poor internet coverage, limited bandwidth, and network congestion, resulting in unreliable telemedicine services (Mahmoud et al., 2022; Owolabi et al., 2022; Pagaling et al., 2021; Singh, 2022; Ye et al., 2023; Xiong et al., 2023). This relates especially to remote areas (Hui et al., 2022; Tchao et al., 2019). Connectivity resources are the key building blocks of telemedicine, and without proper access, one cannot operate efficiently (Tiwari et al., 2023).

Interviewees emphasized that data is limited in the context of LRS, with some areas having better connection than others. And, as described in literature, the further away from the urban centers, the less reliable the internet connection. One interviewee shared their experience with this issue:*"Sometimes if I do a consultation, but I don't have great internet, I might not be able to connect to our software system as easily".* And another interviewee:*"In urban areas, a video call may be achieved, but the quality may vary.".* The poor telecommunication infrastructure, relating to unsTable internet connections and poor bandwidth limit the effectiveness of telemedicine. This has been summarized as: *"Devices are wonderful, but if there is no internet, forget about it."*

Barrier: **Lack of policy, guidelines, and regulation**
In LRS, the adoption of telemedicine faces significant barriers due to a lack of policy, guidelines and regulation. Governments have no clear development roadmap on digital health, as seen by the absence of national e-health policies or laws, and little contribution from the government in promoting telemedicine (Chowdhury et al., 2021; Hui et al., 2022; Leochico et al., 2020; Tchao et al., 2019; Takuwa et al., 2023). From the ministries of health there is resistance to adoption, due to poorly informed decision makers on the benefits of telemedicine and lack of programme alignment with national health. The absence of standardized guidelines, support evidence, weak governance and low political commitment, hinder adoption (Leonard et al., 2020; Xiong et al., 2023).

From the interviews, it follows that telemedicine is a new field, which is not regulated and where there is a lack of digital health policies. Legislation must be implemented to regulate these kinds of practices, also quoted from one interviewee: *"It starts from the policy from the top because the digital health policy will spell out the fact that there is a need to train and build capacity".* This barrier extends to data protection issues that will be addressed.

Barrier: **Lack of data protection (for privacy)**
From literature, low adoption rates are also associated with the lack of data protection for privacy. The lack of confidence in data protection poses significant challenges in the exchange of patient data across various IT systems (Hui et al., 2022; Ndlovu et al., 2017; Takuwa et al., 2023). Ensuring that patient data is standardized, secure, timely, and accurate is critical (Ndlovu et al., 2017). These difficulties include complexity of data privacy laws, security restrictions, inadequate technology standards, confidentiality, access rights, and the protection of personal information obtained via telemedicine platforms, decreasing trust in telemedicine (Leochico et al., 2020). Healthcare professionals are particularly concerned about safety, privacy and confidentiality (Mahmoud et al., 2022; Owolabi et al., 2022; Pagaling et al., 2021; Tiwari et al., 2023; Ye et al., 2023; Zayyad & Toycan, 2018).

Some interviewees discussed the cultural shift towards using social media and sharing personal lives online has reduced privacy to some extent. Expressed by: *I think culturally and what are some of the social norms around how much you expose to someone over the phone?".* However, people still desire to maintain a high level of privacy, and this raises concerns on who is ensuring data privacy and what quality controls are in place. Addressing

privacy issues is crucial, particularly given the costs associated with sustaining a system for data protection. It is critical to ensure that patient consent is obtained, as telemedicine may cause patients to feel anxious about freely talking. Overall, issues have been discussed on where the data will be stored, and how this will be protected: *"So these are big words, not just awareness but ethics, safety and data protection."* and *"I think one of the biggest challenges in telemedicine is ensuring not just talking about data protection, but ensuring data is actually protected".*

4.2.3 Comparison Identified Facilitators

An important facilitator highlighted in the interviews and from literature is the accessibility to mobile technology infrastructure, while other facilitators were less frequently mentioned, cited by fewer than 7 different interviewees. This number for findings for facilitators is comparable to that used for barriers.

Facilitator: **Accessibility to mobile technology infrastructure**
According to literature the smartphone market is growing at an exponential rate in various LRS, along with the emergence of local smartphone companies and service providers (Singh, 2022). Mobile phone ownership by patients and healthcare professionals has been shown as a predictor for telemedicine adoption (Addotey-Delove et al., 2023; Singh, 2022; Tahir et al., 2022). Furthermore, the opportunities for telemedicine offered through mobile phones have even generated enthusiasm for telemedicine projects in LRS (Akhlaq et al., 2016). This expansion of mobile phone networks also contributes to lowering the costs of internet services (Akhlaq et al., 2016). In addition to mobile phones, different power resources and supplying necessary electricity for telemedicine may facilitate adoption (Akhlaq et al., 2016).

The increased accessibility of mobile phones was also noted throughout the interviews. For example, mobile phone subscriptions in Ghana exceed the total population, with significant smartphone usage even in rural regions, meaning that practically everyone is constantly carrying a phone, often with WhatsApp installed. This trend is seen throughout Sub-Saharan Africa, where the majority of people own mobile phones. As one interviewee mentioned: *"The phones that allow for good video calls are also making telemedicine a lot more accessible."* Another interviewee shared their experience: *"I've been to Tanzania several times, and there are a lot of things missing if you compare it to the Netherlands, but what they do have are mobile phones actually".*

4.3 Approaches to Overcome

In addition to identifying barriers and facilitators, findings highlight approaches to overcome these barriers, and therefore transforming them into facilitators. To support these, approaches to overcome from the literature review and from the interviews are presented in Table 6, which will be discussed and compared to the identified barriers and facilitators. **L** refers to the number of articles from the literature review that discussed the approach to overcome, **C** denotes the frequency of coding occurrences in Atlas.ti from the interview transcripts, and **I** represent the number of interviewees that did mention the approach to overcome at least once.

	Overcome	**L**	**C**	**I**	**Construct**	**Item label**
1	Improve connectivity		4	4	Perceived Behavioral Control	Resources

2	Decentralize servies		7	4	Perceived Behavioral Control	Resources
3	Increase the number of medical specialists		5	2	Perceived Behavioral Control	Resource
4	Provide technical support	5	4	2	Facilitating Conditions	Assistance
5	Provide training	3	28	9	Facilitating Conditions	Guidance
6	Focus on strategy and implementation	10	14	6	Compatibiilty	Integration
7	Work with existing platforms	4			Compatibility	Compatibility
8	Look at preferred medical practises and workstyles	2			Compatibility	Alignment
9	Patient involvement		5	3	*Emerging*	*Patient centric*

Table 6. Approaches to overcome from literature review and interviews (L: number of articles from literature review, C: number of coding occurrences, I: mentioned by number of different interviewees)

4.3.1 Comparison Identified Approaches to Overcome

Over coupling themes from literature and interviews are to provide technical support, provide training, and focus on strategy and implementation. These approaches to overcome will be addressed through data from the literature, interviews, and direct quotations.

Overcome: **Provide technical support**
To overcome barriers in technical support for telemedicine, from literature it is expected that by assistance and support users become more familiar with telemedicine technology and this will ensure that individuals are more comforTable using computers (Hoffer-Hawlik et al., 2020; Mensah et al., 2023; Pagaling et al., 2021). Offering technical support to those with limited access or familiarity with new technology can promote telemedicine adoption (Ye et al., 2023).

Interviewees discussed the importance for a team or person available for technical support for the healthcare professionals. They highlighted the importance of building the capacity of technology staff who can support technological development: *"Making sure that every health facility has a technology support team on site that can provide support".*

Overcome: **Provide training**
Literature addressed that with appropriate training and engaging the community with telemedicine technology it will more readily be adopted (Akhlaq et al., 2016; Hoffer-Hawlik et al., 2020). And those people with limited access and technical illiteracy should receive attention, with training options available (Xiong et al., 2023). From the interviews, nine interviewees discussed providing training to overcome barriers to telemedicine adoption. Different aspects of training were addressed, emphasizing the need to ensure healthcare staff can comprehend and effectively use telemedicine. One interviewee mentioned the support for health institutions: "*Support for health institutions to develop training programs around digital*

health". Additionally, the importance of designing telemedicine with input from the end users was highlighted and to learn from experiences on telemedicine training in different countries.

Overcome: **Focus on strategy and implementation**
To overcome barriers to telemedicine adoption, literature addressed to focus on strategy and implementation. Telemedicine must fit with existing technologies and practices, supported by organizational guidelines since the adoption of telemedicine depends on its fit with organizational routines and practices (Akhlaq et al., 2016; Getachew et al., 2022; Ndlovu et al., 2017). A coordinated approach involving health policy, infrastructure development, and community participation is crucial and telemedicine should become an integral part of a country's health infrastructure (Alboraie et al., 2022; Mahdi et al., 2022; Singh, 2022; Xiong et al., 2023).

The focus on strategy and implementation also appeared from the interviews. Interviewees raised the importance of taking into account the differences between strategies in countries, and also addressed the idea for telemedicine to become an integral part of the health infrastructure: *"The goal is to get it into a national health framework, not a local health framework".*

4.3.2 Comparison Barriers, Facilitators, Overcome

Analyzing the data shows that the approaches to overcome barriers are related to the identified barriers and facilitators. In Table 7 the relationships between the identified adoption factors can be seen. Some relationships are more less direct for example improving connectivity may solve the issue of connectivity and facilitates access to mobile technology infrastructure. Considering the approach to look at preferred medical practices and workstyles, addresses the barriers of physical evaluation absence and high workload. To focus on this, this relates to the facilitator flexibility to work/life balance. Focusing on strategy and implementation addresses the lack of an implementation strategy by integrating telemedicine into existing workflows. The approaches of providing technical support and training are directly related to solving the barrier, turning it into a facilitator. It might be argued that overcoming these barriers turns them into facilitators, highlighting the interconnectedness of these concepts. This allows to see the relationship that emphasizes the dynamic nature of adoption processes. And this interplay sheds light on the evolving definition of adoption within the context of telemedicine adoption.

Approach to overcome	**Barrier**	**Facilitator**
Improve connectivity	Issue on connectivity	Accessibility to mobile technology infrastructure
Increase the number of medical specialists	Lack of medical specialists	
Provide technical support	Lack of technical assistance	Technical support
Provide training	Lack of training facilities	Training
Look at preferred medical practises and workstyles	Physical evaluation absence / High workload	Flexibility to work/life balance

Focus on strategy and implementation	Lack of implementation strategy	Integrate to existing workflows
Work with an existing platform		Work with an engaging technology/system

Table 7. Comparison barriers, facilitators, and approaches to overcome

See Figure 10 for the Venn diagram on the overlap of the concept's barriers, facilitators, and approaches to overcome, corresponding to the findings presented in Table 7. The overlapping circles of the Venn diagram present the interplay of barriers, facilitators, and approaches to overcome. This Figure illustrates the interconnected relationships between the adoption factors in the context of telemedicine adoption. This visualization is useful for understanding how overcoming barriers may change them into facilitators, highlighting the telemedicine adoption process.

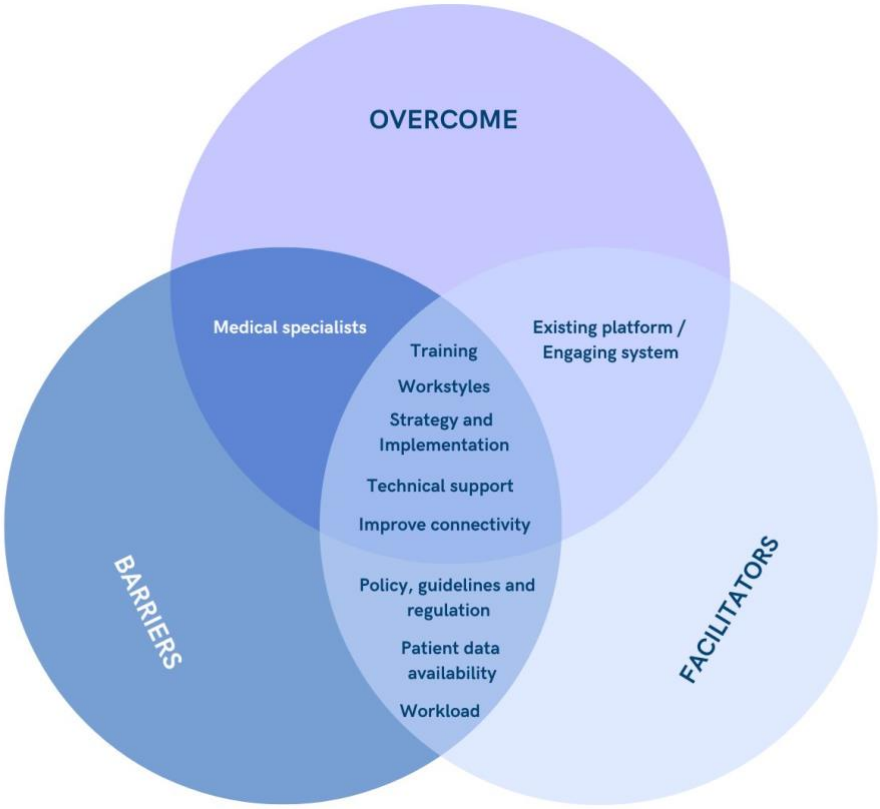

Figure 10. Venn diagram barriers, facilitators and approaches to overcome.

4.4 Conclusion

For this Chapter the organizational adoption factors of telemedicine in LRS have been examined, these have been compared from literature and interviews. The lack of geographic and infrastructure resources, financial constraints, issues on connectivity, lack of policy, guidelines, and regulation and the lack of data protection (for privacy), these barriers have been highlighted frequently. The facilitator of accessibility to mobile technology infrastructure appeared from both research methods. Following, approaches to overcome have been identified, this has highlighted the interconnectedness of the barriers, facilitators, and

approaches to overcome and therefore the dynamic nature of adoption processes. The identified barriers, facilitators, and approaches to overcome have been linked to the construct of the UTAUT if possible, emerging themes have been discovered, which will be addressed in the following Chapter. Furthermore, the lens of perspectives has been studied, in Appendix XX, by three different analyses. Overall, has been concluded not to consider the different perspectives but the collective insights from all interviewees for this study.

5 Refined Adoption Framework

5.1 Introduction

This Chapter reflects on how the adoption framework of the UTAUT might be refined to better align with the identified organizational adoption factors identified in Chapter 5. This Chapter synthesizes insights from the literature review, interviews, and own contributions to assess the applicability of the UTAUT framework for this study. The emerging themes from literature and interviews will be explained, along with how to refine the UTAUT model. As discussed in Chapter 4, the different perspectives of the interviewees are neglected in this Chapter.

SQ3. How might existing frameworks be refined to better align with the identified organizational adoption factors for telemedicine in LRS?

5.2 Emerging Themes

From Chapter 5, the identified barriers and facilitators have been aligned against the UTAUT construct to explore emerging organizational adoption factors. The study in this Chapter has found that it is important to address the emerging themes, which have been widely discussed and coded. Regardless of the frequency of these emerging adoption factors, these will be addressed, see Table 8 for the emerging adoption factors. This Table reflects the mentioned adoption factor, the type of adoption factor (barrier and/or facilitator) and from which research method this adoption factor appeared or from both.

Adoption factor	Barrier and/or facilitator	Source: Literature	Source: Interviews
Lack of policy, guidelines and regulations	Barrier	19	10
Lack of government funding	Barrier and Facilitator	8	7
Lack of data protection (for privacy)	Barrier	14	7
Lack of liability laws	Barrier	3	4
Lack of awareness	Barrier *(Patient centric)*		8
Distrust in healthcare and technology	Barrier *(Patient centric)*		5
Influence of age/generation	Barrier *(Patient centric)*		5
Willingness to accept	Barrier *(Patient centric)*		3

Influence of convenience	Barrier *(Patient centric)*		2
Ethical issues	Barrier *(Patient centric)*		2
Cultural values	Facilitator		3

Table 8. Emerging adoption factors

Barriers: **Lack of policy, guidelines and regulations, lack of government funding, lack of data protection (for privacy) and lack of liability laws**
These barriers have been examined together, they have not been clustered since this would overlook the differences in these barriers. The barriers on lack of policy, guidelines and regulations and lack of government funding have not been addressed by other constructs from the UTAUT of Venkatesh et al. (2003). For the lack of government funding it can be argued that this indirectly belongs to facilitating conditions, as funding might impact the availability of resources. However, this is not addressed by the items of the construct defined by Venkatesh et al. (2003). The lack of data protection (for privacy) and lack of liability can refer to when the UTAUT was established in 2003, technological advancement since then, as discussed in criteria 6, in Table 1, have increased. It could be argued that during that period, concerns regarding data protection, privacy, security and liability were not as important as today. The evolving landscape of these considerations of data protection and liability appear crucial for adoption. These issues were less prominent when developing the UTAUT, but the rapid evolution of technologies may have brought these concepts into focus.

Addressing these factors would require a broader framework beyond the current scope of the UTAUT, these emerging themes could cover the concept of organizational conditions. Organizational conditions add a new dimension to the construct of facilitating conditions by creating an interaction where the constructs both influence and impact each other. This interaction is visualized by broken lines and arrow pointing in both directions, for which the term interdependent can be used: this represents the relationship between the constructs highlighting interconnectedness but also recognizing that the nature of the interaction is not yet completely understood. These organizational conditions include two sub-constructs: **Security Expectancy and Regulatory Influences.**

These organizational conditions should thus be related to the existing construct of facilitating conditions because Venkatesh et al. (2003) defines this main construct as the "degree to which an individual believes that an organizational and technical infrastructure exists to support the use of the information system." This definition covers the identified adoption factors for the organizational conditions. See Table 9, for the integrated developed construct, including definitions and items, similar to how Venkatesh et al. (2003) describes the constructs. By adding this construct to facilitating conditions, the models' complexity will increase, and it could also be argued that for identifying the broader organizational adoption factors, the UTAUT framework is not sufficient. In this context broader refers to organizational factors that cover considerations that impact adoption at a larger scale, since policies, regulation, funding, data protection and liability issues extend beyond individual beliefs and attitudes. Thereby expanding the scope of the UTAUT framework beyond its initial focus. Analyzing UTAUT on this concept, it can be suggested that UTAUT's construct on facilitating conditions is more focused on individual organizations dynamics and perspectives compared to broader organizational factors, which have been addressed by this study. For the empirical foundation of the UTAUT, it has been developed in organizations in the U.S, within specific organizational structures (Venkatesh et al., 2003). These broader factors are considered at a higher level of analysis, and during the validation of this UTAUT framework may not have been directly relevant. Furthermore, according to Venkatesh et al. (2003), the primary purpose of his

research was to assess the current state of knowledge with respect to understanding individual acceptance of new information technologies. The broader adoption factors identified, which include wider regulatory issues, may fall outside the scope of the UTAUT, which primarily focuses on individual-level adoption factors.

Organizational Conditions (Facilitating Conditions): Root Constructs, Definitions, and Scales		
Construct	**Definition**	**Items**
Security expectancy	The degree to which security measures implement for privacy is perceived consistent with the introduced telemedicine technology	1. Measures are in place to safeguard patient data. 2. Patient privacy is respected and maintained.
Regulatory influence	The degree to which regulations, policy and guidelines are perceived consistent with the introduced telemedicine technology	1. Using the telemedicine systems is compatible with existing regulations, guidelines, and policies. 2. Liability standards are in place.

Table 9. Developed construct: Organizational conditions added to facilitating conditions

Barriers: **Lack of awareness, distrust in healthcare and technology, influence of age/generation, willingness to accept, influence of convenience, ethical issues and patient involvement**

These barriers, which cannot be categorized as organizational adoption factors, have been mentioned frequently from the interviews, therefore highlighting their importance and influence on the findings of this study. The identified barriers have been discussed from the interviewees according to the perspectives of the patients without being asked to do so, showing that healthcare professionals naturally emphasize the patient's perspective. This could relate to the relationship between the healthcare professionals and the patient, for successful adoption of telemedicine it will only work for the healthcare professionals if the patients accept it too.

First, the influence of generation and age is reflected in one of the four moderating variables from the UTAUT, but on the perspective of the interviewer. Venkatesh et al., (2003) argued from the construct of effort expectancy on the influence of age, as effort expectancy may be more salient for the older generation of workers and those with relatively little experience with a system. The concept of generation and age can thus be covered in the construct of effort expectancy.

The other emerging themes may be related to the construct of attitude by Venkatesh et al., (2003). This construct has been theorized by Venkatesh et al., (2003) but determined not to be a direct determinant on intention to adopt. Attitude has been defined as 'an individual overall affective reaction to using a system' covering sub constructs on: attitude toward behavior, intrinsic motivation, affect toward use and affect. This construct was not significant, and may operate through other constructs of the UTAUT, therefore this relationship between attitude and intention has resulted to be spurious in the study of Venkatesh et al., (2003). And it has been argued that attitude does not have a direct or interactive influence on intention. However, this construct incorporates these identified emerging themes, looking at Appendix XXII the construct Attitude by Venkatesh et al. (2003) in comparison with the emerging themes that reflect the construct, in Table 10. In this Table the emerging themes have been related to the construct 'attitude' from UTAUT, along with quotes from the interviews.

The emergent themes align closely with the non-significant, excluded construct 'Attitude' from Venkatesh et al., (2003). Therefore, has been determined in this study to explore technology adoption in healthcare settings from the perspective of healthcare professionals through this construct. Technology adoption by healthcare professionals is not only determined by factors that directly affect healthcare professionals but also by how they perceive patient perspectives. As a result, for UTAUT to capture this dual perspective, the construct of attitude toward using technology could be included for healthcare settings in LRS and from the perspective of healthcare professionals. However, this construct will be discussed from the perspective of the patient, differing from the original concept of attitude proposed by Venkatesh et al. (2003).

Emerging theme	Quote	Relating construct UTAUT from Attitude
Lack of awareness	"*It is still a new idea, and there is always resistance to change and resistance to new ideas"* *"I think the only challenge with the buy in would be convincing people"*	Attitude toward behavior and intrinsic motivation
Distrust in healthcare and technology	*"They don't trust a lot of internet technologies"* *"Trust in the healthcare system is typically very low, in fact it is distrust"*	Attitude toward behavior
Willingness to accept	"*I think they have to be more accepting and this is one of the aspects I saw in telemedicine in Africa, many people resisted when they got help from abroad"*	Attitude toward behavior and intrinsic motivation
Influence of convenience	*"Convenience is not something that people want to pay for."*	Affect toward use
Ethical issues	"*We are talking about the human treating another human"*	Attitude toward behavior

Table 10. Emerging themes on patient perspective comparing to the construct attitude by UTAUT

Facilitator: **Cultural values**

Analyzing UTAUT on the cultural values that have been addressed as a facilitator, could be argued that these cultural values are captured by the construct of social influence by Venkatesh et al. (2003), see Appendix XXIII, specifically the sub construct social factors defined as 'the individual's internationalization of the reference group's subjective culture, and specific interpersonal agreements that the individual has made with others, in specific social situations'. Looking at the definition from the UTAUT and what the interviewees discussed, as referred to this quote: *"Telemedicine, generally aligns with our cultural values, in terms of being willing to share"* can be argued that the UTAUT does not fully capture the type of cultural influence as discussed by the interviewees. From this definition UTAUT may overlook the deeper intrinsic cultural values that influence technology adoption. In this context, the cultural alignment with values supporting telemedicine adoption, capturing broader cultural contexts.

Venkatesh et al., (2003) distinguishes between mandatory and voluntary implementations, for social factors, the mandatory implementations were only significant. However intrinsic motivations from cultures, such as willingness to share and help may have an impact regardless of mandatory or voluntary implementations. Furthermore, the research of Venkatesh et al., (2003) has been validated using data from four organizations among individuals being introduced to a new technology in the workplace. First, these organizations were in the United States, arguing the model is designed for other countries/contexts. But, this may also explain the difference in social factors. Because those items are more related to cultural aspects of the workplace instead of the broader social factors. So, the UTAUT has been rooted in a specific cultural and organizational context, and this could have influenced the development of the framework. For applying this in LRS this requires consideration of cultural factors. This also has been acknowledged by Venkatesh et al., (2003), considering the need for further validation in different cultural and organizational contexts. And arguing that for future research alternatives measured on intention and behavior should be examined in revalidating or extending the research to other contexts (Venkatesh et al., 2003). UTAUT's development in a specific cultural and organizational setting may have influenced the framework. Cultural aspects for adoption of LRS may not be fully captured by the framework, particularly in terms of broader social factors. Venkatesh et al. (2003) recognized this limitation and the need for additional validation in a variety of cultural and organizational contexts. In conclusion, while UTAUT captures certain aspects of cultural values by the construct of social factors, it may not fully cover the intrinsic cultural values discussed in relation to telemedicine adoption in LRS. Therefore, suggesting the need for broader cultural considerations beyond the current scope of the UTAUT.

5.3 Conclusion

The analysis of emerging themes from identified barriers and facilitators, provided insights on the UTAUT framework applicability for telemedicine adoption in LRS by healthcare professionals. The conclusions have been grouped into two: first, framework adaptations, and secondly a consideration for using this model in the context of this study. This has been summarized in Table 11.

Conclusion type	Description	Adaption or Consideration
Framework adaptation	Incorporating organizational conditions	Adapt UTAUT to include broader organizational adoption factors from healthcare professionals perspective in LRS
Framework adaptation	Incorporating patient attitude	Adapt UTAUT to include a construct for patient attitudes from healthcare professionals perspective in LRS
Consideration	Cultural values from social influence construct UTAUT	Considering intrinsic cultural values when applied in LRS

Table 11. Conclusions summarized

First the barriers identified: lack of policy, guidelines, regulations, government funding, data protection and liability laws highlighted the need for considering broader organizational factors which are not captured by the UTAUT. This could suggest a construct: **Organizational conditions,** with the sub construct of **security expectancy** and **regulatory influences.** Secondly, the emerging themes on healthcare professionals discussing the patient perspective

point to the relevance of the attitude construct of the UTAUT. In the UTAUT framework this construct has been excluded due to non-significance, however for this study this construct could consider patient attitudes from the perspective of healthcare professionals. Therefore, suggesting a construct: **Patient attitude.**

Cultural values, identified as facilitator, may not be fully captured by the UTAUT construct social influence. This construct focuses more on workplace dynamics rather than broader cultural contexts, which have been discussed in the interviews. This limitation has been acknowledged by Venkatesh et al (2003).

Summarizing, the findings suggest framework adaptations and considerations when applying this framework in the context of LRS by the perspective of healthcare professionals. Including the two new constructs based on the findings of this study, have been presented in Figure 11. Patient attitude is in line with the other constructs, with an arrow pointing to behavioral intention because this construct reflects on adoption factors other than discussed in facilitating conditions. Organizational conditions are added as a new dimension to the construct of facilitating conditions, with an arrow pointing in both directions and visualized by broken lines. This visualization represents the relationship between the constructs highlighting interconnectedness.

For the construct, definitions and items of the new construct patient attitude, the construct attitude by Venkatesh et al. (2003) can be applied, and for the new construct of organizational conditions, see Table 9. However, these findings require more research for validation. Furthermore, the UTAUT framework has been criticized on suitability for this study due to empirical foundation, period of development, rise of technology, and the individually oriented emphasis on organizational dynamics rather than broader.

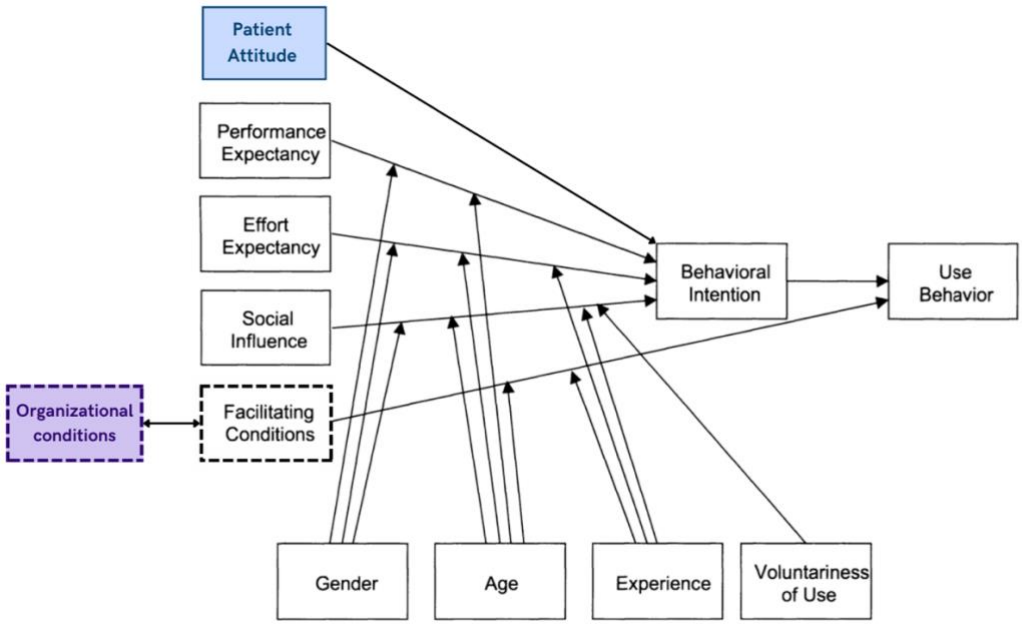

Figure 11. Modified UTAUT framework for addressing organizational adoption factors for telemedicine in LRS

6 Discussion

6.1 Introduction

Through the comparative analysis in Chapter 5 it has been evaluated how well the identified organizational adoption factors align with the facilitating conditions construct, or other constructs of the UTAUT framework. Following this analysis adaptations have been proposed to the UTAUT framework specifically for identifying organizational adoption factors relevant to telemedicine adoption among healthcare professionals LRS. In this discussion Chapter, will be reflected on the findings and compare these with the modified framework of Rouidi et al (2022) and Rouidi et al (2023), as discussed in Chapter 3. Additionally, the findings will be analyzed considering existing literature. These discussions will also address limitations of this study, which will be elaborated on in Chapter 7.

6.2 Comparison of Findings with Modified UTAUT Framework

Findings from sub question 1, in Chapter 3 indicated that the UTAUT framework has been prioritized for exploring technology adoption, while also acknowledging the insights provided by the modified UTAUT framework. This study's findings may complement and reflect that framework by Rouidi et al (2022) and Rouidi et al (2023). The adaptations and consideration described in sub question 3, Chapter 5, will be examined in relation to Rouidi et al. (2023) and Rouidi et al. (2022), with a particular focus on the 2023 research, which is specific to an LRS context.

The study emphasized the importance of incentives and support from the government, this is captured in the construct of perceived incentive (Rouidi et al., 2023), defined as 'The extent to which an individual believes that the provision of telemedicine services would be rewarded with financial support of compensation for medical expenses.' This construct has been derived from the study by Rho et al. (2014), which looked at telemedicine acceptance by TAM, and included predictive constructs according to literature. The construct of perceived incentive is mainly focused on reimbursement, noting that the lack of reimbursement for the use of telemedicine may be a barrier to adoption (Rouidi et al., 2023). Additionally, a regulatory framework and support from the government have been discussed, comparable with the findings from interviews in this study (Rouidi et al., 2023). However, for the framework of Rouidi et al. (2023) the primary focus is on reimbursement as a significant factor, none of the interviewees in this study discussed financial incentives and reimbursement, and therefore the construct of 'perceived incentive' is in contrast with the framework adaptation of 'organizational conditions'.To support this finding, the interview questions from Rouidi et al. (2023) were evaluated. The first question is on government support, including policy, guidelines, and regulations. However, the second and third questions cover financial incentives and reimbursement, not mentioned in the interviews. This suggests a difference in focus, Rouidi et al. (2023) focuses more on individual incentives, this study is more focused on broader organizational factors as policy, guidelines and regulations. Furthermore, from the study of Rouidi et al. (2023) there was no emphasis on the patient perspective from healthcare professionals, only mentioning a few potential benefits for patients. And the study was limited to a narrow cultural context, concentrating on one telemedicine use case and involving only subject matter experts (Rouidi et al., 2023).

In conclusion, comparing the results from this study to the studies Rouidi et al. (2022) and Roudi et al. (2023), the importance of financial incentives and governmental support have been

emphasized by the construct ‘perceived incentive’. Comparing these themes for the adapted framework, it appears that the results of this study focus more on broader influences. While the government support aligns with the Rouidi et al. (2023), the concept of reimbursement for LRS did not appear in this study. Therefore, the construct of perceived incentive may not fully apply for this study but the concept of governmental support complements the findings. Since the study by Rouidi et al (2023) is more focused on one telemedicine use case in one specific context, this broader organizational construct may not fully complement the adoption framework.

The study’s findings on broader adoption factors highlight that the UTAUT is more individually oriented. As concluded in Chapter 5, the emphasis from the UTAUT is more on individual organizational dynamics rather than broader which is also evident when comparing these findings to Rouidi et al. (2022) and Rouidi et al. (2023). Looking at the framework in Appendix XVIII, can be reflected that according to the findings of this study there is some overlap in organizational context and the individual context. As discussed, the individual context covers the perceived incentive and social influence. For the perceived incentive this not fully applies to this study, although it has some overlap with the concept of governmental support. Furthermore, as discussed in Chapter 5, cultural aspects for adoption of LRS may not be fully captured by the framework, particularly in terms of broader social factors. Since both perceived incentive and social influence are stated for the individual context but appeared from results in this study on the organizational adoption factors, it can be argued that there is some overlap in the individual and organizational context. This overlap has been visualized by the in purple in Figure 12 on the modified UTAUT framework of Rouidi et al. (2022) and Rouidi et al. (2023). Reflecting on these organizational adoption factors, because UTAUT or Rouidi et al. (2022) and Rouidi et al. (2023) do not address the broader adoption variables, it may be claimed that UTAUT is more individually oriented.

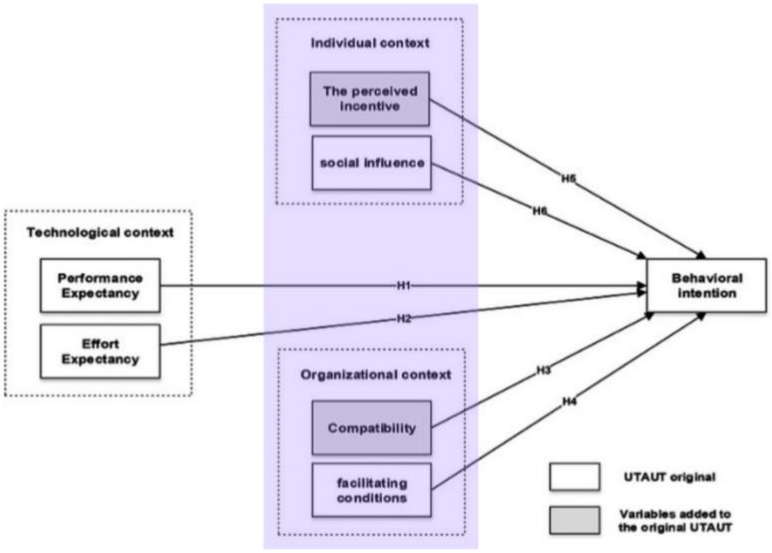

Figure 12. Overlap on the individual and organizational context

6.3 Discussion on Findings

The discussion of the findings has been structured in four main paragraphs, examining how the study populations, use cases and time period influenced the results, comparing barriers, facilitators and approaches to overcome. Following, the emerging themes will be discussed

compared to existing literature, and the impact of patient perspectives and professional backgrounds have been analyzed.

Study populations, use cases and time period

It is important to take into account the study population of the studies, looking at the study's methodologies. For this study, 65 articles have been reviewed and 10 healthcare professionals have been interviewed, grouped into three different perspectives. The study of Rouidi et al. (2022) performed a literature review on 13 articles, and the study of Rouidi et al. (2023) was built on this literature review. Furthermore, the qualitative analysis was based on data obtained from interviews with 35 healthcare professionals (15 doctors and 20 nurses) in Moroccan hospitals (20 in urban areas and 15 in rural areas) (Rouidi et al., 2023). Conversely, Venkatesh et al. (2003) used a quantitative methodology for the longitudinal field study (six month period with three different points of measurement), which involved questionnaires from 215 participants across four organizations and reviewed eight prominent models for individual acceptance of new information technologies. Considering these differences, the qualitative insights of this study offer valuable depth but compared to Venkatesh et al. (2003), lack broader empirical generalizability, also due to the qualitative nature of this study. The study of Rouidi et al. (2023) performed 35 interviews in the time frame from July to September 2021 and this study performed 10 interviews between April to May 2024. The larger sample size and extended time frame of Rouidi et al. (2023) might provide more insights on telemedicine adoption. However, the impact of different time periods can be considered. As discussed, the study of Rouidi et al. (2023) was conducted during COVID-19 pandemic. The participants' attitudes and perceptions may be influenced by this situation, which emphasized the necessity and rapid applicability of telemedicine solutions. Interviews for this study were performed after the COVID-19 pandemic. Due to this temporal difference responses may have varied, which could have had an impact on the results and therefore the comparison of the articles. It is also relevant to discuss the use cases which have been assessed in the different articles. It can be argued that for the study of UTAUT, the participants were introduced to an implementation of a new information technology. The studies of Rouidi et al. (2022) and Rouidi et al. (2023), focus on more general telemedicine, similar to the general telemedicine use cases examined in this study. Therefore, it could be argued that whether the use case is specific or general does not impact the results. However, the specificity of the research context does have considerable influence.

Comparisons between barriers, facilitators and approaches to overcome

The analysis of barriers and facilitators presented that these can be mentioned interchangeably due to differences in perspectives and organizational context. From the results this may have been dependent on the interviewees with different backgrounds and different discussed use cases. But from literature, a study by Naing et al. (2023) on facilitators and barriers to engaging communities in health service research, found that in many instances, the opposite side of a problem, challenge, tension, or barrier was framed as a facilitating factor or 'enabling factor'. This illustrates the multifaceted nature of the concepts. Overall, barriers have been mentioned almost three times more as facilitators. These identified barriers reflect the literature on the slow or underutilized adoption of telemedicine in LRS, and limited evidence for adopted interventions (Kiberu et al., 2018; Ncube et al., 2023; Takuwa et al., 2023; Ye et al., 2023). The interconnectedness between approaches to overcome and the identified barriers and facilitators has been discussed in Chapter 4. Overcoming these barriers transforms them into facilitators, highlighting the relationship of these concepts. Venkatesh et al. (2003) argued that the existing model is notably weak in providing guidance to designers. By this finding, the interconnectedness between barriers, facilitators and overcome, this may provide the guidance that Venkatesh et al. (2003) found lacking in the existing model. Following these findings, can be discussed what adoption means in light of this study. This research is positioned at the edge of adoption towards implementation. By the identification of the barriers, facilitators, and approaches to overcome has been concluded that these concepts are

interrelated and influence each other throughout the adoption process. While the primary focus of this study was on identifying adoption, insights from interviews and comparisons with existing literature suggest that a new type of term is needed to better capture the process from adoption to implementation. Since the process from adoption to implementation appears to involve a process that current terminology does not fully capture. Therefore, this research examines and bridges the gap between adoption and implementation, indicating a need for future studies to explore this evolving terminology.

Emerging themes comparing to literature

Articles reviewed from literature focused on organizational adoption barriers and facilitators. As a result, some of the emerging themes from the interviews have not been addressed from the literature review. The relevance of these emerging themes can be questioned, this will be discussed in the limitations. Nonetheless, these themes emerged from the interview data and are therefore considered in this study. Table 8 indicates that the barriers on the broader and organizational construct have been addressed in literature. Reflecting on the literature, the barriers on lack of awareness and distrust in healthcare and technology have been mentioned. Insufficient awareness of availability is a barrier to adoption (Hui et al., 2022; Kissi et al., 2023; Ye et al., 2023). And there is also a lack of awareness regarding the advantages of telemedicine, more widespread in order populations and people with lower educational levels (Getachew et al., 2022; Mahmoud et al., 2022; Zayyad & Toycan, 2018). Furthermore, in healthcare settings undermining trust and acceptability issues will increase the risk of telemedicine solutions to be rejected (Mahmoud et al., 2022). As discussed, these barriers are covered by the new construct patient attitude, referred from the attitude construct by Venkatesh et al. (2003). A study applying the UTAUT model in LRS suggested context sensitive constructs, this extended UTAUT model also proposed to include the construct of attitude for intention to use technology (Shiferaw et al., 2021). These findings from literature support the introduction of this construct ‘patient attitude’.

Patient perspective and professional backgrounds

Healthcare professionals naturally emphasize the patient’s perspective, when not explicitly asked, this has been discussed in Chapter 3. This finding suggests that there is a relationship between the perspective of the interviewee and the end-users of technology, in case of telemedicine this includes both the healthcare professional and the patient. Venkatesh et al. (2003) concluded in the development of the UTAUT that the present work advanced individual acceptance by unifying theoretical perspectives common in the literature and incorporating four moderations to account for dynamic influences including organizational context, user experience and demographic characteristics. However, the UTAUT has not addressed this dual perspective, this may be due to the study population and the use case of new information technology for which this has not been relevant or by the quantitative nature of the study. This finding on the relationship between the healthcare professional and patient aligns with the literature review, discussed in Chapter 3, on the point that healthcare professionals are the principal users of telemedicine systems, and their acceptance is crucial, as there is a trust relationship between clinicians and patients (Sander et al., 2021). And that acceptance of technology is directly related to patients and must be addressed to ensure successful implementation (Adenuga et al., 2017; Rouidi et al., 2023).

3D telemedicine

As discussed in Chapter 2, the concept of 3D has been excluded from the data analysis of this study and included in Appendix X. However, this concept of 3D will shortly be discussed. From the interviews the introduction of 3D telemedicine revealed barriers and facilitators. Key barriers include high financial costs, uncertainty about the added value of 3D over 2D, set up complications and a preference for simplicity. Facilitators include the potential for improved surgical planning and patient engagement. These findings did not align with the construct of facilitating conditions but aligned with the UTAUT model’s construct of performance

expectancy and effort expectancy, highlighting the need for considering these constructs for 3D telemedicine adoption in LRS. However, for 3D telemedicine there is not extensive literature available, which has been substantiated by the literature review and search strings. Therefore, the results could not have been examined more extensively. As discussed, the idea was to apply this study it to different settings of telemedicine, to the advanced technology of 3D telemedicine. Interview results revealed new knowledge however, the findings do not really contribute to the goal of this study as a result 3D telemedicine was not predominant for this research.

7 Limitations

7.1 Introduction

In this Chapter, the limitations for this study will be examined. Each limitation is a point of reflection. This Chapter is structured as follows discussing limitations on the methodology, selected framework and data analysis and results.

7.2 Methodology Limitations

The methodology of this study has several limitations. The decision to use Scopus as a database for this study may have resulted in additional relevant research from other databases as PubMed and Web of Science that has been overlooked. Furthermore, for the selection of the participants, the interviewees had experiences in the context of Sub-saharan Africa, for the literature review, the scope of LRS was also on other countries, such as India, the Philippines and Pakistan for example. This may have influenced the findings. Additionally, because of this multi-context approach rather than focusing on one specific context, may have resulted in findings that are too generalized. After this study, appeared that in the search string country was included, instead of countr*, this could have generated more hits in Scopus. Therefore, this adaptations to the search string have been made, this resulted in 589 articles, the original string resulted in 568 articles, so by this change only 21 articles more, not a very significant difference. Therefore, this limitation not that relevant. It can also be seen in Appendix III, that the reviewed articles following from the search string were mainly relevant for the first Chapter, as well as Chapter 4 identifying the barriers and facilitators. The articles reviewed through snowballing were mostly addressed in Chapter 3, identifying a suitable adoption framework for this study. It can be argued that it would have been more effective to develop a separate search string in Scopus for Chapter 3, sub question 1. By snowballing maybe not all relevant literature has been covered, and by using a separate string this would have improved the reproducibility of this study.

7.3 Selected Framework Limitations

The primary limitation of the UTAUT framework is that it was not originally designed for the healthcare context (Rouidi et al., 2022). As discussed from literature, each country may require different models of technology acceptance that introduce specific factors and models (Garavand et al., 2022). Therefore, it might have been important to select a framework specifically for the context of LRS. The study by Rouidi et al. (2023) explored this in the specific context in LRS, but only the specific context of Morocco, which is also not in the context of Sub-Saharan Africa, from which most interviewees discussed their perspective. While several studies have tested the UTAUT in healthcare context, the generalizability in different healthcare settings, specifically in LRS, is limited (Rouidi et al., 2022). This influenced the applicability of UTAUT for this study.

As discussed, the use of the UTAUT framework in this study revealed the interconnectedness of identified barriers, facilitators, and approaches to overcome. UTAUT focuses on identifying adoption factors, however there is a disconnectedness between the identified adoption factors and the responses of the framework. As a result, it lacks guidelines on how to use the framework. For example, UTAUT does not provide guidance on how to leverage facilitators,

how to reduce barriers or how to address approaches to overcome. The UTAUT framework also does not specify who should be interviewed or for who the framework is meant for. Overall, while the UTAUT framework is useful for understanding the factors that influence technology adoption, it lacks guidance on managing these factors, highlighting the need for guidelines on how to apply the framework.

7.4 Data Analysis and Results Limitations

Term telemedicine
For this study the term telemedicine is interchangeably used with similar concepts of e-health, m-health, telehealth and digital health. From literature and interviews different types of telemedicine have been examined, especially from literature, this approach may have been too general. Literature indicates that each specific type of telemedicine has its own patients, and certain factors that may influence its use, and that these differences can change the influencing factors (Garavand et al., 2022). Using the term telemedicine for these different types may be a limitation in understanding the different adoption factors of each type, and therefore applicability of findings. Relating to this, this study examined different use cases of telemedicine. A potential limitation is that if these use cases would have been more similar, the findings might have been different.

Perspectives
The perspectives and roles from the 10 interviewees may have influenced the results. It can be argued that respondents act in accordance with their roles, therefore can be questioned how the interviewees responded in the context of organizational adoption factors. This implies that some perspectives may have been more interesting than others, particularly the interviewees with a more organizational role. Since the focus of this study was on organizational adoption factors their perspectives may have been more relevant.

Furthermore, the interviewees in this study do not form a cohesive group, this may indicate that the results are not a collective set of evidence. However, this limitation is also a strength, because this set of interviewees is random, the results may have been interesting.

In Chapter 4 the results have been discussed from the lens of the different perspectives, which has its limitations. First of all, the perspectives have been divided into three groups, but some overlap exists. Furthermore, the groups of perspectives were not equal, which might have influenced results. For the quantitative analysis on the perspectives this has been considered, see Appendix XI and XII. By performing research with more participants, the differences allow for more differentiation, this requires further research. Because of these different perspectives, different interview questions have been designed, this could have influenced answers and bias on interpretation of the questions, although this was necessary to capture the experiences of the interviewee. In the analysis of the different perspectives' conclusions have been drawn according to barriers not mentioned. These barriers were either not addressed by the participants directly or did not follow from the questions asked, so the validity to draw conclusions based on these findings can be questioned. The percentages in the Sankey diagrams represent the total construct, not the separate item labels, this could have led to misunderstanding by the readers. For the analysis of the emerging themes, no differentiations have been made on item labels, also because those are not existing. However, this lack of differentiation might contribute to the high percentages to the overall influence of the interviewees on the emerging themes. The differentiations are addressed in Chapter 4 The differences in the three analyses on the perspectives, specifically the data interpretation, may have led to wrong conclusions. Overall, to really draw conclusions based on the perspectives, a broader study needs to be performed, with a more balanced representation of the

perspectives. This limitation substantiates the decision to exclude the focus on the perspectives, also because the differences were not that noticeable. The decision to exclude the influence of perspectives in this study in Chapter 4 may have influenced the results of Chapter 5, and the conclusion to this research.

Emerging themes

In the data analysis for emerging themes no difference has been made in the number of times an emerging cluster appeared. This has been done when looking at barriers and facilitators by the UTAUT. This can be a limitation, but on the other hand the emergent themes are assumed all to be relevant since they have not been covered by the existing framework of the UTAUT. Furthermore, the focus of this study was to identify organizational adoption factors, however from the emerging themes followed barriers and facilitators that were not applicable for the organizational context. This might indicate that the interview questions were not well-defined, and the right type of questions were not asked for the organizational context. Or, as discussed, that for identification of adoption factors it is not possible to only focus on one type of adoption factors. Furthermore, for the organizational conditions the sub constructs of security expectancy and regulatory influence have been defined following the analysis of the data. However, this does not indicate that this construct of organizational conditions is complete by these two sub constructs. There may be other sub constructs which are also relevant, but have not been defined for this study.

Adapted framework

For sub question 3, Chapter 5, two types of conclusions have been discussed: framework adaptations and findings that require consideration. One finding emphasized considering intrinsic cultural values when applying the framework in LRS. However, this conclusion is based on data of only three interviewees, raising questions about the generalizability. Furthermore, adaptations to the UTAUT framework were introduced, see Figure 11 the location and directional arrows of these new constructs in the existing UTAUT have not been empirically tested, which is a limitation to the interpretation of the findings.

Ordinal structure

Furthermore, the finding of the ordinal structure within the construct facilitating conditions, may be influenced by interpretations and meanings of the words used. This study revealed differences on how the constructs of perceived behavioral control, facilitating conditions and compatibility have been discussed. Adoption factors covered by compatibility were often addressed more personally, facilitating conditions more on an intermediate level and perceived behavioral control considered from a broader perspective. This variation could suggest that there is an ordinal structure of the sub constructs within the construct of facilitating conditions and the wider framework of the UTAUT. However, this finding cannot be verified, therefore more research is necessary, which will be discussed in future research of this study.

8 Conclusion

8.1 Conclusion

To answer the main research question, how to address organizational adoption factors for telemedicine in LRS, the answers to the sub questions have been summarized below.

How to address organizational adoption factors for telemedicine in LRS?

SQ1. How can the adoption of telemedicine in LRS be examined?
The adoption of telemedicine in LRS can be examined using the UTAUT framework by Venkatesh et al. (2003). Literature highlighted the importance of organizational adoption factors for successful adoption. As a result, this study focused on the construct of facilitating conditions within the UTAUT framework, emphasizing the importance of the perspective from the healthcare professionals in shaping attitudes towards telemedicine adoption.

SQ2. What are organizational adoption factors of telemedicine in LRS?
The organizational adoption barriers highlighted include a lack of geographic and infrastructure resources, financial constraints, issues on connectivity, lack of policy, guidelines, and regulation and the lack of data protection (for privacy). Access to mobile technology infrastructure has been identified as a facilitator. The identification of the organizational adoption factors, highlighted the interconnectedness of barriers, facilitators, and approaches to overcome, demonstrating the dynamic nature of adoption processes. In this Chapter the identified organizational adoption factors have been linked to the UTAUT if possible, emerging themes have been discovered which have been addressed in sub question 3.

SQ3. How might existing frameworks be refined to better align with the identified organizational adoption factors for telemedicine in LRS?
The analysis of emerging themes resulted in findings concerning the applicability of the UTAUT framework for telemedicine adoption in LRS. As discussed for the identified organizational adoption factors has been looked if they can be covered by the UTAUT framework, if possible. If not, emerging themes have been studied and has been concluded to modify the framework, to capture the adoption factors discussed so that the modified framework is sufficient to address the organizational adoption factors in this study. This study proposes two new constructs: patient attitude, which is in line with the existing constructs of the UTAUT, and organizational conditions, which adds a new dimension to the construct of facilitating conditions by creating an interaction where the constructs both influence and impact each other. This modified framework is presented in Figure 11. The visualization represents the relationship between the two constructs, highlighting interconnectedness and explaining that the interaction is not fully understood. These organizational conditions include two sub-constructs: **Security Expectancy and Regulatory Influences.** Additionally, for applying the framework for this study's setting intrinsic cultural values need to be considered.

Overall, in this study, the applicability of the UTAUT framework, particularly concerning the construct facilitating conditions, has been studied. It has been shown that the identified adoption factors cannot be entirely covered by this construct or other construct from the UTAUT. In this research, emerging themes have been revealed, although not all discussed organizational adoption factors. As a result, it has been concluded that focusing on one construct of the UTAUT is not adequate for addressing organizational adoption factors. This indicates that adoption is an umbrella term and when discussing one specific adoption factor,

other adoption factors are also important. From focusing on one type of adoption factors others also emerge and are relevant. Concluding, for addressing organizational adoption factors for telemedicine adoption by healthcare professionals in LRS UTAUT is not fully applicable. Furthermore, it can be concluded that the UTAUT is more individually oriented. Therefore, when considering adoption from a broader perspective, the UTAUT may have limited relevance. Additionally, conclusions have been drawn on the interrelated nature of the concept's barriers, facilitators, and approaches to overcome covering adoption factors. Barriers and facilitators can be context-dependent and sometimes contradictory, highlighting the complexity of telemedicine adoption suggesting for a new type of term to better capture the process from adoption to implementation.

To conclude, this study contributes to an understanding the context-dependency and interrelated nature of barriers, facilitators, and approaches to overcome. By proposing the modified framework, this study aims to provide new insights on how to address telemedicine adoption among healthcare professionals in LRS.

8.2 Future Research

This study suggests different future research potentials. Future research should focus on validating the proposed UTAUT framework in this study. This involves research that examines the dual perspective in healthcare settings, from the perspective of healthcare professionals. As described technology adoption is not only determined by factors that directly affect healthcare professionals but also by how they perceive patient perspectives. For example, a study could focus on an understanding of the factors driving technology adoption, considering both the practical and patient-centered aspects. Additionally, testing with a larger and more diverse group of participants from different perspectives, or more participants from the same perspective, would enhance the validity of the results. This may be achieved by longer-term studies, which would also allow to observe changes over time. This study has determined to exclude the influence of perspectives since the impact from the perspectives resulted to be limited. A future study might focus more on these influences, since as discussed respondents act in accordance with their roles and therefore some perspectives could be more interesting than others. Therefore, a study could focus on the perspectives separately, instead of the collective insights from interviewees. Furthermore, rather than only focusing on the construct facilitating conditions, investigate the influence of the new constructs across the entire UTAUT framework. For example, a study could test the proposed framework in this study for telemedicine adoption in LRS, to further validate the findings. Also, future research could focus on the effects of the moderating factors from the UTAUT: experience, voluntariness, age, and gender on the proposed new constructs: organizational conditions and patient attitude. Other future research topics could focus on specific telemedicine use cases to assess the applicability of this proposed framework. The finding on the interconnectedness between the concept's barriers, facilitators, and approaches to overcome can also be further explored in a study. As discussed, the interconnectedness suggests a new type of term needed to better capture the process from adoption to implementation. A future study could explore this evolving terminology on the gap between adoption and implementation. Since this study indicated differences on the ordinal structure within the facilitating conditions construct, this finding requires more research to confirm. Future study might focus on whether the adoption constructs in the UTAUT have an ordinal structure.

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Appendices

Appendix I. Overview Tested Search Strings

	Main concepts	Search string	Results	Reason excluded
1	Adoption, telemedicine, 2D/3D	(TITLE-ABS-KEY (adoption OR implementation OR viability OR scale-up OR feasibility) AND TITLE-ABS-KEY ("telemedicine" OR "electronic consultation" OR "teleconsultation" OR telemonitoring OR "health monitoring" OR "remote healthcare" OR "remote health care" OR "remote medical diagnosis" OR "remote patient monitoring" OR telecare OR telehealth OR telehealthcare OR "virtual medicine") AND TITLE-ABS-KEY (2d OR two-dimensional OR 3d OR three-dimensional) AND NOT TITLE-ABS-KEY (print*)) AND PUBYEAR > 2013 AND PUBYEAR < 2025	378	No relevant articles in the context of LRS
2	Adoption, telemedicine, 2D/3D, LRS	(TITLE-ABS-KEY (adoption OR implementation OR viability OR scale-up OR feasibility) AND TITLE-ABS-KEY ("telemedicine" OR "electronic consultation"OR "teleconsultation" OR telemonitoring OR "health monitoring" OR "remote healthcare" OR "remote health care" OR "remote medical diagnosis" OR"remote patient monitoring" OR telecare OR telehealth OR telehealthcare OR "virtual medicine") AND TITLE-ABS-KEY (2d OR two-dimensional OR 3d ORthree-dimensional) AND TITLE-ABS-KEY ("lower-middle-income country" OR "LRS" OR "low-income country" OR "developing country" OR "less developed country" OR "underdeveloped nation" OR "resource-poor country" OR "economically challenged country" OR "impoverished nation" OR"socioeconomically varied country" OR "mixed-income country") AND NOT TITLE-ABS-KEY (print*)) AND PUBYEAR > 2013 AND PUBYEAR < 2025	2	Not enough results
3	Telemedicine, 2D/3D, LRS	(TITLE-ABS-KEY ("telemedicine" OR "electronic consultation" OR "teleconsultation" OR telemonitoring OR "health monitoring" OR "remote healthcare" OR"remote health care" OR "remote medical diagnosis" OR "remote patient monitoring" OR telecare OR telehealth OR telehealthcare OR "virtual medicine")AND TITLE-ABS-KEY (2d OR two-dimensional OR 3d OR three-dimensional) AND TITLE-ABS-KEY ("lower-middle-income country" OR "LRS" OR "low-income country" OR "developing country" OR "less developed country" OR "underdeveloped nation" OR "resource-poor country" OR "economically challenged country"	13	Not enough results

		OR "impoverished nation" OR "socioeconomically varied country" OR "mixed-income country") AND NOT TITLE-ABS-KEY (print*))AND PUBYEAR > 2013 AND PUBYEAR < 2025		
4	Adoption, telemedicine	(TITLE-ABS-KEY (adoption OR implementation OR viability OR scale-up OR feasibility) AND TITLE-ABS-KEY ("telemedicine" OR "electronic consultation" OR "teleconsultation" OR telemonitoring OR "health monitoring" OR "remote healthcare" OR "remote health care" OR "remote medical diagnosis" OR "remote patient monitoring" OR telecare OR telehealth OR telehealthcare OR "virtual medicine") AND NOT TITLE-ABS-KEY (print*))AND PUBYEAR > 2013 AND PUBYEAR < 2025	22416	Too many results
5	Telemedicine, 2D/3D	(TITLE-ABS-KEY ("telemedicine" OR "electronic consultation" OR "teleconsultation" OR telemonitoring OR "health monitoring" OR "remote healthcare"OR "remote health care" OR "remote medical diagnosis" OR "remote patient monitoring" OR telecare OR telehealth OR telehealthcare OR "virtual medicine") AND TITLE-ABS-KEY (2d OR two-dimensional OR 3d OR three-dimensional) AND NOT TITLE-ABS-KEY (print*)) AND PUBYEAR > 2013AND PUBYEAR < 2025	3291	Too many results
6	Adoption, telemedicine, LRS	(TITLE-ABS-KEY (adoption OR implementation OR viability OR scale-up OR feasibility) AND TITLE-ABS-KEY ("telemedicine" OR "electronic consultation" OR "teleconsultation" OR telemonitoring OR "health monitoring" OR "remote healthcare" OR "remote health care" OR "remote medical diagnosis" OR "remote patient monitoring" OR telecare OR telehealth OR telehealthcare OR "virtual medicine") AND TITLE-ABS-KEY ("lower-middle-income country" OR "LRS" OR "low-income country" OR "developing country" OR "less developed country" OR "underdeveloped nation" OR "resource-poor country" OR "economically challenged country" OR "impoverished nation" OR "socioeconomically varied country" OR "mixed-income country") AND NOT TITLE-ABS-KEY (print*)) AND PUBYEAR > 2013 AND PUBYEAR < 2025	568	**Chosen search string**

Appendix II. Reviewed Articles by Literature Search Methods

Literature search method	CH1, CH2	CH4	CH5	CH6
Search String (31 articles)	24	8	27	1
Expert (1 article)		1		

Snowballing (33 articles)	10	27	3	1

Appendix III. Reviewed Articles (Country of research, Telemedicine technology, Adoption framework, Applied in which Chapters, Literature search method)

	Article	Country of research	Telemedicine technology	Adoption framework	CH1	CH3	CH4	CH5	Literature search method
1	Mengesha & Garfield, 2018	Ethiopia	Digital Health, ICT						Search String
2	Chowdhury et al., 2021	India	ICT						Search String
3	Ye et al., 2023	China	Telehealth						Search String
4	Leochico et al., 2020	Philippines	Telerehabilitation						Search String
5	Kissi et al., 2023	LRS in general	Telehealth						Search String
6	Singh, 2022	India	Telemedicine						Search String
7	Akhlaq et al., 2016	LRS in general	Health information exchange, ICT						Search String
8	Tiwari et al., 2023	LRS in general	Telehealth						Search String
9	Lawal et al., 2022	Sub Saharan Africa	Telemedicine						Search String
10	Mahdi et al., 2022	Pakistan	Telemedicine						Search String
11	Hoffer-Hawlik et al., 2020	LRS in general	Telemedicine						Search String
12	Owolabi et al., 2022	LRS in general	Telemedicine						Search String
13	Mensah et al., 2023	Ghana	Telemedicine						Search String
14	Xiong et al., 2023	LRS in general	Digital health						Search String
15	Hui et al., 2022	Bangladesh, India,	Telemedicine						Search String

		Indonesia, Malaysia, Pakistan							
16	Grace et al., 2021	Philippines	Telemedicine						Search String
17	Zayyad & Toycan, 2018	Nigeria	e-Health						Search String
18	Wubante et al., 2022	Ethiopia	Telemedicine						Search String
19	Ndlovu et al., 2017	Botswana	m-Health						Search String
20	Adenuga et al., 2017	Sub Saharan Africa	Telemedicine						Search String
21	Sagaro et al., 2020	Ethiopia	Telemedicine						Search String
22	Adenuga et al., 2016	Sub Saharan Africa	Telemedicine						Search String
23	Ncube et al., 2023	Sub Saharan Africa	Telemedicine						Search String
24	Tchao et al., 2019	Sub Saharan Africa	Telemedicine						Search String
25	Addotey-Delove et al., 2023	LRS in general	Telemedicine						Search String
26	Alboraie et al., 2022	Egypt	Telemedicine						Search String
27	Tahir et al., 2022	Nigeria	Teleradiology						Search String
28	Rackimuthu et al., 2022	India	Teleradiology						Search String
29	Getachew et al., 2022	Ethiopia	Digital health						Search String
30	Takuwa et al., 2023	Uganda	m-Health						Search String
31	Pagaling et al., 2. 021	Philipines	Teleneurology						Search String

32	Adlung et al. 2024		Medical Devices and equipment (MDE)	Adoption frameworks					Expert
33	AlQudah et al., 2021	Dubai	Healthcare	TAM/UTAUT					Snowballing
34	Biloš & Budimir, 2024	Croatia	Technology acceptance (UTAUT 2)	UTAUT 2					Snowballing
35	Campbell et al., 2017	Uganda		TAM for resource limited settings					Snowballing
36	Davis., 1985	USA		TAM					Snowballing
37	Dearing, 2008	USA		Diffusion					Snowballing
38	Frei-Landau et al., 2022	Israël		Diffusion					Snowballing
39	Garavand et al. 2022	Not specific country perspective	Telemedicine	Adoption frameworks					Snowballing
40	Hassani et al., 2017	Not specific country perspective		Diffusion					Snowballing
41	Janssen et al., 2021	Australia	Digital Health						Snowballing
42	Kee,, 2017	USA		Diffusion					Snowballing
43	Kiberu et al., 2018	Uganda	Telemedicine						Snowballing
44	Leonard et al., 2020	LRS in general	Health innovations						Snowballing
45	Lo et al., 2023	Ghana	3D telemedicine						Snowballing
46	Lo et al., 2024	Ghana	3D telemedicine						Snowballing
47	Lu et al., 2022	China	3D telemedicine						Snowballing
48	Mahmoud et al., 2022	LRS in general	Telemedicine						Snowballing
49	Mcdonald & Shirk, 2023	Not specific country perspective	3D telemedicine						Snowballing

50	Miller & Khera, 2010	Cross-country analysis		TAM					Snowballing
51	Mohammadi et al., 2017	Iran		Diffusion					Snowballing
52	Momani & Jamous, 2017	Malaysia		UTAUT					Snowballing
53	Nguyen et al., 2022	Vietnam	Telehealth	Adoption frameworks					Snowballing
54	Rogers, 1983	USA		Diffusion					Snowballing
55	Rouidi et al., 2023	Morocco	Telemedicine	Modified UTAUT					Snowballing
56	Rouidi et al., 2022	Cross-country analysis	Telemedicine	Modified UTAUT					Snowballing
57	Schmitz et al., 2022	Spain	Telemedicine	UTAUT2					Snowballing
58	Shiferaw et al., 2021	LRS in general	Telemedicine	UTAUT					Snowballing
59	Soroush et al., 2010	Australia	Telehealth	Adoption frameworks					Snowballing
60	Venkatesh & Davis, 1996	USA		Technology acceptance, UTAUT					Snowballing
61	Venkatesh & Davis, 2000	USA		Technology acceptance, UTAUT					Snowballing
62	Venkatesh et al., 2003	USA		UTAUT					Snowballing
63	Virtanen et al., 2023	Finland	Digital health	Technology acceptance					Snowballing
64	Vogelsang et al., 2013	Austria		Technology acceptance					Snowballing
65	Zhang et al., 2015	Australia	e-Health	Diffusion					Snowballing

Appendix IV. Interviewees

	Job title	Perspective	Country of experience	Country of base	Telemedicine use case
1	Medical Doctor at Medical University of Graz	Medical	Sub-Saharan Africa	Austria	Teleconsultation, Telemonitoring
2	Professor Human Physiology	Medical	Sub-Saharan Africa	South-Africa	Teleconsultation, Teleradiology
3	Professor Cardiology and Head of Department Cardiology VU AMC	Medical	Tanzania	Netherlands	Tanzanian Hearts Program: Teleradiology, Teleconsultation, Telemonitoring
4	Consultant Physician Cardiologist	Medical	Tanzania	Tanzania	Tanzanian Hearts Program: Teleradiology, Teleconsultation, Telemonitoring
5	Professor and Consultant Plastic Surgery	Medical	Ghana	Scotland	Microsoft 3D Holoportation: Teleconsultation
6	Founder at Macquarie Medical	Medical / Organizational	Namibia	Namibia	Teleconsultation (DrMacQ telemedicine app)
7	CEO CheckUps	Medical / Organizational	Kenya	Kenya, Sudan	Teleconsultation, Telemonitoring (Urgent care centers)
8	President Pan-African Health Informatics Association	Academic / Organizational	Ghana	Ghana	Teleconsultation and Digital Adaptation Kits (EMR)
9	Professor Health Systems and Public Health	Academic / Organizational	Sub-Saharan Africa	South-Africa	Teleconsultation
10	Scientist at WHO	Academic / Organizational	Ethiopia	Switzerland	Teleconsultation, Telemonitoring

Appendix V. Main construct, sub construct and item labels color-coded

Main construct: Facilitating Conditions	
Sub constructs	**Item labels**
Perceived Behavioral Control	• Resources • Knowledge
Facilitating Conditions	• Support • Assistance • Guidance
Compatibility	• Compatibility • Alignment • Integration
Emerging themes	

Appendix VI. Interview Design

Introduction

- Introduce myself & purpose of the research: Master Thesis, Telemedicine, 2D/3D, organizational adoption barriers and facilitators
- Introduce the interviewee
  - What is your academic or professional title?
  - What is your journey that got you into your current position?
  - Could you please reflect on your schooling and education?
  - What type of support have you received in your journey?
  - Can you talk about your professional goals in your current position?
  - How much time do you spend on your work every week?

Consent Form

Thank you for participating. My name is Christine Schets. As part of my Master Thesis at the Technical University Delft, I am looking into the adoption of 3D Telemedicine in LRS.

The purpose of this research is to identify the adoption barriers and facilitators of 3D Telemedicine by also discussing 2D Telemedicine and will take you approximately 45 to 60 minutes to complete. In this context all personal data will be deleted at the end of the Master Thesis process and will not be shared unless we obtain your explicit permission. The transcript will be anonymized before we use it for analysis.

You have of course the right to stop the interview at any time or free to omit any questions. I would like to record the session via MS Teams and use Teams transcription service. The interview will involve transcription and recording, the data will be used to support the research of this Master Thesis, in which you will be fully anonymous. Your data will be treated with the utmost care, by keeping it stored on One Drive, only accessible by the researcher, Christine Schets and TU Delft supervisors. This data will be deleted at the latest 1 month after the research of this Master Thesis is finished. Do I have your consent on participating in this

interview? I would like to use exact quotes, provided they do not identify you. Do you agree to be anonymously quoted?

Start the recording

Structure of the Interview

- First we will discuss your background and experience, with some general questions. Followed by interview questions separated in two parts, one focussing on facilitating conditions and the other on compatibility. I will conclude the interview by a short summary and discuss if there are questions left. I expect the interview will take 45 to 60 minutes.

Interview Questions

GENERAL QUESTIONS

- Could you provide a brief overview of your background, including your current role?
- What is your experience with telemedicine, more specifically in the context of LRS?
    - Take their experience as a **use case (telemedicine application)** for the interview
    - Perhaps focus on one example from your experience or those of your peers/colleagues?

Example **[use case telemedicine application]**: 2D teleconsultation refers to a form of telemedicine where healthcare providers communicate with each other or with patients using two-dimensional video conferencing technology. In this setup, participants can see each other and interact in real-time, discussing medical issues, providing diagnoses, and offering treatment recommendations remotely. It is a convenient way to bridge the gap between healthcare professionals and patients, especially in situations where in-person consultations are not feasible or accessible, like for example during COVID.

CONSTRUCT RELATED QUESTIONS

See Appendix VII.

ADDITIONAL QUESTIONS & CLOSURE AND APPRECIATION

- Shortly summarize what has been discussed
- Ask if there are questions left?

Appendix VII. Interview Questions

CONSTRUCT RELATED QUESTIONS

Construct 1: Perceived Behavioral Control

- **Resource availability**
- **Knowledge accessibility**

Perspective. Medical

1. Resource availability: Can you describe the resources you rely on related to telemedicine [specific use case]

- Follow up: Could you specify which resources you find most crucial for telemedicine in your practice?
- Follow up: How does the availability of these resources impact the ability to use telemedicine [specific use case]?
- Follow up: Are these resources accessible to everyone in your organization, or are they limited?
- Follow up: Can you discuss any measures implemented to enhance the effectiveness of these resources?

2. Knowledge accessiblity: What knowledge and skills are important to adopt for your telemedicine [specific use case]?

- Follow up: Could you share examples of knowledge or skills that have proven crucial in your experience with telemedicine in an LRS?
- Follow up: What knowledge do you have, or do you have access to?
- Follow up: Are there any challenges in accessing the knowledge or skills needed for telemedicine within your organization?

Perspective. Medical / Organizational

1. Resource availability: Can you describe the resources your telemedicine system [specific use case] relies on?

- Follow up: Could you specify which resources you find most crucial?
- Follow up: Are these resources accessible to everyone in your organization, or are they limited?
- Follow up: Can you discuss any measures implemented to enhance the effectiveness of these resources?

2. **Knowledge accessibility:** What knowledge do healthcare professionals need to engage with your telemedicine technology [specific use case]?

- Follow up: Could you share examples of knowledge or skills that have proven crucial in your experience with telemedicine in an LRS?
- Follow up: Can you walk me through a process of access in your organization?
- Follow up: Are there any challenges in accessing the knowledge or skills needed for telemedicine within your organization?

Perspective. Academic / Organizational

1. **Resource availability:** From your perspective, can you identify the resources necessary for adopting and utilizing telemedicine in LRSs for [specific use case]?

- Follow up: If so, what are they?
- Follow up: How does the availability of these resources impact the ability to use telemedicine [specific use case]?

2. **Knowledge accessibility:** What knowledge do you believe healthcare professionals in LRS need to engage with telemedicine technology [specific use case]?

- Follow up: Is this knowledge accessible to healthcare professionals in LRS? If not, what are the barriers to access?
- Follow up: Who or what entities provide this essential knowledge to healthcare professionals in LRS?
- Follow up: Can you walk me through a process of access in your organization?

Construct 2: Facilitating Conditions

- **Support systems**
- **Technical assistance**
- **Guidance**

Perspective. Medical

3. Support systems: In [specific use case], are there support systems in place for LRSs?

→ Example: Electronic medical record

- Follow up: Could you provide examples of support systems you have encountered or are utilized in LRSs?
- Follow up: How do these support systems help you make decisions when you encounter challenges with telemedicine?
- Follow up: Can you elaborate on how these support systems are integrated or embedded within the organizational structure of healthcare facilities in LRS?

4. Technical assistance: Could you describe the technical features for [specific use case] and how they align with the surrounding environment?

- Follow up: Can you describe the process of embedding it into the technical infrastructure for your specific use case?
- Follow up: Could you elaborate on any challenges encountered during the embedding process?

5. Guidance: How has your experience been in the process of selecting a telemedicine system [specific use case]?

Perspective. Medical / Organizational

3. Support systems: For your telemedicine system [specific use case], are there support systems in place?

→ Example: Electronic medical record

- Follow up: How do these support systems help you make decisions when you encounter challenges with telemedicine?

- Follow up: Can you elaborate on how these support systems are integrated or embedded within the organizational structure of healthcare facilities in LRS?

4. Technical assistance: Could you describe the technical features for [specific use case] and how they align with the surrounding environment?

- Follow up: Can you describe the process of embedding it into the technical infrastructure for your specific use case?
- Follow up: Could you elaborate on any challenges encountered during the embedding process?

5. Guidance: How has your experience been in the process of selecting a telemedicine system [specific use case]?

Perspective. Academic / Organizational

3. **Support systems:** How do you perceive the support infrastructure available in LRS?

- Follow up: In your experience, what specific aspects of the support infrastructure are important for telemedicine implementation?
- Follow up: Based on your experience on infrastructure support systems, have you experienced challenges?

4. Technical assistance: Could you describe the technical features for [specific use case] and how they align with the surrounding environment?

- Follow up: Can you describe the process of embedding it into the technical infrastructure for your specific use case?
- Follow up: Could you elaborate on any challenges encountered during the embedding process?

5. Guidance: Could you give examples or insights into guidance specific to LRS contexts?
→ Where guidance refers to advice or support provided to healthcare organizations

Construct 3: Compatibility

- **Compatibility**
- **Alignment**
- **Integration**

Perspective. Medical

6. Compatibility: How would you describe how [specific use case] fits into the way you do your daily work styles in LRS?

- Follow up: Can you provide examples of successful integration of telemedicine into your daily work?
- Follow-up: Are there any aspects of telemedicine that you find particularly challenging to incorporate into your daily routine?

7. Alignment: Do you feel like telemedicine [specific use case] matches well with how you prefer to interact with patients and provide care?

- Follow up: Could you share an example of a telemedicine interaction that aligns with your preferred methods?

8. Integration: How do you think telemedicine [specific use case] fits into the workflows in your [LRS context]?

- Follow up: Can you explain how telemedicine works with your existing routines?
- Follow up: Have you encountered any resistance or challenges when trying to integrate telemedicine into your workflow, and if so, how have you addressed them?

Perspective. Medical / Organizational

6. Compatibility: How would you describe how your telemedicine system [specific use case] fits into the daily work in LRS?

- Follow-up: Are there any aspects of your telemedicine system [specific use case] that you find particularly challenging to incorporate into daily routines?

7. Alignment: How does your telemedicine system [specific use case] align with work styles involved in care delivery?

- Follow up: Are there any specific aspects of your telemedicine system [specific use case] that you feel align well with care delivery methods?

8. Integration: How do you think telemedicine [specific use case] fits into the workflows in your [LRS context]?

- Follow up: Can you explain how telemedicine works with existing routines?
- Follow up: Have you encountered any resistance or challenges when trying to integrate telemedicine into workflows, and if so, how have you addressed them?

Perspective. Academic / Organizational

6. Compatibility: When considering the organizational structure for telemedicine [specific use case], how does it align with the current organizational framework?

- Follow up: Can you provide an example of the impact between organizational policies and regulations on daily operations?

7. Alignment: To what extent do you believe that telemedicine [specific use case] aligns with work styles involved in care delivery?

- Follow up: Can you describe a scenario where telemedicine didn't match the usual way care is given?
- Follow up: Are there any specific aspects of telemedicine that you feel align well with care delivery methods?

8. Integration: How would you describe how [specific use case] fits into the existing workflows in your [LRS context]?

- Follow up: Can you provide examples of how telemedicine integration has impacted daily routines?
- Follow up: Have you noticed any challenges to integrating telemedicine into existing workflows?

Introduce Mock-up

10. Mock-up: Discussing the introduced mock-up, what would be the difference concerning adoption barriers and facilitators for 3D Telemedicine compared to the discussed telemedicine use case?

3D telemedicine platform designed to facilitate remote medical consultations between patients and healthcare providers by Microsoft Holoportation. Microsoft's Holoportation communication technology is a real-time 3D Telemedicine system (3DTM) validated for clinical use in plastic and reconstructive surgery, creating a 3DTM model of the patient, giving the healthcare professional a realistic 360-degree perspective. (Lo et al., 2024). And has the potential to enhance the delivery and access to comprehensive rehabilitation care in LRS contexts (Moreau et al., 2020; Lo et al., 2024).

Concluding

11. Evaluation: What excites you about its potential use, and what opportunities do you see from using telemedicine?

Appendix VIII. Mock Up 3D Telemedicine / Plastic-Reconstructive Surgery

I. Use-Case

3D telemedicine platform designed to facilitate remote medical consultations between patients and healthcare providers by Microsoft Holoportation. Microsoft's Holoportation communication technology is a real-time 3D Telemedicine system (3DTM) validated for clinical use in plastic and reconstructive surgery (Lo et al., 2024). And has the potential to enhance the delivery and access to comprehensive rehabilitation care in LRS contexts (Moreau et al., 2020; Lo et al., 2024). In 3D telemedicine, distance is a critical factor. Patients in remote areas are assessed by a specialist physician from a tertiary hospital (Tsagkaris, 2019). Integrating telemedicine enables remote digital design and expert clinical and technical support. A multidisciplinary team (MDT) provides personalized medicine for comprehensive care while also undertaking long-term assessments and maintaining communication with patients (Moreau et al., 2020).

II. Design Features

Holoportation is a type of capture technology enabling high-quality 3D models of individuals to be reconstructed, compressed and transmitted live anywhere in real time (Tsagkaris, 2019). Pre- and post-operative meetings are held using Microsoft Holoportation communication technology (Stetkiewicz, 2023). Creating a 3DTM model of the patient, giving the healthcare professional a realistic 360-degree perspective. The system technology consists of 10 capture devices radially positioned around the patients, Figure 1. Data is collected and sent to a GPU-powered workstation where Holoportation algorithms fuse the depth maps to produce a streaming 3D model of the patient. This model is sent to a remote viewer application interacting with the healthcare professional in real-time, Figure 2 and 3. For the patient, the system includes a monitor and audio system for Microsoft Teams video call with the healthcare professional (Microsoft, 2023).

III. Integration with Current Setting

Real-time 3D Telemedicine in an international MDT setting in an LRS context (Lo et al., 2024). These contexts include isolation, distance from tertiary care facilities, resource scarcity, challenging (and expensive) emergency transfers, limited access to specialists, and limited opportunities for training of medical staff (Tsagkaris, 2019). Technical restrictions are mostly

related to the availability of high-speed internet in LRS and last-mile infrastructure connections (Lo et al., 2024).

IV. User Journey

3DTM enables better planning, safety, and integration among the international team and better patient education and follow-up care (Stetkiewicz, 2023). Specific benefits in LRS are related to first global preoperative discussion of the complex reconstructive patients in 3D, patient education and inclusion and thirdly, follow-up and delivery of allied services (Lo et al., 2024).

V. References

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Appendix IX. Mock Up 3D Telemedicine Presentation

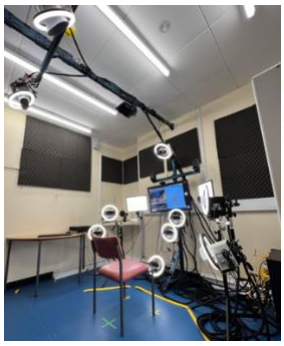


Figure 1. System set-up (Lo et al., 2024)

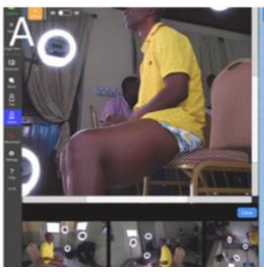


Figure 2. 3DTM viewer screen (Microsoft, 2023)

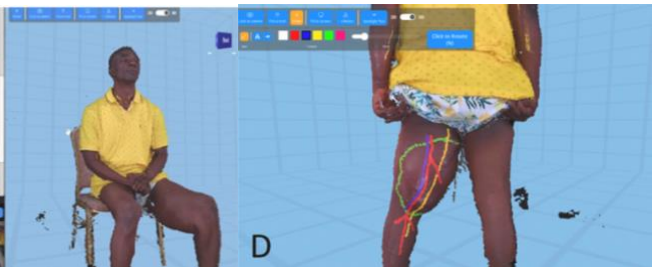


Figure 3. Drawing on 3D model (Microsoft, 2023)

Appendix X. Consent Form

Consent Form

Note: A Copy of the consent form statement will be given in written form to the interviewee

Consent Form for Interviews
Thank you for participating. My name is Christine Schets. As part of my Master Thesis at the Technical University Delft, I am looking into the adoption of 3D Telemedicine in LRS.

The purpose of this research is to identify the adoption barriers and facilitators of 3D Telemedicine by also discussing 2D Telemedicine and will take you approximately 45 to 60 minutes to complete. In this context all personal data will be deleted at the end of the Master Thesis process and will not be shared unless we obtain your explicit permission. The transcript will be anonymized before we use it for analysis.

You have of course the right to stop the interview at any time or free to omit any questions. I would like to record the session via MS Teams and use Teams transcription service. The interview will involve transcription and recording, the data will be used to support the research of this Master Thesis, in which you will be fully anonymous. Your data will be treated with the utmost care, by keeping it stored on One Drive, only accessible by the researcher, Christine Schets and TU Delft supervisors. This data will be deleted at the latest 1 month after the research of this Master Thesis is finished. Do I have your consent on participating in this interview? I would like to use exact quotes, provided they do not identify you. Do you agree to be anonymously quoted?

Signatures

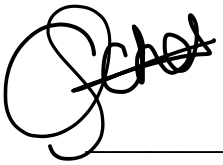
I have read and understood, and I consent to participate in the experiment and the data processing described above.

_____ _____

Name of participant [printed] Signature Date

[Add legal representative, and/or amend text for assent where participants cannot give consent as applicable]

I, as researcher, have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.



Christine Schets

_____ _____ 02 / 04 / 2024

Researcher name [printed] Signature Date

Study contact details for further information: Christine Schets, C.M.C.Schets@student.tudelft.nl

Appendix XI. Calculations Quanitative Analysis – Single code occurrence

For the analysis of the influence of the different perspectives form the interviewees in this study on the findings, three different analyses have been performed, from which also a quantitative analysis. This quantitative analysis has been performed quantitatively on single code occurrence, here the adoption factors have been examined collaboratively. The percentages have been determined to reflect the number of interviewees from each perspective who addressed the adoption factors. These percentages have been normalized based on the varied group sizes. The calculation steps will be shortly addressed below:

- **Construct:** Refers to the broader category or theme under which item labels are grouped, perceived behavioral control, facilitating conditions, compatibility and emerging themes
- **Item Label:** Refers to specific barriers, facilitators, or approaches to overcome, categorized within constructs.

.

1. Calculate mentions per perspective for each item label: For each item label, the number of mentions from per perspective have been calculated. This has been done by dividing the total number of mentions for an item label in a specific perspective by the total number of people in that perspective. This has been done for all item labels belonging to the construct.

2. Normalize the mentions per perspective across item labels: For the second step the mentions per perspectives have been normalized following two calculations.

2.2.1 Calculate the total mentions per perspective across item labels: The sum of mentions for each perspective across all item labels.

2.2.2 Normalize the mentions per perspective: For each item label and perspective, divide the number of mentions from 2.1 by the sum of the total mentions from the perspectives. This resulted in percentages introduced in the Tables 17,18,19,20

Appendix XII. Calculations Quanitative Analysis – Multiple code occurrence

(OpenAI., 2024).

The third quantitative analysis focused on multiple code occurrences and analyzed the Sankey Diagrams following from Atlas.ti, the groups of perspectives have also been normalized.

- **Construct:** Refers to the broader category or theme under which item labels are grouped, perceived behavioral control, facilitating conditions, compatibility, and emerging themes
- **Item Label:** Refers to specific barriers, facilitators, or approaches to overcome, categorized within constructs.

1. Totals for each construct (item label group) derived from Atlas.ti: Sum of all mentions for a specific item label across all perspectives. And calculate the total for the construct, which is the sum of total for all item labels.
2. Calculate percentage contribution of each perspective to each item label: For each item label, determine the percentage of mentions from each perspective. By dividing

the item label for a perspective by the sum of all mentions for a specific item label from 1.
3. Normalize percentages within the construct: By ensuring that the sum of percentages of each construct equals 100%.
4. Calculate the total contribution of each perspective to the construct: By the sum of the normalized percentages for all item labels for the different perspectives.
5. Calculate the total influence of each perspective on each construct: For each perspective sum up the total influences on the different item labels to arrive at the influence of the perspective on the construct.
6. Verify that the total influence sums to 100% for each perspective. This resulted in percentages introduced in the Tables 21,22,23,24

Appendix XIII. Analysis 3D Telemedicine

As described in Chapter 2 of the 3D telemedicine has been excluded from the main text. However, the data analysis and results have been presented here.

The interviews have been introduced to the mock-up version of a 3D telemedicine system. While barriers and facilitators identified in general telemedicine use cases applied, distinct adoption factors emerged to 3D telemedicine in specific. These findings contribute to the understanding of adopting more advanced telemedicine applications. Previously noted barriers were mentioned after interviewees were shown to the 3D mock-up, with financial constraints being addressed extensively. Facilitators for this mock-up version were less acknowledged.

3D Telemedicine Barriers from Interviews

See Table 12, for the identified barriers from interviews on 3D telemedicine. These will be elaborated on in this paragraph.

	Barrier	**n**	**x**	**Construct**	**Item label**
1	Financial constraints	14	7	Perceived Behavioral Control	Resources
2	Added value uncertainty	15	5	*Emerging*	
3	Set up complications	9	4	*Emerging*	
4	Simplicity preference	9	3	*Emerging*	
5	Lack of awareness	4	3	*Emerging*	*Patient centric*

Table 12. Barriers from interviews on 3D Telemedicine

Barrier: **Financial constraints**
The introduction of 3D telemedicine is expected to be very expensive, compared to other telemedicine applications, as described: *"A 3D would be more expensive than for example the use of 2D, but the benefits from 3D are more significant".* It is also assumed that complex telemedicine applications like these will have been developed by individuals who received grants, yet this demonstrates that adding money to something does not necessarily solve a problem. Furthermore, it is expected that the set up costs of this technology will be very high. For more advanced technologies the healthcare costs tend to go up, higher costs reflect accessibility, and therefore adoption. As one interviewee noted, *"Often when there are*

resource limitations, adding more layers of technology sometimes increases its costs and decreases its accessibility".

Barrier: **Added value uncertainty**
The added value of these 3D telemedicine applications has been questioned. The added value of exploring 3D representations would have been beneficial, though 2D photographs were deemed sufficient for the purposes: *"It would have been nice to see a 3D image of something, but a photograph was sufficient too".*

3D is used for more complex conditions, but it has been argued that if the condition is serious, the patient needs to be evacuated anyway. Thus, the added value of such a system is questioned. Many interviewees argued on what the problem was trying to solve: *"The added value of this over just camera looking around I don't see it yet"* and *"What is the problem you are trying to solve specifically with this solution?".*

3D Telemedicine Facilitators from Interviews

See Table 13, for the identified facilitators from interviews on 3D telemedicine. There will be elaborated on one facilitator.

Facilitators from interviews on 3D telemedicine

Barrier		n	x	Construct	Item label
Complex surgically feasible	1	12	5	*Emerging*	
Patient involvement	2	7	1	*Emerging*	*Patiënt*

Table 13. Facilitators from interviews on 3D Telemedicine

Facilitator: **Complex surgical feasibility**
3D telemedicine also excites interviewees as it can be used for complex conditions, and may enhance patient care in a user-friendly environment. As discussed: *"Being able to see the person in full 3D, I think that would be huge.".* According to an interviewee with experience on the 3D project this concept is a solution for very specific conditions and indeed more complex than 2D.

3D Telemedicine Emerging Themes

The identified barriers and facilitators have been aligned against the UTAUT construct to explore emerging organizational adoption factors. For the introduction of 3D telemedicine also emerging themes have been identified, see Table 14 These barriers will be elaborated on below.

Adoption factor	Barrier and/or facilitator	Source: 3D
Added value uncertainty	Barrier	5
Set up complications	Barrier	4

Simplicity preference	Barrier	3
Complex surgical feasible	Facilitator	5
Patient involvement	Facilitator (*Patient centric)*	1

Table 14. Emerging adoption factors on 3D Telemedicine

Barriers: **Added value uncertainty, set up complications, simplicity preference, complex surgical feasible**

The identified barriers and facilitators from the introduction of the mock-up version align with the construct of performance expectancy and effort expectancy by Venkatesh et al., (2003), see Appendix XXIV and XXV. The findings from interviews relating to this construct have been presented in Table 15. These quotes illustrate how healthcare professionals initially may evaluate a technology based on its perceived performance and effort expectancy. Performance expectancy is the strongest predictor of intention following from Venkatesh et al., (2003), and effort-oriented constructs are expected to be more salient in the early stages of a new behavior. Facilitating conditions do have a direct influence on usage, but do not have a significant influence on behavioral intention (Venkatesh et al., 2003). It can be claimed that when introducing a new technology, the intention comes first before usage. For individuals encountering a new technology, their first considerations could be among the benefits and how easy the technology is to use. And that organizational and broader factors come into play when perceptions and intentions have already been formed. This study did not primarily focus on the construct of performance expectancy and effort expectancy, since facilitating conditions are the most important construct in the model to test organizational adoption factors (Getachew et al., 2022; Grace et al., 2021; Shiferaw et al., 2021). The findings indicate that adoption factors related to performance expectancy and effort expectancy are relevant when introducing a completely new technology to interviewees, compared to discussing experienced telemedicine use cases.

Emerging theme	Quote	Relating construct UTAUT
Added value uncertainty	*“The added value of this over just camera looking around I don’t see it yet”*	Performance expectancy: Relative advantage
Set up complications	*“I didn’t even realize that the set up of this, is so gross, it is really gross”*	Effort expectancy: Complexity

Simplicity preference	*"So when it boils down to how people actually work, they look for the simplest and the easiest, quickest sort of solutions, and these complex solutions don't necessarily solve a problem"* *"Make it as simple as possible"*	Effort expectancy: Ease of use and complexity
Complex surgically feasible	*"There is a lot more benefits for the 3D complex reconstructions"* *"That kind of technology will be very exciting and in a way also treat patients psychologically and also by a user friendly environment, you are physically engaging with your patient"*	Performance expectancy: Outcome expectations

Table 15. Findings from interviews relating to social influence construct by UTAUT

Conclusion

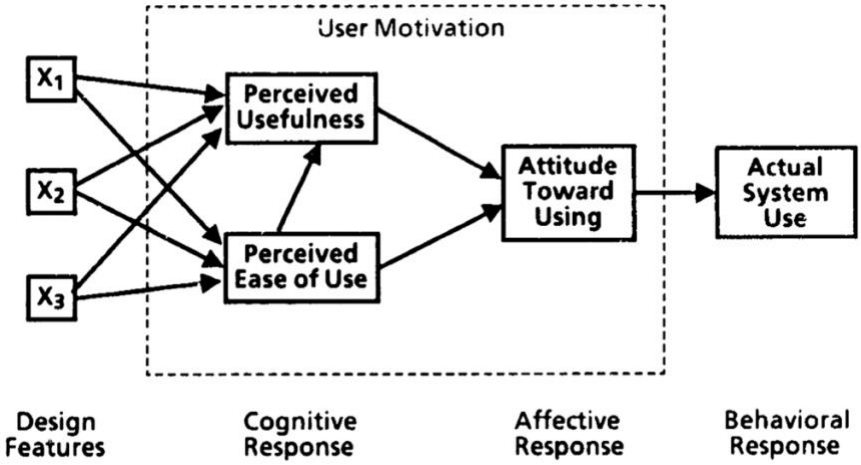
To conclude in the context of introducing new technologies like the 3D mock-up, the constructs performance expectancy and effort expectancy are relevant. It can be argued that these constructs cover initial evaluations when introduced to new technologies, compared to experienced telemedicine use cases that point out the organizational adoption factors, this is presented in Table 16.

Conclusion type	Description	Consideration
Finding	Initial evaluation on telemedicine technology from performance expectancy and effort expectancy construct UTAUT	Addressing performance expectancy and effort expectancy for 3D telemedicine adoption factors when applied in LRS

Table 16. Conclusion on 3D Telemedicine

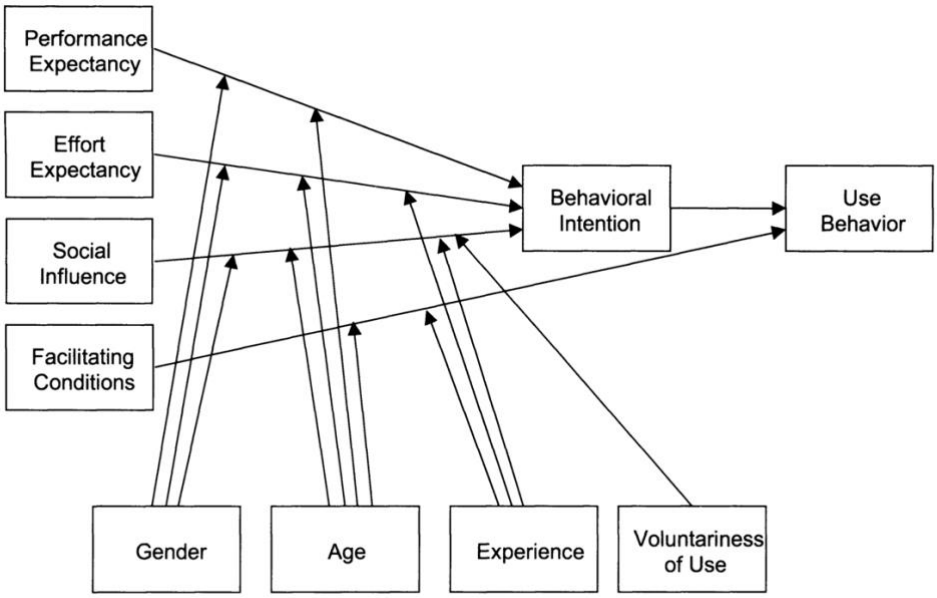
Appendix XIV. Visualization TAM

(Davis, 1985)



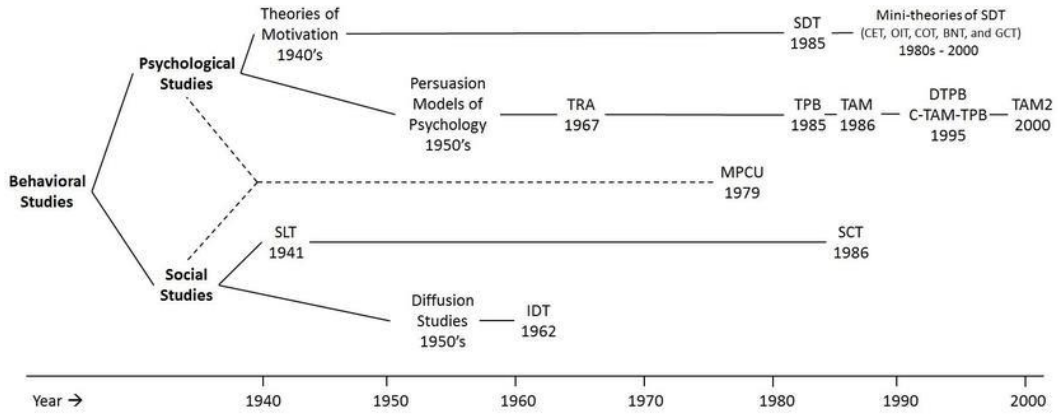
Appendix XV. Visualization UTAUT

(Venkatesh et al., 2003)



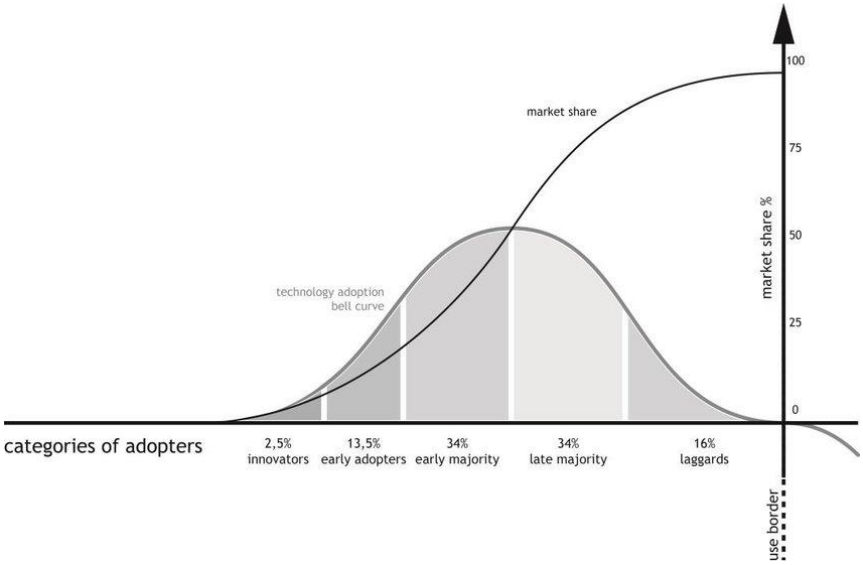
Appendix XVI. Development Stages UTAUT

(Momani & Jamous, 2017)



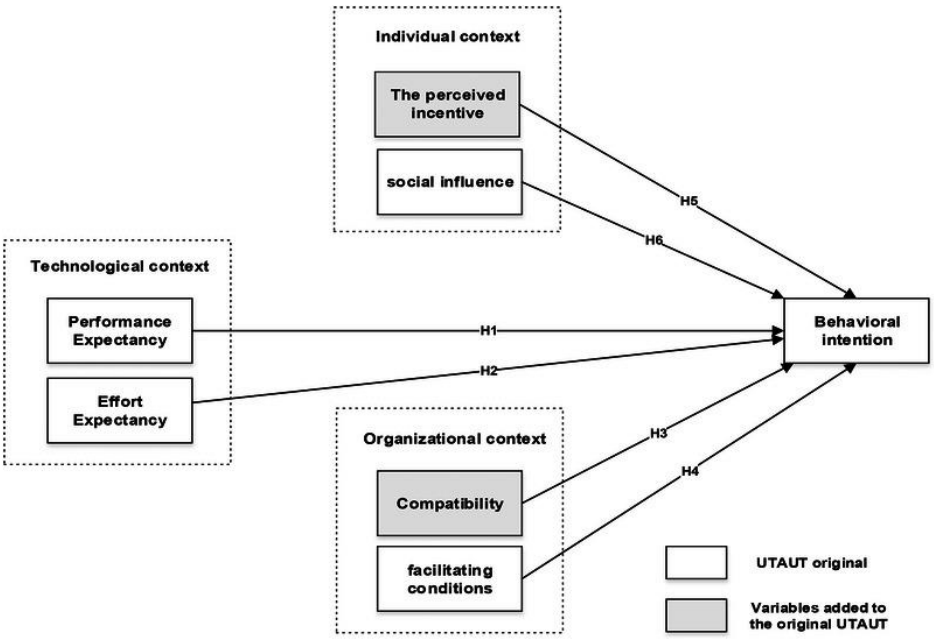
Appendix XVII. Visualization DoI

Based on Rogers, 1983 (Augustin et al., 2020)



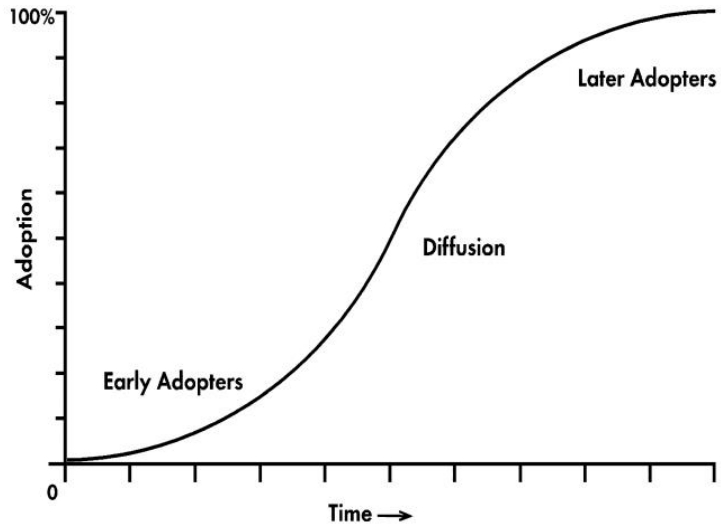
Appendix XVIII. Visualization Modified Version of UTAUT

(Rouidi et al., 2023)



Appendix XIX. Adoption and Diffusion in a Graph

Innovations spread through social system after positive adoption decisions of the innovation (Dearing, 2008)



Appendix XX. Analysis of Lens of Perspectives

This paragraph examines the identified barriers and facilitators through the varied perspectives of the interviewees: medical (5 interviewees), medical/organizational (2 interviewees) and organizational/academic perspective (3 interviewees). It will be evaluated how these different perspectives influence the identified adoption factors. The lens of perspectives will be analyzed through qualitative analysis manually and quantitative analysis calculating the mentioned barriers, facilitators, and approaches to overcome by the interviewees from the different perspectives, this is discussed in the Chapter 3. Third, by the visualization of the code-document Sankey diagrams on the perspectives, the UTAUT constructs, and emerging themes. Combining these three analyses, leads to a conclusion on the influence of the perspectives on the findings.

I. Through Qualitative Analysis

For the qualitative analysis of the three different perspectives, data from Atlas.ti has been obtained identifying which interviewees mentioned the barriers, facilitators, and approaches to overcome. See Appendix XXI or the Tables presenting the three different perspectives and 10 interviewees, the findings from the Tables have been analyzed manually. Following the constructs of the UTAUT framework the findings will be discussed separately for the barriers, facilitators, and approaches to overcome.

Identified barriers on use cases

Perceived Behavioral Control: All perspectives recognize the importance of resources, with medical perspectives highlighting specific shortages in medical resources, likely reflecting direct experience. Digital health literacy barriers are only cited by the medical/organizational perspective and the academic perspectives, perhaps owing to their organizational roles. The lack regarding interpretation from the medical/organizational perspective could imply that this aspect is already addressed within their telemedicine organization. This suggests that this requirement may not be perceived as a significant barrier in their context.

Facilitating conditions: For the barriers related to facilitating conditions, not very remarkable distinctions were observed based on the different perspectives. It could be noted that concerns on patient data unavailability are only raised by the academic/organizational perspectives, indicating awareness in academic and organizational settings.

Compatibility: Issues on technology, culture and disruptions to workflow have not been addressed by medical perspectives, compared to the other perspectives, suggesting a focus on clinical procedures over administrative procedures. The importance of doctor-patient relationships is overlooked in the academic/organizational perspective, possibly due to their non-clinical activities. However, physical evaluation absence is noted by all perspectives, contradicting the idea that academic/organizational do not have a focus on clinical activities. Concerns about increased workload have been mentioned by two perspectives but not by the medical/organizational perspective, which appears more focused on operational benefits.

Emerging themes: Lack of policy, guidelines and regulations and the lack of government funding are widespread issues across all perspectives, highlighting their importance. Other barriers, such as the lack of data protection (privacy), are universally acknowledged within the academic/organizational perspective. The medical perspective especially stresses ethical implications. And the lack of patient awareness is acknowledged across all perspectives, with an extended emphasis from the medical perspective. Concerns about willingness to accept are absent from the medical/organizational perspective, possibly reflecting a different organizational focus.

Identified facilitators on use cases
Drawing conclusions on facilitators is difficult because they have not been frequently mentioned, however perspectives will be addressed for the constructs of the UTAUT. Assumptions are not examined on emerging themes since they do not appear. The findings indicate that respondents with a medical/organizational perspective value different facilitators, which might be explained by the fact that they have their own telemedicine organization, so they know how to strengthen these characteristics. Furthermore, an interviewee from a medical perspective, is engaged in a successful study on telemedicine in Ghana, offering practical insights about facilitators. Two other interviewees from the medical perspective are now working on a proof-of-concept telemedicine project, potentially explaining their less experience in the field.

Perceived Behavioral Control: The accessibility to mobile technology infrastructure, emerges as a critical facilitator across all perspectives, highlighting its relevance.

Facilitating Conditions: The medical perspective emphasizes familiarity with one another, reflecting their direct engagement with patient care in healthcare settings. Support for patient data availability is considered as a facilitator, particularly by medical/organizational stakeholders, reflecting their attempts to solve this issue within their organizational context.

Compatibility: In terms of integration all perspectives discussed integrating telemedicine into existing workflows as a facilitator. The concept of flexibility to work/life balance reflects the individuals from a medical or medical/organizational perspective, most likely due to their direct engagement with patient care in healthcare settings.

Identified approaches to overcome on use cases
Analyzing the suggested approaches to overcome barriers and facilitators did not reveal specific differences in the three perspectives from the interviewees.

Key findings through qualitative analysis
The distinctions between the perspectives are discrete. For the barriers and facilitators recognized across all perspectives, most of the times they are consistently mentioned by almost all interviewees. The medical perspectives tend to focus more on practical challenges, reflecting their direct experience in patient care in healthcare settings. In contrast medical/organizational perspectives, those interviewees associated with their own telemedicine organization, have a more nuanced view by emphasizing practical facilitators from experience in managing telemedicine services. The organizational/academic perspective focuses more on insights from broader systemic issues. Overall, the distinction among these perspectives is primarily based on their level of experience and operational involvement in telemedicine.

II. Through Quantitative Analysis – Single code occurrence

For the quantitative analysis, percentages in Table 17, 18, 19 and 20 represent the number of interviewees from each perspective who discussed barriers, facilitators, and approaches to overcome within the constructs of the UTAUT, and the emerging themes. These percentages have been calculated separately for the item labels as well as overall influence. To account for the disparities in group sizes in the perspectives, the percentages have been adjusted as described.

Looking at Table 17, there are little differences in the consideration of resource adoption factors. Although considering the percentages for knowledge, the medical perspective did mention these less compared to the academic/organizational perspective. Overall, the total influence indicate that the academic/organizational perspective identified the most barriers,

facilitators and approaches to overcome, this shows they may have a higher value on the construct of Perceived Behavioral Control.

Perspective	Identification resources (%)	Identification knowledge (%)	Total influence (%)
Medical	34%	15%	25%
Medical / Organizational	29%	25%	27%
Academic / Organizational	37%	59%	48%

Table 17. **Perceived Behavioral Control**

Interpreting the results in Table 18, it appears that the medical perspective has the lowest overall total influence on the construct Facilitating Conditions. The other two perspectives have a more comparable overall total influence. The medical/organizational, in particular, scores high on the identification of barriers, facilitators and approaches to overcome on the item label of support.

Perspective	Identification support (%)	Identification assistance (%)	Identification guidance (%)	Total influence (%)
Medical	8%	15%	24%	16%
Medical / Organizational	63%	37%	35%	45%
Academic / Organizational	28%	49%	41%	39%

Table 18. **Facilitating Conditions**

According to the data in Table 19 high percentage on identification of compatibility can be referred to the medical/organizational perspective. For the other two item labels, the results are more comparable. In terms of overall influence, the medical/organizational perspective has a greater influence on the construct of Compatibility than the other two perspectives.

Perspective	Identification compatibility (%)	Identification alignment (%)	Identification integration (%)	Total influence (%)
Medical	8%	30%	24%	21%
Medical / Organizational	79%	38%	36%	51%
Academic / Organizational	13%	32%	40%	28%

Table 19. **Compatibility**

Interpreting the data based on the emerging themes in Table 20, it can be determined that differentiating between the perspectives is not necessary, since these percentages are comparable.

Perspective	Total influence (%)
Medical	31%
Medical / Organizational	38%
Academic / Organizational	31%

Table 20. **Emerging Themes**

Key findings through quantitative analysis

The Tables suggest differences in how the perspectives identified barriers, facilitators, and approaches to overcome. There are no
Table differences, but it is important to note that these differences only exist within a few item labels and constructs. Furthermore, the comparable percentages for the emerging themes suggest that further differentiation between the perspectives may not be necessary.

III. Through Quantitative Analysis and Visualizations – Multiple code occurrences

The presented Sankey Diagrams in Figure 13, 14 and 15 present the analysis of multiple code occurrences in Table 21, 22, 23 and 24 present the calculated percentages based on the data from Atlas.ti. The percentages in the Figures represent the total code-influence on the construct, not on the separated item labels. In Table 25 and Figure 16, the percentages present the proportion of multiple code occurrences from all interviews on the item labels of the constructs. For these percentages the focus has been on the overall rather than the perspectives, but these influences are still visualized in the Sankey diagram in Figure 15. For the qualitative and quantitative analysis on the perspectives has been looked at if the interviewees mentioned barriers, facilitators or approaches to overcome at least ones. For analysis of multiple code occurrences this is neglected, and it represents how many times the code belonging to the construct appeared. These codes cover barriers, facilitators, and approaches to overcome.

Interpreting the data in Table 21, it is obvious that for the medical/organizational perspective, there has been minimal focus on resources and knowledge, resulting in a low total influence on the construct when compared to the other two. Figure 13 also shows these percentages.

Perspective	Code-document resources (%)	Code-document knowledge (%)	Total Code-document influence on construct (%)
Medical	45%	34%	44%
Medical / Organizational	17%	7%	15%
Academic / Organizational	38%	59%	41%

Table 21. **Perceived Behavioral Control**

Figure 13. Sankey Diagram: Perceived Behavioral Control

Considering the percentages in Table 22, and shown in the Sankey diagram, Figure 14 These do not differ as much, what does appear is a low percentage coded on assistance for the medical perspective.

Perspective	Code-document support (%)	Code-document assistance (%)	Code-document guidance (%)	Total Code-document influence on construct (%)
Medical	25%	6%	35%	26%
Medical / Organizational	42%	38%	32%	36%
Academic / Organizational	33%	56%	32%	38%

Table 22. **Facilitating Conditions**

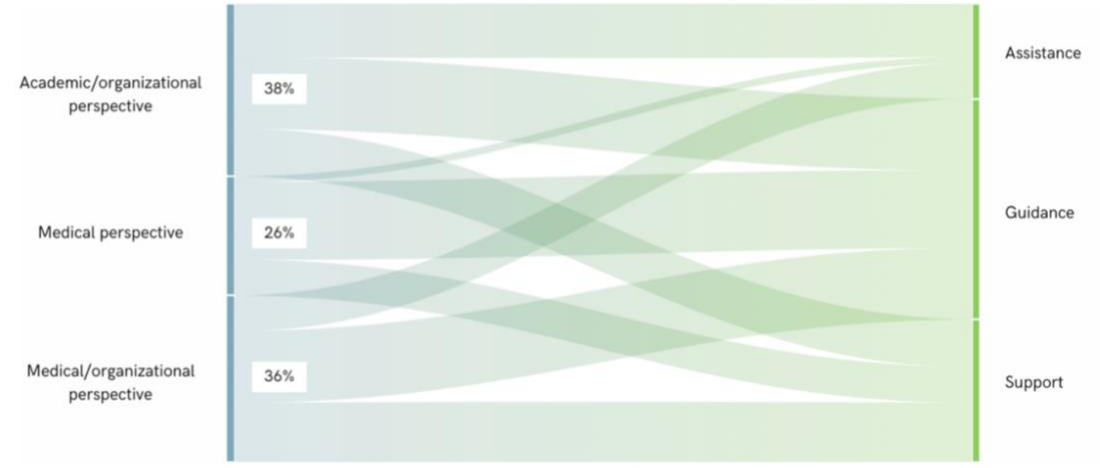


Figure 14. Sankey Diagram: Facilitating Conditions

Interpreting the percentages in Table 23, and see Figure 15, there are no major differences. Also, for one item label, the interviews from the medical perspective have been coded more on alignment, but for the item label of integration has been coded more for the

academic/organizational perspective. As a result, the overall influence of code-document on the construct compatibility is relatively comparable.

Perspective	Code-document compatibility (%)	Code-document alignment (%)	Code-document integration (%)	Total Code-document influence on construct (%)
Medical	42%	50%	21%	38%
Medical / Organizational	26%	34%	19%	27%
Academic / Organizational	32%	16%	60%	36%

Table 23. **Compatibility**

Figure 15. Sankey Diagram: Compatibility

According to the data in Table 24, the medical perspective has the greatest total influence on coding's for emerging themes, followed by the academic/organizational and medical/organizational perspective.

Perspective	Total influence (%)
Medical	49%
Medical / Organizational	20%
Academic / Organizational	31%

Table 24. **Emerging Themes**

Figure 16, and Table 25 reveals which construct most appeared from the interviewees. It can be argued that the percentages for the item label of resources is comparable to the coding's for emerging themes. The other item labels have been coded much lower compared to these two. The most coding's has been done regarding emerging themes. Therefore, it is important to address these emerging themes for the adoption of telemedicine in LRS, this will be discussed in Chapter 5.

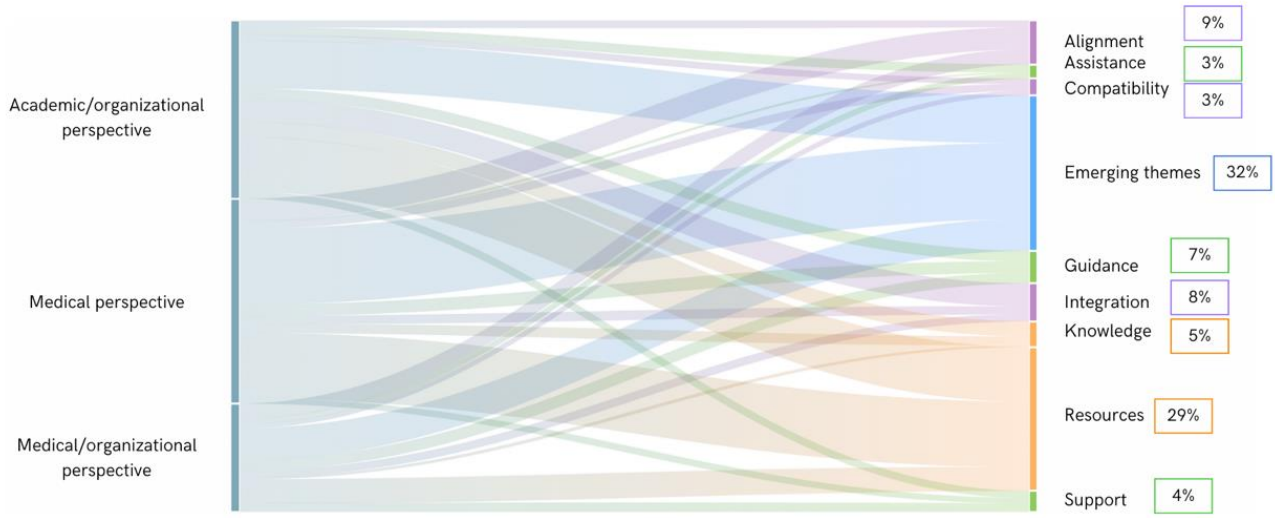


Figure 16. Sankey Diagram: Overall

Resources (%)	Knowledge (%)	Support (%)	Assistance (%)	Guidance (%)	Compatibility (%)	Alignment (%)	Integration (%)	Emerging (%)
29%	5%	4%	3%	7%	3%	9%	8%	32%

Table 25. Proportion multiple code occurrences all constructs

Conclusion on Perspectives

For the qualitative analysis the barriers, facilitators, and approaches to overcome have been analyzed individually, for the quantitative analysis on single code occurrence and multiple code occurrences these have been considered together. The distinction among these perspectives is primarily based on their level of experience and operational involvement in telemedicine. And when looking from the quantitative findings there are differences, but only in a few constructs.

Comparing the results from the quantitative analysis on single code occurrence on how many interviewees discussed the barriers, facilitators, and approaches to overcome at least ones compared to the quantitative analysis of multiple code occurrences and the Sankey Diagram, this provides some insights, but the overall influence on the findings is limited. It can also be stated that the analysis of the multiple code occurrences, code occurrences are less valuable than the quantitative analysis on single code occurrence since this focuses on the different interviewees instead of the amount of coding's. The percentages of the construct of perceived behavioral control on the academic/organizational perspective are comparable. However, the other two perspectives not, resulting in different total influences. For the construct of facilitating conditions, the percentages are more comparable. However, the influence of the medical perspective is slightly greater here, and slightly lower for the medical/organizational perspective. Considering these findings, it may be argued that however the adoption factors have not been addressed from the medical perspective in the different interviews, but when addressing this perspective explains more compared to the medical/organizational perspective and therefore scores higher in the analysis of multiple code occurrences. For the construct of compatibility, these are incomparable, and no assumptions can be drawn. For the coding on the emerging themes can also be argued that the medical perspective scores high. Therefore, it is concluded that however from quantitative analysis of single code occurrences the medical perspective did not always mention all barriers, facilitators and overcome, but when they do, they discuss them in greater detail, possible reflecting their practical experiences. This also resulted from the qualitative analysis. Most coding has focused on emerging themes.

Therefore, addressing these themes is important for telemedicine adoption in LRS, which will be discussed in Chapter 5.

Overall, the impact on the assessment of barriers, facilitators, and approaches to overcome from the perspectives on telemedicine adoption in LRS is limited. Especially, from both quantitative analyses, it appears there is no difference in how the perspectives influence the emerging themes. And comparing the quantitative findings with the quantitative findings from the analysis on multiple code occurrences this does not reveals new insights, it only confirms the finding from the qualitative findings on the focus of the medical perspective on their practical experiences. Therefore, in addressing the third sub question, the emphasis will not be on the perspectives separately, but rather on the collective insights gathered from the interviews.

Appendix XXI. Perspectives on Barriers, Facilitators, and Approaches to Overcome

	Barrier	M	M	M	M	M	M/O	M/O	A/O	A/O	A/O
1	Lack of geographic and infrastructure resources										
2	Issues on connectivity										
3	Financial constraints										
4	Power supply problems										
5	Lack of medical resources										
6	Lack of medical specialists										
7	Lack of interpretation knowledge capabilities										
8	Digital health literacy										
9	No patient data availability										
10	No technical support										
11	No training facilities										
12	Technology and culture clash										
13	Physical evaluation absence										
14	High workload										
15	Attached to doctor										
16	Disrupts workflow										
17	Lack of implementation strategy										
18	Lack of policy, guidelines, and regulation										

19	Lack of government funding										
20	Lack of data protection (for privacy)										
21	Lack of liability laws										
22	Lack of awareness										
23	Distrust in healthcare and technology										
24	Influence of age/generation										
25	Willingness to accept										
26	Influence of convenience										
27	Ethical issues										

Perspectives on barriers: Medical perspective refers to M (5 interviewees), Medical/organizational perspective refers to M/O (2 interviewees), Academic/organizational perspective refers to A/O (3 interviewees)

	Facilitator	M	M	M	M	M	M/O	M/O	A/O	A/O	A/O
1	Accessibility to mobile technology infrastructure										
2	Compatible with other systems										
3	Working with an engaging technology / system										
4	Knowing each other / familiar										
5	Patient data availability										
6	Technical support										
7	Training										
8	Flexibility to work/life balance										
9	Integrate to existing workflows										
10	Cultural values										
11	Implemented policy, guidelines, regulation										

Perspectives on facilitators: Medical perspective refers to M (5 interviewees), Medical/organizational perspective refers to M/O (2 interviewees), Academic/organizational perspective refers to A/O (3 interviewees)

	Approaches to overcome	M	M	M	M	M	M/O	M/O	A/O	A/O	A/O

1	Improve connectivity										x
2	Decentralize servies								x		
3	Increase the number of medical specialists								x		x
4	Provide technical support								x		
5	Provide training								x	x	x
6	Focus on strategy and implementation								x	x	x
7	Patient involvement									x	

Perspectives on approaches to overcome: Medical perspective refers to M (5 interviewees), Medical/organizational perspective refers to M/O (2 interviewees), Academic/organizational perspective refers to A/O (3 interviewees)

Appendix XXII. Construct Attitude by UTAUT

(Venkatesh et al., 2003)

Table 13. Attitude Toward Using Technology: Root Constructs, Definitions, and Scales

Construct	Definition	Items
Attitude Toward Behavior (Davis et al. 1989; Fishbein and Ajzen 1975; Taylor and Todd 1995a, 1995b)	An individual's positive or negative feelings about performing the target behavior.	1. Using the system is a bad/good idea. 2. Using the system is a foolish/wise idea. 3. I dislike/like the idea of using the system. 4. Using the system is unpleasant/ pleasant.
Intrinsic Motivation (Davis et al. 1992)	The perception that users will want to perform an activity for no apparent reinforcement other than the process of performing the activity per se.	1. I find using the system to be enjoyable 2. The actual process of using the system is pleasant. 3. I have fun using the system.
Affect Toward Use (Thompson et al. 1991)	Feelings of joy, elation, or pleasure; or depression, disgust, displeasure, or hate associated by an individual with a particular act.	1. The system makes work more interesting. 2. Working with the system is fun. 3. The system is okay for some jobs, but not the kind of job I want. (R)
Affect (Compeau and Higgins 1995b; Compeau et al. 1999)	An individual's liking of the behavior.	1. I like working with the system. 2. I look forward to those aspects of my job that require me to use the system. 3. Using the system is frustrating for me. (R) 4. Once I start working on the system, I find it hard to stop. 5. I get bored quickly when using the system. (R)

Appendix XXIII. Construct Social Influence by UTAUT

(Venkatesh et al., 2003)

Table 11. Social Influence: Root Constructs, Definitions, and Scales

Construct	Definition	Items
Subjective Norm (Ajzen 1991; Davis et al. 1989; Fishbein and Azjen 1975; Mathieson 1991; Taylor and Todd 1995a, 1995b)	The person's perception that most people who are important to him think he should or should not perform the behavior in question.	1. People who influence my behavior think that I should use the system. 2. People who are important to me think that I should use the system.
Social Factors (Thompson et al. 1991)	The individual's internalization of the reference group's subjective culture, and specific interpersonal agreements that the individual has made with others, in specific social situations.	1. I use the system because of the proportion of coworkers who use the system. 2. The senior management of this business has been helpful in the use of the system. 3. My supervisor is very supportive of the use of the system for my job. 4. In general, the organization has supported the use of the system.
Image (Moore and Benbasat 1991)	The degree to which use of an innovation is perceived to enhance one's image or status in one's social system.	1. People in my organization who use the system have more prestige than those who do not. 2. People in my organization who use the system have a high profile. 3. Having the system is a status symbol in my organization.

Appendix XXIV. Construct Performance Expectancy by UTAUT

(Venkatesh et al., 2003)

Table 9. Performance Expectancy: Root Constructs, Definitions, and Scales

Construct	Definition	Items
Perceived Usefulness (Davis 1989; Davis et al. 1989)	The degree to which a person believes that using a particular system would enhance his or her job performance.	1. Using the system in my job would enable me to accomplish tasks more quickly. 2. Using the system would improve my job performance. 3. Using the system in my job would increase my productivity. 4. Using the system would enhance my effectiveness on the job. 5. Using the system would make it easier to do my job. 6. I would find the system useful in my job.
Extrinsic Motivation (Davis et al. 1992)	The perception that users will want to perform an activity because it is perceived to be instrumental in achieving valued outcomes that are distinct from the activity itself, such as improved job performance, pay, or promotions	Extrinsic motivation is operationalized using the same items as perceived usefulness from TAM (items 1 through 6 above).
Job-fit (Thompson et al. 1991)	How the capabilities of a system enhance an individual's job performance.	1. Use of the system will have no effect on the performance of my job (reverse scored). 2. Use of the system can decrease the time needed for my important job responsibilities. 3. Use of the system can significantly increase the quality of output on my job. 4. Use of the system can increase the effectiveness of performing job tasks. 5. Use can increase the quantity of output for the same amount of effort. 6. Considering all tasks, the general extent to which use of the system could assist on the job. (different scale used for this item).

Table 9. Performance Expectancy: Root Constructs, Definitions, and Scales (Continued)

Construct	Definition	Items
Relative Advantage (Moore and Benbasat 1991)	The degree to which using an innovation is perceived as being better than using its precursor.	1. Using the system enables me to accomplish tasks more quickly. 2. Using the system improves the quality of the work I do. 3. Using the system makes it easier to do my job. 4. Using the system enhances my effectiveness on the job. 5. Using the system increases my productivity.
Outcome Expectations (Compeau and Higgins 1995b; Compeau et al. 1999)	Outcome expectations relate to the consequences of the behavior. Based on empirical evidence, they were separated into performance expectations (job-related) and personal expectations (individual goals). For pragmatic reasons, four of the highest loading items from the performance expectations and three of the highest loading items from the personal expectations were chosen from Compeau and Higgins (1995b) and Compeau et al. (1999) for inclusion in the current research. However, our factor analysis showed the two dimensions to load on a single factor.	If I use the system… 1. I will increase my effectiveness on the job. 2. I will spend less time on routine job tasks. 3. I will increase the quality of output of my job. 4. I will increase the quantity of output for the same amount of effort. 5. My coworkers will perceive me as competent. 6. I will increase my chances of obtaining a promotion. 7. I will increase my chances of getting a raise.

Appendix XXV. Construct Effort Expectancy by UTAUT

(Venkatesh et al., 2003)

Table 10. Effort Expectancy: Root Constructs, Definitions, and Scales

Construct	Definition	Items
Perceived Ease of Use (Davis 1989; Davis et al. 1989)	The degree to which a person believes that using a system would be free of effort.	1. Learning to operate the system would be easy for me. 2. I would find it easy to get the system to do what I want it to do. 3. My interaction with the system would be clear and understandable. 4. I would find the system to be flexible to interact with. 5. It would be easy for me to become skillful at using the system. 6. I would find the system easy to use.
Complexity (Thompson et al. 1991)	The degree to which a system is perceived as relatively difficult to understand and use.	1. Using the system takes too much time from my normal duties. 2. Working with the system is so complicated, it is difficult to understand what is going on. 3. Using the system involves too much time doing mechanical operations (e.g., data input). 4. It takes too long to learn how to use the system to make it worth the effort.
Ease of Use (Moore and Benbasat 1991)	The degree to which using an innovation is perceived as being difficult to use.	1. My interaction with the system is clear and understandable. 2. I believe that it is easy to get the system to do what I want it to do. 3. Overall, I believe that the system is easy to use. 4. Learning to operate the system is easy for me.