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Digital Transformation of the Healthcare Sector in Africa

A qualitative study on the success factors and barriers for the implementation of mHealth in South Africa and Tanzania

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DigiHealth

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Abstract

Healthcare systems worldwide are facing several challenges with regard to topics such as accessibility, affordability and quality of healthcare, particularly in low-and middle-income countries. As a response to these obstacles, the implementation of mHealth solutions has gained prominence However, despite its promising potential, many mHealth projects are not able to move past the pilot stage and ultimately end up failing. Therefore, the aim of this study is to identify the crucial success factors and barriers for implementing mHealth in South Africa and Tanzania as well as strategies on how to potentially overcome these barriers, in order to ease the implementation process. A literature review was conducted to analyze both countries' healthcare systems, laying the groundwork for a qualitative study that identifies success factors, barriers, and strategies for implementing mHealth. Semi-structured interviews with eight experts in the field of mHealth from South Africa and Tanzania were carried out, utilizing the Consolidated Framework for Implementation Research to pinpoint success factors and barriers. The findings revealed that both countries' healthcare systems face similar issues that hinder mHealth implementation. These are characterized by a lack of alignment with user needs and existing constraints, inadequate government support and difficulties in obtaining sustainable financial resources. Some success factors that were identified are a user-friendly design alongside an adaptable tool provided at low or no cost. Overall, this study offers productive insights for organizations and startups engaged in the development and implementation of mHealth in South Africa and Tanzania, with an emphasis on essential considerations regarding success factors and barriers. Additionally, the study provides actionable strategies for these entities and policymakers, fostering an environment conducive to mHealth integration and sustainable adoption within the healthcare system.

Keywords: mHealth, Success Factors, Barriers, South Africa, Tanzania

Zusammenfassung

Gesundheitssysteme weltweit stehen vor mehreren Herausforderungen in Bezug auf Zugänglichkeit, Erschwinglichkeit und Qualität der Gesundheitsversorgung, insbesondere in Ländern mit niedrigem und mittlerem Einkommen. Als Reaktion auf diese Herausforderungen hat die Einführung von Lösungen im Bereich mHealth an Bedeutung gewonnen. Trotz ihres Potenzials sind jedoch viele mHealth-Projekte nicht in der Lage, über die Pilotphase hinauszukommen und scheitern daher letztendlich. Daher ist das Ziel dieser Studie, die entscheidenden Erfolgsfaktoren und Barrieren für die Umsetzung von mHealth in Südafrika und Tansania zu identifizieren, sowie Strategien, wie diese Barrieren möglicherweise überwunden werden können, um den Umsetzungsprozess zu erleichtern. Zur Analyse der Gesundheitssysteme beider Länder wurde eine Literaturrecherche durchgeführt, die die Grundlage für die qualitative Studie bildet, in der Erfolgsfaktoren Hindernisse und Strategien für die Umsetzung von mHealth identifiziert wurden. Es wurden haltstrukturierte Interviews mit insgesamt acht Experten im Bereich mHealth aus Südafrika und Tansania durchgeführt, wobei das Consolidated Framework for Implementation Research verwendet wurde, um die Erfolgsfaktoren und Hindernisse zu ermitteln. Die Ergebnisse zeigten, dass die Gesundheitssysteme beider Länder ähnlichen Herausforderungen bei der Umsetzung von mHealth gestellt sind, die sich durch eine mangelnde Abstimmung mit den Bedürfnissen der Benutzer und bestehenden Einschränkungen, unzureichende staatliche Unterstützung und Schwierigkeiten bei der Sicherung nachhaltiger Finanzierung auszeichnen. Als Erfolgsfaktoren wurden ein benutzerfreundliches Design sowie ein anpassungsfähiges Tool ermittelt, das zu geringen oder gar keinen Kosten angeboten wird. Insgesamt bietet diese Studie wertvolle Erkenntnisse für Organisationen und Start-ups, die sich mit der Entwicklung und Umsetzung von mHealth in Südafrika und Tansania beschäftigen. Darüber hinaus liefert die Studie umsetzbare Strategien für diese Organisationen und Entscheidungsträger, die eine Umgebung fördern wollen, die die Integration von mHealth und deren nachhaltige Einführung im Gesundheitssystem begünstigt.

Schlüsselwörter: mHealth, Erfolgsfaktoren, Barrieren, Südafrika, Tansania

List of Abbreviations

CFIR   Consolidated Framework for Implementation Research

CHW   Community Health Worker

CSIR   Council for Scientific and Industrial Research

DHIS   District Health Information System

DHMIS   District Health Management Information Systems

eHealth   Electronic Health

EHR   Electronic Health Record

FBO   Faith-based organizations

GDP   Gross Domestic Product

GOE   Global Observatory for eHealth

GPRS   General Packet Radio Service

GPS   Global Positioning System

GSMA   Global System for Mobile Communication Association

HC   Health Center

HDI   Human Development Index

HIV   Human Immunodeficiency Virus

HMIS   Health Management Information System

HPHB	Healthy Pregnancy Healthy
ICT	Information and Communication Technologies
ICU	Intensive Care Unit
IT	Information Technology
LMIC	Low-and Middle-Income Country
LRE	Low Resource Environment
MDG	Millenium Development Goal
mHealth	Mobile Health
MTEF	Medium Term Expenditure Framework
NCD	Non-Communicable Diseases
NGO	Non-Governmental Organizations
PDA	Personal Digital Assistant
SDG	Sustainable Development Goals
SMS	Short Messaging Service
SSA	Sub-Saharan Africa
TMDA	Tanzania Medical Devices Authority
UHC	Universal Health Coverage
WHO	World Health Organization

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1 Introduction

Worldwide healthcare systems are facing obstacles such as a decreasing number of physicians, especially in rural areas, in addition to an increasing number of patients due to a higher life expectancy and rising health costs (Menvielle et al., 2017, p. 8). Healthcare systems in low resource settings face additional challenges, especially in the poorest regions. In African countries like in Sub-Saharan Africa (SSA), e.g., health facilities are distributed sparsely throughout the country, with limited access to resources like electricity, clean water and overall poor equipment. This deficiency can be attributed, in part, to the minimal allocation of resources to healthcare. Moreover, governance issues such as ineffective legislation enforcement, corruption and inefficient resource allocation frequently contribute to these challenges (Stephani, 2019, pp. 1–3). The strain on healthcare systems is particularly pronounced in Africa, which has the lowest healthcare worker-to-population ratio, while simultaneously bearing the highest disease rate of all continents (WHO Regional Office for Africa, 2021, p. 10). The situation is believed to worsen with time. By 2030, a global shortage of about 10 million healthcare professionals is predicted. This trend, alongside the anticipation to see more than half of the world's population growth between now and 2050 in Africa, will put the healthcare systems in these countries under more pressure (Aboye et al., 2023, 14).

All of these challenges make it apparent that Africa is in need of helpful solutions. One of these solutions is mobile Health (mHealth). mHealth is a fast-expanding field that could completely transform how healthcare is provided in low-and middle-income countries (LMICs) (World Health Organization, 2011, p. 21). The use of mobile devices and wireless technologies to support healthcare services has been shown to improve access to care, increase efficiency and reduce costs. In SSA, mHealth has the ability to alleviate some of the issues that patients and healthcare practitioners encounter in setting where healthcare systems are frequently overworked and underfunded (Ezezika et al., 2022, p. 1). This could transform the way the population interacts with national health services (World Health Organization, 2011, p. 1). Several trends are shaping in favor of this new way of delivering health services, e.g., rapid advances in mobile technologies, a rise in new opportunities for the integration of mHealth into existing eHealth services as well as increasing mobile coverage. It can also be said that by now, most African citizens have better access to mobile phones than to clean water, electricity or paved roads. As a result, the potential of mHealth has been widely recognized and led to the implementation of many mHealth pilot projects over the years. After the pilot phase however, the projects tend to be terminated (Stephani, 2019, pp. 1–3). There are many challenges to implementing mHealth in LMICs, including limited infrastructure,

inadequate funding and a lack of trained personnel, which often leads to failed mHealth interventions, given that these issues are not addressed properly (Greve et al., 2022, p. 50). Therefore, organizations involved in implementing mHealth could benefit from more guidance during the implementation phase (World Health Organization, 2011, pp. 2–3). Research in this area especially for Africa has so far focused on the implementation of specific mHealth applications in a particular focus on success factors and barriers for Africa. One example is MomConnect (Ezezika et al., 2021, p. 7). The top six obstacles to the adoption of mHealth have also been highlighted by the World Health Organization (WHO) (World Health Organization, 2011, p. 7). However, the studies thus far have dealt with these factors in a general manner that relates them to broader regions like Africa or SSA. The aim of this research paper is a focused analysis on the implementation of mHealth in South Africa and Tanzania, in order to provide country-specific success factors and barriers for the implementation in these countries as well as potential strategies on how to overcome these obstacles. The results are supposed to ease the implementation process of current and future mHealth applications in these countries.

So as to achieve these objectives, the following five research questions will be answered by conducting a literature review and expert interviews. The empirical study will utilize the Consolidated Framework for Implementation Research (CFIR) as a framework to identify success factors and barriers to mHealth implementation. The central research question to be answered is:

Research Question 1:

What are the success factors and barriers for the implementation of mHealth in South Africa and Tanzania?

In addition to this central research questions, several sub-questions will be answered:

> **RQ 2:** What is the status quo of the healthcare sector in South Africa and Tanzania?

> **RQ 3**: What are the differences between the success factors and barriers for the implementation of mHealth in South Africa and Tanzania?

> **RQ 4:** How can the identified barriers be overcome?

> **RQ 5:** What recommendations can be given to startups that want to introduce mHealth in South Africa and Tanzania?

Outline of the study

The study consists of six chapters, beginning with the introduction. Chapter two provides an overview of the state of research regarding digital transformation in healthcare, with a specific focus on mHealth in SSA and an explanation of the key concepts. Thereafter, a comparative analysis of healthcare systems in South Africa and Tanzania is presented to establish a foundational understanding of the healthcare systems necessary for the empirical investigation. Prior to delving into the methodology in the subsequent chapter, the conceptual framework used for implementation research is introduced and situated within the relevant theoretical contexts. Chapter three outlines the methodological research design applied in the study. The following chapters four and five provide a presentation of research results and their comprehensive discussion. Finally, the thesis concludes with a summarizing chapter that recapitulates the findings, in addition to offering insights into future directions.

2 State of Research

This chapter aims to display the state of research relevant for understanding the different concepts surrounding the implementation of mHealth in Africa. Therefore, key terminologies relevant for this study are classified. After the terms' explanation, the current situation of mHealth in SSA as well as success factors and barriers for the implementation in the respective area are described. The next section provides a literature review on the status quo of healthcare sectors in the countries discussed, in order to understand the resulting challenges that affect the implementation of mHealth. Lastly, the chapter finishes off with an introduction of the research framework that is used for the empirical part of this study, in addition to a discussion of the research gap.

2.1 Digital Transformation in Healthcare

Healthcare professionals worldwide encounter a common obstacle: the requirement to enhance patient results while managing expenses. This is driven by factors such as the growing demand for managing chronic illnesses in an aging demographic, advancements in technology and patients who are participating actively in their healthcare journey. One component that aims to tackle these issues is the digital transformation in healthcare by way of the integration of technologies and the establishment of health data (Gopal et al., 2019, p. 328). Hence, digital transformation can be defined as "the use of digital technologies for the transformation of businesses and services" (Stoumpos et al., 2023, p. 1). These integrated technologies include the internet of things, artificial intelligence, machine learning advanced analytics and the establishment of health data (Gopal et al., 2019, p. 328). The adoption of these technologies is supposed to aid "to deliver secure, high-quality patient care and drive greater business efficiency" (Haggerty, 2017, p. 7). Some of the digital services that have been incorporated into the Information technology (IT) Systems of healthcare organizations fostering the digital transformation are electronic health records and digital imaging, electronic prescriptions (e-prescription) among other tools (Haggerty, 2017, p. 7). The digital transformation in healthcare encompasses shifts related to the internet, digital tools and their integration into therapies and practices for improved health management. Furthermore, digital technologies are impacting medical education, prompting experts to explore innovative methods for training individuals (Stoumpos et al., 2023, p. 1). The digital transformation of healthcare is a complex phenomenon, especially considering "new developments as self-tracking, big data and predictive analytics, e-health, mobile health, health apps, participative medical research, e-patient communities, electronic medical records, and shared decision-making in diagnosis and

therapy" (Belliger & Krieger, 2018, p. 311). The developments relevant for this study are digital health, eHealth and mHealth and will be described in the following sections.

2.1.1 Key Concepts

Within academic literature, one may encounter various definitions and conceptualizations of the terms that address digital health, resulting in contradictions and discrepancies regarding their interrelationships. The concept used for this thesis is based on a study by Burrell et al. (2022, p. 1475), who reviewed the definitions of the four umbrella terms digital health, eHealth, mHealth and telehealth/telemedicine. The terms telehealth and telemedicine are not considered in this study. The terms' content overlaps, yet they are not relevant to the focus of this study. Only telemedicine is mentioned briefly in the chapter of mHealth. Figure 1 highlights the connection among the terms that are applicable for this thesis.
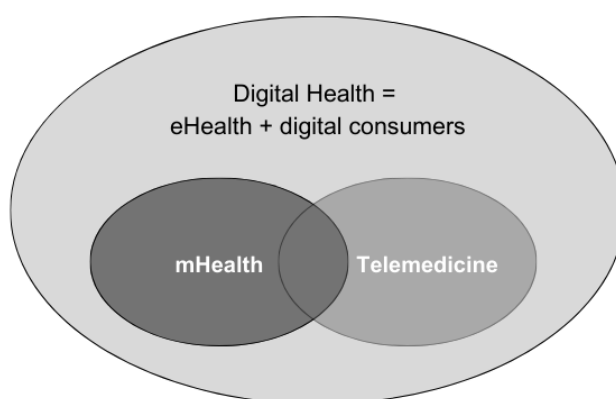
Figure 1: Conceptual framework for digital health umbrella terms. Adapted from Burrell et al. (2022)

2.1.1.1 Definition of Digital Health

Digital health serves as a comprehensive term encompassing the utilization of digital technologies and tools to enhance health outcomes and healthcare delivery (Kim et al., 2023, p. 551). The WHO describes digital health as "the field of knowledge and practice associated with the development and use of digital technologies to improve health" (World Health Organization, 2021, p. 11). Early efforts in the development of electronic health records (EHRs) and telemedicine led to the evolution of digital health over time. In conjunction with the further development of the internet and mobile technology, the definition of digital health has expanded to include categories such as eHealth, mHealth, wearable devices, telehealth and telemedicine (FDA, 2020). Digital health as a concept expanded, to include the entire sector of healthcare and to serve digital consumers who use a greater variety of smart and connected devices. The expression also covers

additional applications of digital technology for health, including robotics, the internet of things, advanced computing, big data analytics and artificial intelligence, including machine learning (World Health Organization, 2021, p. 11). The potential for global interconnection and the growth of digital technology is the acceleration of efforts to guarantee that everyone has access to high-quality healthcare, irrespective of location or their socioeconomic status (World Health Organization, 2018, 2-3).

2.1.1.2 Definition of eHealth

The term eHealth tends to be used interchangeably with digital health. However, according to the WHO, digital health is an extension of eHealth by including "digital consumers, with a wider range of smart devices and connected equipment" (WHO, 2023). eHealth is the electronic management of all healthcare delivery and administrative activities, such as the use of EHRs. The term eHealth first surfaced in the late 1990s and has since then gained recognition, alongside terms like eCommerce and eSolutions that are used for other industries (Redaktion, 2019).

EHealth refers to the use of information and communication technologies (ICT) for health and health-related fields by the WHO (World Health Organization, 2012, pp. 1–2). ICT can be understood as a "diverse set of technological tools and resources used to transmit, store, create, share or exchange information" (UNESCO Institute for Statistics, 2023). Some of these technological tools and resources include computers, the internet, live and record broadcasting technologies and telephony (UNESCO Institute for Statistics, 2023). ICT in health systems has the potential to facilitate disease monitoring and surveillance and to speed up and improve public health reporting (World Health Organization, 2012, pp. 1-2). EHealth in its broadest definition entails an easier flow of information through electronic channels, so as to facilitate the provision of healthcare services and the management of health systems. Furthermore, the aim of eHealth is to ensure that the appropriate health information is supplied to the respective person at the appropriate place and time in a secure and electronic form (World Health Organization, 2012, p. 2). Additionally, the strategic use of eHealth can aid in sector-wide planning, the coordination of decentralized district health systems and an improvement in the efficiency of service planning, budgeting and delivery (World Health Organization, 2012, p. 2). The present focus on this field is related to the challenges that health systems face, e.g., a decreasing number of staff in healthcare systems, as well as the rising demand for better services and increased accountability for results. Changes in population, growing urbanization and poverty add to the strain on health services. Thus, nations worldwide are forced to reduce healthcare costs to the lowest possible level (World Health Organization, 2012, p. 1).

2.1.1.3 Definition of mHealth

"Mobile Health (mHealth) represents a subset of eHealth, namely the application of mobile technology to provide or use health services, share clinical information and collect data" (Crico et al., 2018). For over ten years, mHealth has become more prevalent as a result of the continued development of ICT (Lee et al., 2017, p. 2). "As technology is evolving so are the capabilities of mobile phones; this has led to the widespread use of mobile phones and in turn the application of mobile health" (Fortuin et al., 2016, p. 1). According to the definition of the Global Observatory for eHealth (GOe), the term 'mHealth' refers to health practices that are facilitated by portable electronic devices such as mobile devices, patient monitoring equipment, personal digital assistants (PDAs), and other wireless devices like health apps and fitness trackers (World Health Organization, 2011, p. 6). In other words, "Mobile health or mHealth refers to the use of wireless communication devices to support public health and clinical practice" (Fortuin et al., 2016, p. 1). Hence, the global positioning system (GPS), Bluetooth technology, third- and fourth-generation mobile telecommunications (3G and 4G systems), general packet radio service (GPRS) and other more sophisticated features and applications are utilized and capitalized on in mHealth, in addition to the standard mobile phone functions like voice and short messaging services (SMS) (World Health Organization, 2011, p. 6). Patients can be monitored via mHealth for follow-up, preventive or treatment-related monitoring prior, during and after hospital stays (Redaktion, 2019). Thus, mHealth is a developing field in disease management with the potential to assist patients during lengthy treatment plans and enhance the level of care (Tilahun et al., 2018, p. 2). Overall, mobile health is evolving into a powerful set of tools centered on clinical trials, data monitoring, patient interaction and other areas. The healthcare workforce may also be able to use digital health services much more effectively due to mHealth, given that it empowers them with tools and resources to streamline their workflows, enhance communication and improve patient care (Ministry of Health, 2018, pp. 18–19).

Some common application fields considered by the WHO for mHealth operate as a tool for communication between individuals and health services. Furthermore, mHealth can be used for consultation between health care professionals by way of mobile telemedicine (Kruse et al., 2019, 2). Telemedicine "is the use of ICT to deliver healthcare services by healthcare professionals; it allows a safe exchange of information, enabling people to communicate health-related issues—such as prevention, diagnosis, treatment and follow-up—from a distance, overcoming logistic and long distance criticalities" (Crico et al., 2018). Additional fields of application concern the intersectoral communication in emergencies, health monitoring and surveillance and lastly the provision of an access

point to information for health care professionals at the location of care (World Health Organization, 2011, p. 12). According to Fortuin et al.'s study (2016), the services that are used most frequently in mHealth are (1) client education and behavior change, (2) sensors and point-of-care devices, (3) registries and vital event tracking, (4) data collection and reporting, (5) electronic health records, (6) electronic decision support, (7) provider-provider communication, (8) provider work planning and scheduling, (9) provider training and education, (10) human resource management, (11) supply chain management and (12) financial transactions and incentives (Fortuin et al., 2016, p. 2). A study by Kruse et al. (2019) revealed that the function of mHealth to be most effective for enhancing population and community health in low resource environments (LREs) is the use of text messaging, encouraging healthy behaviors and lifestyle choices (Kruse et al., 2019, 2). The majority of the publications assessed in this study used SMS as a mHealth intervention to enhance patient treatment adherence, health outcomes and infectious disease (Kruse et al., 2019, 8).

<u>Potential of mHealth for health systems</u>

MHealth is regarded as a health-enabling technology that has a favorable effect on the healthcare system in terms of improved access, higher-quality care and lower-cost medical services - three of the current main issues in the way of providing sufficient healthcare (Fortuin et al., 2016, p. 1). The iron triangle of health care is comprised of these three interconnected aspects, and all three must be in balance for the health systems to run smoothly.

Access is the potential to obtain healthcare through the supply and availability of services. Quality entails the delivery of healthcare that is safe, efficient, timely, and equitable. Whether a setting includes cost benefit, cost savings or cost-effectiveness is addressed by the cost of healthcare or the affordability in the iron triangle (Fortuin et al., 2016, p. 2). Since mHealth is the practice of delivering healthcare services through mobile technology, it can boost citizens' total access to healthcare by removing geographic barriers, thereby expanding access to healthcare services. Mobile devices enable patients in remote or underequipped locations to connect with healthcare professionals and obtain medical advice, consultations and assistance (Aboye et al., 2023, 2). Additionally, mHealth can deliver healthcare more affordably by utilizing mobile technologies that reduce healthcare expenses. It allows for remote monitoring and consultations, which minimize the need for in-person visits and its additional costs. Moreover, timely treatments and increased patient self-management made possible by mHealth interventions can aid in preventing expensive complications and hospital readmissions. The service provides the possibility for real-time communication and data

exchange, which can improve patient care, given that health data produced by mHealth can be used to inform data-driven decision-making. Healthcare professionals can learn more about patient behavior, treatment responses and population health trends by gathering and evaluating data provided by patients. Mobile platforms that use real-time data collection and reporting make it possible to monitor public health indicators, perform targeted interventions and quickly identify and respond to disease outbreaks. Lastly, mHealth has the potential to enhance users' knowledge, provide them with more authority and autonomy by switching from a provider-centric approach to a patient-centric model (Greve et al., 2022, pp. 49–50).

2.1.2 mHealth in Sub-Saharan Africa

After having covered the basic concepts of digital transformation within the healthcare sector and the potential of mHealth on healthcare systems, this chapter delves into the current literature on the status quo of mHealth in SSA as well as the success factors and barriers for the implementation of mHealth in the region of SSA. A literature review summary table can be found in Appendix 2.

2.1.2.1 Current mHealth Situation

A broad consensus prevails that providing healthcare in isolated, rural locations with limited physical infrastructure can be complemented by mHealth and eHealth. Health interventions provided through mobile technologies have the potential to improve healthcare delivery in LREs by reaching more people more quickly, even in remote areas (Greve et al., 2022, pp. 49–50). The findings of Kruse et al.'s study (2019) regarding the usage of mHealth indicate that infectious illnesses and maternal health were the two of the main health outcomes impacted by mHealth interventions. Poverty, which results in poor nutrition, indoor air pollution, lack of access to proper sanitation and lack of health education, is a major contributor to the burden of infectious diseases in LREs. According to estimates, diseases contribute up to 45% to the burden of poverty in LREs. HIV, tuberculosis and malaria account for 18% of the former percentage and LREs account for 99% of all maternal deaths worldwide. Women living in poverty are more likely to receive poor care when living in rural areas, especially when the availability of qualified medical personnel is limited (Kruse et al., 2019, 8). These examples show that mHealth could have a significant impact on these challenges. Therefore, mHealth is especially beneficial in countries with a low resource setting. Hence, this thesis focuses on the implementation of mHealth in SSA and more specifically on South Africa and Tanzania.

SSA, which is notorious for having a high prevalence of communicable, maternal, neonatal and nutritional illnesses, has poor health outcomes and restricted access to care compared to other continents (Hampshire et al., 2021, pp. 1–2). Despite its young population, SSA is plagued by both communicable and non-communicable diseases that result in a high death rate. Moreover, the region has a high fertility rate, adding to the strain on limited healthcare personnel. The population's access to high-quality healthcare services is further constrained by the low number of health care workers and the poor health coverage noted in the universal health coverage (UHC) data (Aboye et al., 2023, 17).

The expansion of wireless network coverage and rising numbers of phone subscription in SSA are pushing the potential and applicability of mHealth interventions (Lee et al., 2017, p. 3). By 2025, it is anticipated that half of all people in SSA will be using mobile services (GSM Association, 2021, p. 4). Meanwhile, mHealth projects have grown significantly in the past ten years in SSA (Opoku et al., 2019, 2). Governments, non-governmental organizations (NGOs) and businesses in the private sector (such as telecommunications firms) are collaborating to develop mHealth projects that will enhance patients' access to care, service quality and health outcomes. Hotspots for mHealth initiatives were set up in the rural and semirural areas of SSA like Kenya, Tanzania, Malawi and Uganda along the eastern coast (Lee et al., 2017, p. 6). Despite not being well established or being widely used, the majority of health issues addressed by mHealth projects were linked to the most common causes of mortality and disease burden in SSA, which adhere to the categories of communicable, maternal, neonatal and nutritional diseases. The majority of mobile health interventions use SMS-based approaches to inform and remind patients as well as telemedicine applications to deliver diagnostic data. All the while, mHealth applications for maternal health, non-communicable diseases (NCD) care and telehealth interventions for hypertension are currently scarce, insufficient and in their infancy in SSA (Aboye et al., 2023, 8). The paucity of empirical evidence may be partially accounted for by a systematic disregard of success factors in the adoption and use of mHealth during the project design phase. The success factors for mHealth are not well documented in SSA, and there is inadequate proof of their efficacy (Aboye et al., 2023, 9). Furthermore, the majority of mHealth programs in SSA are pilot studies that were carried out at a community level, rather than being scaled up to more encompassing levels and integrated into the mainstream of public health. Therefore, there is little proof of their efficacy, and the course of mHealth in the long run is unknown.

A pilot refers to the small-scale implementation of a mHealth application to evaluate processes, guiding principles, the design and general scaling-up viability. Research demonstrates the viability and promising potential of these initiatives to support African healthcare systems by addressing challenges such as accessibility (Aranda-Jan et al., 2014, p. 3). However, LREs, as is the case in SSA, struggle to provide the enabling factors to ensure mHealth success due to the limited infrastructure, scarce resources, shortage of healthcare workers and limited funding and support. Given these factors, numerous mHealth pilot initiatives have failed (Greve et al., 2022, p. 50). For instance, the case of Uganda shows that 23 of 36 mHealth projects between 2008 and 2009 did not make it past the pilot stage, serving as an example of the situation in SSA. Such failure rates are frequent in many LREs and have led to a condition known as "pilotitis," which refers to stakeholders' discontent with the small number of mHealth applications that transitioned from pilots to common and sustainable applications. Consequently, governments demand that upcoming mHealth applications offer notions of interoperability, sustainability and compliance with laws and standards in advance, as a result of the discontent with the usual "early death" of mHealth pilots (Greve et al., 2022, p. 50).

2.1.2.2 Success Factors and Barriers for the Implementation of mHealth

In order to avoid the previously mentioned condition, known as pilotitis, success factors and obstacles can facilitate the adoption and expansion of mHealth projects (Greve et al., 2022, p. 50). Reviewing the literature regarding the implementation of mHealth in SSA has already revealed some success factors and barriers. One example is the mHealth best practice MomConnect. In a study by Ezezika et al. (2021), the discovered that the strategic partnership and coordination between partner levels, cost-effective technology, sustainable funding methods, adequate adaptation of the innovation to local and national settings and guiding mHealth policy and legislative frameworks were the key elements that supported the implementation of the MomConnect project. According to the study's findings, strong political will and a solid collaboration are essential in order to steer the strategic implementation of mHealth programs. Such mHealth initiatives prosper in a regulatory environment that can foster their development and execution. Additionally, the creation of mHealth projects that are long-lasting by incorporating affordable technology requires a comprehension of the accessibility requirements of the project's target demographic, as outlined in this study (Ezezika et al., 2021, p. 1). Kruse et al. (2019) conducted research that highlighted significant barriers of the implementation of mHealth interventions in LREs, detailing infrastructure limitations, lack of equipment, and technology gaps as being the foremost categories of concern. So as

to address these challenges, the authors recommended that project leaders establish partnerships with local governments and NGOs, focusing on securing funding, leadership and essential infrastructure. It was underscored that LREs, characterized by slow industrialization and low income, should prioritize investments in infrastructure and collaborations with equipment providers, in order to enhance access to phones and promote digital literacy. Embracing emerging technologies is imperative to prevent lagging behind in the advancements of health technology. Overcoming these obstacles necessitates robust governance, private sector involvement, increased phone accessibility, comprehensive training and a consideration of population characteristics. Innovative solutions like microcredit programs were suggested for areas with limited phone ownership, so as to facilitate communal access and utilization of health-enhancing resources. Successful mHealth intervention development hinges on critical research elements, including collaboration across all project phases (Kruse et al., 2019, 9). A study by Aboye et al. (2023) highlighted that the implementation of mHealth in antenatal care programs in SSA faces challenges arising from organizational and financial constraints, particularly preventing its scale-up. Progress has been hindered in landlocked and LREs like South Sudan, Rwanda and Somalia, due to limited experience with mHealth technologies. The facilitation of an effective expansion beyond pilot phases entails being accompanied by research that assesses the enduring impacts of mHealth interventions on antenatal care outcomes and their cost-effectiveness. Such insights would inform the formulation of suitable policies and protocols for integration within healthcare facilities, thereby promoting the broader implementation of mHealth interventions. Investing in uncomplicated, economical and dependable telemonitoring strategies becomes crucial for enhancing acceptability, uptake and retention within health systems. The consideration of existing evidence from other medical contexts is paramount throughout the development process of mHealth. This knowledge serves to guide the creation of interventions aligned with the evolving needs of patient populations, especially those that may experience heightened demands for chronic care in the future (Aboye et al., 2023, 9).

2.2 Healthcare Sector in South Africa and Tanzania

The previous chapters served as the foundation for this thesis by explaining the concepts surrounding mHealth and providing an initial overview of the current situation of mHealth in SSA as well as success factors and barriers for the implementation of mHealth in SSA or other LREs. Yet the purpose of this thesis is a thorough analysis of the factors enabling and hindering the implementation of mHealth in South Africa and Tanzania. Therefore, a close look at the healthcare system of a country is essential, given that it makes

possible an understanding of the environment in which mHealth is implemented and challenges and opportunities brought on by the health system's current state for the implementation. As a result, this chapter provides an in-depth analysis of the healthcare sector in South Africa and Tanzania. Tanzania and South Africa have been chosen in order to draw a comparison between a country with a high Human Development Index (HDI), South Africa, and a country with a low HDI, Tanzania. The HDI is an indicator of prosperity for countries. A long and healthy life, knowledge and a reasonable standard of living are the three fundamental dimensions of human development measured by way of average achievement with the help of the HDI (United Nations, 2021).

A health system is a grouping of all organizations, individuals and activities whose primary goal is to advance, maintain and improve health (Fortuin et al., 2016, p. 1). Using the WHO building blocks framework to compare the healthcare systems of South Africa and Tanzania provides insights into the healthcare systems' current challenges. The WHO building blocks framework can be applied to compare health systems by describing health systems in terms of six core components or building blocks. These are service delivery, health workforce, health information systems, access to essential medicines/technologies, financing and leadership/governance, displayed below in Figure 2.

Figure 2: The WHO Health Systems Framework. Adapted from WHO (2010)

The building blocks aid in comprehending the contextual aspects, advantages and disadvantages of each nation's healthcare system (World Health Organization, 2010, p. 6). They comprise the foundation for supporting the improvement of health systems.

The foundation for the overall policy and regulation of all the other building blocks of the health system is provided by the leadership/governance and health information systems building block. Finance and the health workforce are two examples of important input components for the healthcare system. The third category, which includes the service delivery and access to medical services and technology, include the healthcare system's quick results, such as accessibility and distribution of care (World Health Organization, 2010, p. 7). The information that will be provided in each of the building blocks is provided in Appendix 1.

2.2.1 Service Delivery

The delivery of healthcare services to people and communities within a healthcare system is referred to in the service delivery category, which prioritizes the organization, delivery and accessibility of the healthcare services (WHO, 2007, p. vi). Here, the organizational structure of the health system is scrutinized as well as the current state of health facilities, hospital beds and the health service index, resilience and overall performance (World Health Organization, 2010, p. xi).

South Africa:

The healthcare system in South Africa is structured into the following layers: the base primary healthcare is delivered by clinics that provide essential healthcare services and health promotion, among other services. The district and regional hospitals make for the next level and provide more specialized services. They are followed by tertiary (academic) hospitals which play a crucial role in providing highly specialized and complex care. These hospitals are often associated with medical schools. Central (academic) hospitals make for the highest level and are commonly located in major urban areas. They serve as leading medical institutions that conduct medical research and offer highly specialized treatments for complex conditions (Steve Biko Academic Hospital, 2023).

An evaluation of the number and distribution of health facilities in South Africa reveals that the country has a sizable healthcare infrastructure to service its population when looking at the quantity and dispersion of health facilities. The number of health facilities for South Africa that could be found dates back to 2012. At the time, the country contained 4200 public health facilities. South Africa's population in 2012 equaled 52,38 million. This equals 0.8 health facilities per 10,000 people (Brand South Africa, 2012). However, rural areas remain underserved by healthcare, hence the accessibility is low especially there (International Citizens Insurance, 2021). Neither more recent

information nor information concerning the distribution of health facilities could be found by the author of this research. About 85% of South Africans are served by the public healthcare system, while the 15% of people who can afford insurance are covered by private healthcare. Basic and more specialized healthcare services are offered by the public and private sector. However, the private sector is more frequently used to provide specialized procedures and more sophisticated, high-tech products (International Trade Administration, 2023). In general, the private system is performing well, while the public system is faced with insufficient funding, poor management and a shortage of resources (International Citizens Insurance, 2021).

The most recent hospital bed data from the World Bank Open Data was gathered in 2010 and shows a hospital bed to population ratio of 2.3. Precise figures for the number of intensive care unit (ICU) beds are not available. As a result, a precise assessment of the ICU bed capacity is not possible (World Bank Open Data, 2023b).

A reasonably high level of accessibility to healthcare services was shown by an assessment in 2022 that resulted in 62% access to health services. Additionally, a significant need for healthcare resources and services has to be met for the population, indicated by the statistic that the demand for healthcare services is at 70%. The level of effectiveness, safety and patient-centeredness of the healthcare services offered are reflected in the quality of care, which is accounted for at 60%. The total quality of care provided by the health system may need to be improved, as indicated by this score, which points toward potential areas for improvement. The health system's ability to respond to, adapt to and recover from a variety of difficulties, including health emergencies and crises, is measured at 94%. The health system may have strong systems in place that guarantee continuity and efficiency of healthcare services in emergency circumstances based on its high resilience rating. The overall performance of the healthcare system was reported at 72%, which indicates a comparatively good performance and efficacy in providing healthcare services. This shows that, while the health system is operating satisfactorily, a potential prevails for advancements to increase access, quality and responsiveness to the population's healthcare demands in a few key areas (WHO Regional Office for Africa, 2022, p. 79).

Tanzania:

Tanzania's health system is based on a decentralized approach that is characterized by the distribution of decision-making authority and control across multiple levels and entities. The referral system for healthcare is set up in a pyramidal structure, ranging from local to national levels (Kapologwe et al., 2020, p. 5). Primary healthcare services,

which include community-based health services, dispensaries, health centers (HC) and district hospitals, make for the base of this pyramidal system and lie at the local government level (Boex et al., 2015, p. 6). While health centers offer both outpatient and inpatient healthcare services, dispensaries offer basic preventive and curative outpatient care as well as labor and delivery services. Dispensaries and HCs " are the main source of health services for a major part of the population, particularly in rural areas" (Boex et al., 2015, p. 7). Patients referred by health centers receive medical and surgical care in district hospitals. The following level, regional administrative, are regional referral hospitals which offer specialized medical services. Zonal and national hospitals are located at the highest level, namely central governmental, which offer innovative medical services and act as educational facilities, while being more expensive since they are based on international standards (Ministry of Health, 2019, p. 4).

Tanzania had a total of 8,458 health facilities at its disposal in 2020 for its approximately 61.7 million inhabitants, which would be 1.3 health facilities per 10,000 population, as dated three years ago. Dispensaries make up the majority of the healthcare institutions in Tanzania (Statista, 2022). The majority of health facilities (roughly 60%) are run by the government with a remaining 40% that is either faith-based or private (International Trade Administration, 2022). Regional disparities in the distribution of health facilities in Tanzania are prevalent. Regions with larger populations, such as Dar-es-Salaam, Mwanza and Morogoro, typically have a higher number to serve the larger population size and need for healthcare. On the other hand, less densely populated areas such as Katavi and Songwe have the lowest health facility density. These regional differences in the density of healthcare facilities draw attention to Tanzania's unequal allocation of healthcare resources and the need for improving healthcare access in underserved areas, particularly with regard to remote and rural regions (Health Facility Registry, 2023). This is pertinent given that roughly only 30% of the population lives in urban areas, and the majority of 70% in rural areas that rely on local health facilities like dispensaries and health centers (Kapologwe et al., 2020, p. 6). The regulation by Tanzanian policy is to have a dispensary for each village and a health center for every ward (which consists of several villages). Nevertheless, the reality is different – numbers from 2015 suggest that only 53% of the villages had a dispensary and only 15.7% of wards contained a health center (Kapologwe et al., 2020, p. 5). A report by the Africa Health Business about the health sector in Tanzania revealed that the private sector contributes around 54% of the health services provided, while the public sector only accounts for roughly 46% of health services. Faith-based organizations (FBOs) own 23.3% of health infrastructure, making them the second largest provider of health infrastructure and the largest provider

of hospital services at 41.1%. The largest provider of health infrastructure is still the state with 60% and the state owning 40% of hospitals. Despite the immense influence of the private sector, its potential is neglected in light of the fact that it is not included in the national health planning (Africa Health Business, 2021, p. 4) .

According to the currently available information, dating back to 2010, roughly 0.7 hospital beds were assigned, per 1,000 residents (World Bank Open Data, 2023b). Furthermore, 244 ICU beds were available in 2021 in total for the population of 63,59 million people, which equals 0.38 per 100,000 population. ICU beds are essential for providing critically ill patients with specialized care, and their scarcity may limit the facility's ability to deal with serious cases and emergencies (World Bank Open Data, 2023b).

The results of the health service index in 2022 indicate that the Tanzanian healthcare sector faces major difficulties. A substantial discrepancy can be detected between the desire for healthcare services and the ability to receive them, with an access rate of 33% and a demand rate of 67%. The 53% quality rating for health services shows room for improvement in providing efficient and dependable care. With a 47% resilience rating, the health system may have flaws that prevent it from responding efficiently to emergencies or crises in the medical field. Overall, the Tanzanian healthcare system still has to be strengthened and improved, and only received a performance rating of 50% (WHO Regional Office for Africa, 2022, p. 97).

2.2.2 Health Workforce

The Health Workforce Building Block of the World Health Organization emphasizes the importance of a skilled, equitable, and well-distributed healthcare workforce, essential for effective healthcare delivery and successful implementation of initiatives like mHealth (WHO, 2007, p. VI).

<u>South Africa:</u>

0.8 physicians per 1000 people were found in 2019 (World Bank Open Data, 2023d), in 2018, 5 nurses and midwives per 1000 people (World Bank Open Data, 2023c) and 9.34 community health workers per 10.000 people in 2018 (World Bank Open Data, 2023a). Compared to professional healthcare workers such as nurses and doctors, community health workers (CHWs) are healthcare providers who reside in the community they are serving and tend to have a less formal education and training. Yet they bear the potential to improve healthcare accessibility for vulnerable populations, e.g., communities in rural areas (Health Workforce UHL, 2021). South Africa, unlike Tanzania, is able to meet the sustainable development goal (SDG) index density threshold of 4.45 doctors, nurses and

midwives per 1000 population as well as the millennium development goal (MDG) density threshold of 2.28 doctors, nurses and midwives per 1000 population (WHO Regional Office for Africa, 2021, p. 17). An inspection of the distribution of the health workforce reveals that nurses and midwives in 2018 were the biggest group of health workers with a total of 63%, followed by community health workers with 12% and 10% of all health workers being physicians. The annual growth rate for the groups is between 2% and 4% in terms of nurses and physicians, but an annual growth rate of 21% from 2017 to 2018 in CHWs (WHO Regional Office for Africa, 2021, p. 86). Furthermore, there are 28 medical training institutions for medical practitioners, dentists and pharmacists (WHO Regional Office for Africa, 2021, p. 32). The overall difficulties health workforce is currently faced with include a lack of the skills and capacity to buy, implement and maintain digital health technologies (National Department of Health, 2019, p. 18). This being said, looking at the National Digital Health Strategy of South Africa 2019-2024 has revealed that universities located in South Africa have started developing short courses in digital health, in addition to supervising master's and PhD students researching these subjects. The management of an eLearning hub and guidelines for eLearning courses have been set up, but a lot of obstacles remain to be solved. The Knowledge Hub, a central electronic interface, was designed by the National Department of Health to facilitate quick access to pertinent professional development opportunities as well as an eLibrary that was piloted in June 2017 and an open-access learner management system to support the Knowledge Hub (National Department of Health, 2019, p. 17).

Tanzania:

The health workforce status in Tanzania is derived from the most recent available data from 2018. In this year, there was a rate of 0.05 physicians per 1000 people (World Bank Open Data, 2023d), 0,6 nurses and midwives per 1000 people (World Bank Open Data, 2023c) and no existing number for CHWs (World Bank Open Data, 2023a). Looking at the distribution of health workers in 2018, the biggest group and 59% of the health workers are categorized as other health workers, which include CHWs. The second biggest group are nurses and midwives with 39% of all health workers, whilst physicians make for 3% of the health workforce in Tanzania. Looking at the annual growth rate during 2018, it can be stated that it is positive for almost all groups. Specifically, physicians had an annual growth rate of 19%, nurses and midwives of 11% and a significant annual growth rate of 31% was assigned to pharmacists (WHO Regional Office for Africa, 2021, p. 86). Furthermore, there are 12 medical training institution for medical practitioners, dentists and pharmacists (WHO Regional Office for Africa, 2021, p. 32). Overall, it can be stated that a lack of an up-to-date complete workforce

registration, staffing shortages, an unequal distribution of human resources for health, and various, unconnected human resources for health systems are influencing factors (Ministry of Health, 2019, p. 6). Additionally, the national digital health strategy of Tanzania revealed that ICT personnel is inadequately skilled, skills among eHealth users and decision makers are limited and that there is resistance to the adoption of eHealth solutions (Ministry of Health, 2019, p. 6).

2.2.3 Information systems

The key data source for national health planning and evaluation tend to be health management information systems (HMISs) (Nisingizwe et al., 2014, p. 2). Even though the HMIS provides chances to guide healthcare decisions at all levels of the health systems, its value is only realized when it enables the conversion of generated data into actionable knowledge and information (Mboera et al., 2021, p. 2). The condition of a country's health information system and its eligibility for the use as a foundation for national planning are assessed using the SCORE Assessment tool. The WHO created the SCORE assessment tool to gauge the robustness and usability of a nation's health information system. The aspects assessed by the system include the survey of populations and health risks, count of births, deaths and cause of death, optimization of health service data, assessment of performance and progress, and permitting data use for policy and action. The evaluation is based on a maturity model, where the rank 1 reflects nascent capacity, 2 limited capacity, 3 moderate capacity, 4 well-developed capacity and 5 sustainable capacity which is the best ranking (World Health Organization, 2020, p. 5).

South Africa:

An important development was the creation of the District Health Information System method (DHIS) in 1996–1997 as a regular method for monitoring the delivery of health services in the public health sector. The DHIS has gradually produced vital data throughout the years with regard to planning, monitoring and reporting on health services. It has played a key role in the comprehensive HMIS, which the health sector is currently working toward. According to the 2015 information systems evaluations carried out by the Council for Scientific and Industrial Research (CSIR), the District Health Management Information Systems (DHMIS) Policy for South Africa was adopted in July 2011. Its goal is to guarantee consistency in the DHMIS's application throughout the nation. By way of the regulation and standardization of the collection, collation and dissemination of health data, the primary goal of the DHMIS Policy is to increase monitoring and evaluation in addition to the use of information in policy and program

planning. A significant percentage of the data used for planning, budgeting, managing health services, monitoring and evaluating at all levels of the South African healthcare system has been provided through the direction of the DHMIS Policy. South Africa made the switch from DHIS 1.4 to WebDHIS successfully (National Department of Health, 2019, p. 16).

Overall, the case of South Africa shows that there is a 69% availability of latest data to monitor the health-related sustainable development goals (SDGs) (World Health Organization, 2023a). Regarding the SCORE assessment of South Africa, the country has a well-developed capacity (4) for survey population and health risks, since it has a sustainable system (5) of regular population-based health surveys and a moderate (3) surveillance of public health threats. Population census is keeping up with international standards and doing so at a sustainable level (5). The following category, count in births, deaths and causes of deaths South Africa has a well-developed capacity (4), given that full birth and death registration are at a well-developed level (4) with the rate of 89% and 89%, in addition to certification and reporting of causes of death. The capacity for optimizing health service data is also well developed (4) in South Africa, with a sustainable (5), meaning very well-developed, regular system to monitor service availability, quality and effectiveness as well as sustainable (5) health service resources regarding health workforce data. Health service resources for health finance data and routine facility and community reporting system with patient monitoring are well developed (4). A consideration of the review progress and performance reveals that South Africa has a sustainable capacity (5) with sustainable (5) regular analytical reviews and institutional capacity for analysis and learning. Enabling data use for policy and action is also at a sustainable capacity level (5) with sustainable (5) data and evidence drive policy and planning as well as data access and sharing. Strong country-led governance of data is at a well-developed capacity (4) in South Africa. Overall, South Africa demonstrates a well-developed healthcare data system with high completeness rates and strong data governance, yet only a moderate level for surveillance of public health threats (World Health Organization, 2023a).

Tanzania:

The HMIS, created in the early 1990s, is Tanzania's primary information system. It is comprised of facility-based health records that are used to manage regular health services and serve as indicators for information regarding morbidity, mortality, the state of the healthcare system and the availability of services. The District Health Information System (DHIS2), a web-based software program for gathering, validating, analyzing and presenting aggregate statistical data customized to integrated health information

management operations, was adopted by the government of Tanzania in order to improve the performance of HMIS. The introduction of DHIS2 served to make data access easier and to increase usage (Mboera et al., 2021, p. 2). According to a study by Rumisha et al. in 2020, strong variations are found in the tool usage and data accuracy at the level of the facility and the district. Data at the district level reflect what is available at the source erroneously, due to the weakness of the routine HMIS. These findings demonstrate the necessity of developing individualized, cross-service methods for enhancing data quality (Rumisha et al., 2020, p. 1). Furthermore, numerous, disparate electronic health information systems on the Tanzanian government's end are not interoperable and/or are not properly matched with the workflow of the health sector, which has increased the workload for health workers (International Trade Administration, 2021). Overall, it can be said that the health information systems are fragmented and interoperable, with a limited data-use culture as well as low data quality and limited ICT infrastructure (Ministry of Health, 2019, p. 7).

Overall, Tanzania has 60% of the latest data available to monitor the health-related SDGs (World Health Organization, 2023b). Looking at the SCORE assessment of Tanzania from 2013 - 2018, the capacities of survey population and health risks lie at a moderate capacity (3), in light of the fact that Tanzania has a well-developed system (4) of regular population-based health surveys that meets international standards and is conducting regular population census. Nevertheless, surveillance of public health threats is located at a moderate level (3). The following category of the SCORE assessment - count births, deaths and causes of death, reveals that Tanzania is only at a nascent capacity (1) in this area: the completeness of birth registration is at a mere 26% and no information concerning the completeness of death registration is available. Furthermore, Tanzania has a well-developed capacity (4) to optimize health service data, which makes for the next category. The routine facility reporting system with patient monitoring is rated as moderate (3) but with a well-developed (4) regular system to monitor service availability, quality and effectiveness as well as health service resources of health financing, since latest data on national health expenditure is available and even sustainable capacity (5) for health service resources for health workforce data. Regarding the capacity to review progress and performance, Tanzania is at a sustainable capacity (5) with sustainable institutional capacity (5) for analysis and learning and well developed (4) regular analytical reviews of progress and performance with equity. The last category, data use for policy and action, is at moderate capacity (3) with policy and planning that is moderately (3) driven by data and evidence as well as data access and sharing, given that health statistics are publicly available and a strong

country-led   governance   of   data.
Overall, Tanzania's healthcare data infrastructure exhibits a moderate capacity, with challenges, e.g., in birth and death registration completeness (World Health Organization, 2023b).

2.2.4 Medical Products and technologies

The WHO's "Medical Products and Technologies" building block relates to the availability, accessibility and appropriate use of necessary medical equipment, technology and products (WHO, 2007, p. vi). The indicators relevant to this thesis, in terms of availability and accessibility of medical products and technologies, are a general overview of the supply of medicines as well as the mobile connectivity in each of the countries. Therefore, the Global System for Mobile Communications Association (GSMA) Mobile Connectivity Index is being used. This index provides an indication regarding the performance of countries – representing key enablers of mobile internet adoption: infrastructure, affordability, consumer readiness, content and services. Infrastructure implies that for mobile internet connectivity to be successful, high-performance mobile network coverage is required. Affordability indicates that, in order for further spreading of mobile internet connectivity, mobile services and devices must be priced reasonably for everyone. Consumer readiness entails that, so as to value and use the internet, citizens must have the knowledge and abilities to do so. Lastly, content and services signify that the expansion of mobile internet connectivity entails a variety of content and services to be offered in, e.g., the regional language (GSMA, 2022). In addition to connectivity standards within a country, the type of mobile devices used by the population is impacting the reach of mHealth, given that it determines what kind of functions can run on a phone (Botha & Booi, 2016, p. 3). Lastly, a short overview for the access and the current status of mHealth will be provided.

South Africa:

South Africa's public healthcare system is confronted with issues such as rising medical expenses, low drug supplies, subpar medical results and the misuse of outdated medications. These factors come with challenges with regard to the access to medical products (Bvuchete et al., 2018, p. 1). All things considered, the South African healthcare system can be seen as a two-tiered system that is neither equitable nor accessible for a significant number of South Africans. Moreover, public sector institutions have also experienced inadequate funding, poor management and deteriorating infrastructure. While access has improved, the quality of health care has decreased (Brand South Africa, 2012).

According to the GSMA Mobile Connectivity index, South Africa has an index score of 66.7 which is significantly higher than in Tanzania and means the country is advanced in this area and has a medium to high connectivity. Looking at the enabler consumer readiness also reveals a promising picture. South Africa has a score of 80.32, indicating that the population is ready and has the skills to use mobile phones. The scores of other enablers are also relatively positive with 68.76 % regarding the infrastructure. In other words, e.g., network coverage and performance are moderately well established. Content and services have the score of 65.82 and affordability is ranked at 54.42, showing that even in South Africa only 50% can afford mobile devices and services (GSMA, 2022). Regarding the type of mobile devices, a survey by Pew Research Center in 2018 has shown that 51% of the adults in South Africa participated with their own a smartphone, 40% with a basic phone and 9% with no phone. As has been mentioned above, the ownership of a smartphone and mobile phone in South Africa depends on educational, financial and generational aspects. For instance, people with a higher level of education are more likely to own a smart or mobile phone (Pew Research Center, 2018).

When it comes to accessibility to mHealth in South Africa, a report by GSMA indicates 83 existing mHealth services in South Africa in 2018, with the majority specializing in HIV/AIDs and women and children (Ojo, 2018, 2). A study by Botha & Booi in 2016 reported that the most relevant mHealth applications trends were donor funding as a financing mechanism, instead of a sustainable business model and a targeting of the general public, e.g., pregnant women (Botha & Booi, 2016, p. 8).

Two successful examples of mHealth in South Africa can be mentioned are:

- **The MomConnect program** is geared toward sending tailored health promotion messages to enhance maternal and newborn health by using a mobile phone-based service. By signing up to the program, expectant mothers get stage-specific information on pregnancy care, labor, infant care, nursing and immunization (National Department of Health, 2019, p. 16).

- **The Stock Visibility System (SVS)** is a pivotal mHealth application that has been expanded to boost the healthcare system. SVS is a stock monitoring and evaluation system for mobile phones, meant to improve access to precise, timely information from medical facilities concerning pharmaceutical availability (Transform Health, 2021).

Tanzania:

The overall access to medical products in Tanzania shows that the supply chain system is a complex network of vertical and interconnected systems, including vital vertical programs for health commodities, lab and diagnostics, equipment, and supplies. Over the years, the supply chain has been improving, yet the distribution of medications remains uneven (Ruhago et al., 2022). In 2020, the delivery structure in supply chain in Tanzania was characterized by an ineffective customer-to-warehouse assignment, where health facilities, instead of being served by the closest warehouse, were assigned a warehouse or any warehouse with the necessary capacity. The result was huge costs. Therefore, structural changes were made toward direct delivery. By optimizing the customer-to-warehouse assignment, transportation costs were predicted to be reduced by 14-17 percent (USAID | DELIVER PROJECT, 2020, p. x). Yet the challenges of a shortage of drugs as well as limited purchasing power remains, on top of the difficulty of maintaining health equipment and infrastructure (Africa Health Business, 2021, p. 6).

Looking specifically at factors that influence the access to mHealth, the GSMA mobile connectivity index is analyzed. Tanzania has an index score of 45.6, in other words, the country is emerging in this area and has a low to medium connectivity. By taking a look at one of the enablers of the index, insights can be found regarding the consumer readiness to using mobile phones. Tanzania scores with 49.43 in this category, which reveals the barriers among the population to using mobile phones. The index infrastructure only realizes 55.55% of what is possible to achieve, mainly because network performance tends to be low. The affordability of mobile devices and services in Tanzania also received a low score of only 34.89%. Lastly, content and services account for 35.16% (GSMA, 2022). Furthermore, in terms of the type of mobile devices that are being used in Tanzania, a study by Pew Research center revealed that 13% of the adults have a smartphone, 62% own a basic phone (such as flip phones or feature phones) and a total of 25% do not own a phone at all. The study also provided insights into the divides of ownership. Here, educational, financial and generational divides in ownership are the case in both Tanzania and South Africa (Pew Research Center, 2018).

The situation of mHealth in Tanzania is discussed with the help of a study by Lee et al. (2017), which revealed that Tanzania can be considered as one of the hot spots for mHealth and mHealth initiatives (Lee et al., 2017, p. 6). Specifically, there were 31 mHealth services available in Tanzania, according to the GSMA's 2015 mHealth country feasibility report. In Tanzania, antimalarial initiatives (35%) and HIV-related health conditions (45%) accounted for the majority of mHealth services provided. Nutrition and

maternal conditions accounted for an additional 29% of mHealth services (GSMA, 2014, p. 43). A more recent overview could not be found. Two examples of mHealth success are given below:

- **Wired Mothers** is aimed at lowering maternal and newborn morbidity and mortality by means of SMS and direct communication with primary care providers (El Joueidi et al., 2021, p. 22)

- **The Healthy Pregnancy, Healthy Baby (HPHB)** text messaging service is a mobile health (mHealth) value added service (VAS). HPHB enables all mobile phone owners, in addition to their families and friends, to have access to vital health and nutrition information via their phones by SMS (GSMA, 2014, p. 50).

Despite these successes, and another study showing that in rural areas, CHWs and other healthcare providers are using mobile devices for the delivery of health services, only a limited number of patients had known about the possibility of using mobile devices for receiving health services (Miyashita et al., 2022).

2.2.5 Financing of Healthcare Systems

The WHO Building Block of Financing encompasses the financial systems and mechanisms that sustain and support a country's healthcare system, influencing its accessibility, quality and overall effectiveness. The functioning of the funding for the health system is described (WHO, 2007, p. vi).

<u>South Africa:</u>

With nearly 50% of the entire budget being provided by the government, it is the major source of funding for the healthcare system. Public health services, including immunization campaigns and HIV/AIDS prevention and treatment are supported by said financing (Ataguba & Di McIntyre, 2018). The public health sector delivers services to about 80% of the population (Brand South Africa, 2012). In contrast, the private sector with nearly 40% of the overall budget coming from private health insurance, is the second largest source of funding for the healthcare system. For those with private health insurance, estimated at 16 % of the population, this money is used to pay for the cost of medical services. Out-of-pocket expenses make for around 10% of the overall budget and are the third greatest source of funding for the healthcare system. People who lack private health insurance and must pay for their own medical expenses make these contributions. This indicates that many South Africans are responsible for covering their own health care expenses, which can be costly (Ataguba & Di McIntyre, 2018). According to the WHO, South Africa's total health expenditure as percentage of gross

domestic product (GDP) was 9.1% in 2019 (WHO Regional Office for Africa, 2022, p. 89). According to these figures, the South African government devotes a sizable amount of its overall budget to healthcare. South Africa's government invested 13.3% of the national budget to health in 2019 (WHO Regional Office for Africa, 2022, p. 89). General government spending on digital health could not be found by the author.

Tanzania:

The majority of the Tanzanian health system's funding is derived from public sources, including income from income tax and value-added tax, donations, grants and loans for health programs, pre-payment plans such as community health funds, private health insurance, and social health insurance schemes, in addition to out-of-pocket payments like direct payments when utilizing services (Kapologwe et al., 2019, p. 3). The contribution by international donors, especially coming from the US government for the health budget, is up to 40% for financing healthcare in Tanzania. In other words, healthcare heavily relies on external sources for funding (International Trade Administration, 2022). Regarding the total current health expenditure as percentage of GDP, the WHO stated that it was 3.8% in 2019. The national budget allocated to health is at 9.4%. According to these numbers, the Tanzanian government devotes a relatively small amount of its entire budget to healthcare (WHO Regional Office for Africa, 2022, p. 97). It is crucial to remember that the WHO also notes that Tanzania's out-of-pocket medical expenses are substantial, at 39.7% of total medical spending. This means that many Tanzanians are paying for their own healthcare costs (World Bank Open Data, 2020a). As of 2019, 32% of Tanzanians were covered by health insurance with 1% of these 32% being members of private health insurance (International Trade Administration, 2022). Any information on the spending on digital health could not be found by the author of this study.

2.2.6 Leadership and Governance

Governmental and political direction is advantageous for the health systems. For all parties involved in healthcare, national policies offer crucial orientation. This section examines whether there are particular plans for mHealth as well as whether there are national policies for the digitization of the health care systems such as a strategy for digital health (Stephani, 2019, p. 14). In order to compare the digital health strategies of the countries, first the vision and mission statement are being looked at, the strategic priorities, focus on mHealth, implementation plan, and lastly legislation affecting the implementation of mHealth.

<u>South Africa:</u>

The National Digital Health Strategy for South Africa 2019–2024 seeks to create a strong integrated platform for the development of information systems, to fortify the governance frameworks for digital health, and to establish the required broadband network infrastructure (National Department of Health, 2019, p. 11).

- Vision and mission statement

South Africa's digital health vision is "Better health for all South Africans enabled by person-centered digital health" (National Department of Health, 2019, p. 17). The mission of South Africa's digital health strategy is "to establish an integrated digital health ecosystem of people, processes and technology that support health systems strengthening to enable the efficient service delivery, effective patient care and person empowerment necessary for achieving UHC" (National Department of Health, 2019, p. 17).

- Strategic priorities and interventions

The digital health priorities for the period of the national digital health strategy of South Africa are the following: (1) developing a comprehensive health electronic record which will enhance the management of patients, (2) digitizing the business process around health systems, (3) launching an integrated platform and architecture for HIS, (4) scaling up high impact mHealth for community-based initiatives and lastly, (5) developing the knowledge among personnel working to support digital health (National Department of Health, 2019, p. 17).

In order to achieve these objectives, the plan proposes nine strategic interventions to be achieved by 2024. These are:

- o Build leadership skills for innovative digital health and flexible management

- o Engage stakeholders appropriately to create chances for collaboration and successful implementation of digital health

- o Create long-lasting interventions and suitable finance and investment strategies to deploy digital health

- o The strategy's governance structures and oversight procedures should be examined and strengthened

- o For interoperability and efficient, secure sharing of health information across health systems and services, creating an integrated information architecture

- o Create relevant digital products and services to enhance patient and healthcare provider experience

- o For key digital health apps and services, build a strong physical and network infrastructure with broadband access

- o Create a national framework for digital health laws, policies, and regulations

- o Educate a trained workforce with improved technical capability for digital health to support and implement it (National Department of Health, 2019, pp. 10–11)

- Focus on mHealth

MHealth plays a pivotal role in the National Digital Health Strategy, since it is one of the digital health priorities. However, there is no mention of any detailed plans or efforts that should be taken to advance mHealth in South Africa, merely that a number of mHealth projects have been put in place to support the top health programs. Consolidating and rationalizing mHealth investments is necessary for the new approach and scaling up projects with the biggest potential impact is also necessary according to the national digital health strategy (National Department of Health, 2019, p. 16).

- Implementation plan

The only found information concerning the implementation plan is that from the strategy, a detailed implementation plan will be created with the South African government Medium Tern Expenditure Framework (MTEF) and annual operational plans. However, the document could not be found by the author of this thesis. The only indication is that a library of the digital health user journeys should be described as well as managing the digital health risks, since digital health is complex and costly. Regarding the monitoring and evaluation, it is also being stated that a clear plan will be developed (National Department of Health, 2019, pp. 25–26).

- Legislation

In order to strengthen the enabling environment for digital health, laws such as the Protection of Personal Information (PoPI) Act, 2013 or the Electronic Communications Security (Pty) Ltd Act, 2002 Article 68 and 25 were introduced to help mature the regulatory environment by defining privacy and confidentiality of health records and how they are being handled (Transform Health, 2021). Article 36 of the same legislation provides the basis for universal connectivity and lastly, The National Archives of South Africa Act, 1996, Article 43 defines a set of security protocols and retention requirements for any health record, including electronic records (National Department of Health, 2019,

p. 15). South Africa's commitment to bridging the digital divide and advancing ICT integration is demonstrated by its comprehensive national integrated ICT Policy white paper. The ICT Policy Review Advisory Panel emphasized the importance of a holistic government leadership, so as to ensure a cohesive digital agenda across all sectors. To foster broad stakeholder participation, a National ICT Forum was established under the Minister of Telecommunications and Postal Services, providing a platform for dialogue and engagement to accelerate policy implementation (telecommunications & postal services Republic of South Africa, p. 26). The South African Health Products Regulatory Authority (SAHPRA), which is in charge of overseeing medical product regulations, is a well-established entity in South Africa. The country's medical device and pharmaceutical product licensing, post-marketing surveillance and registration are all governed by SAHPRA (Keyter et al., 2018).

Tanzania:

Tanzania's National Digital Health Strategy 2019-2024 aims to improve the standard of living for Tanzanians, by guaranteeing universal access to high-quality primary healthcare, ensuring that all individuals who are of reproductive age have access to quality reproductive health services and by lowering the rates of maternal and infant mortality (Ministry of Health, 2019, p. 1).

- Vision and mission statements

The vision of Tanzania's national digital health strategy is: "Better health outcomes through a digitally enabled health system", while their mission is "to accelerate the transformation of the Tanzanian health care system through innovative, data-driven, client-centric, efficient, effective, and integrated digital health solutions" (Ministry of Health, 2019, p. xii).

- Strategic goals and strategic priorities

This strategy consists of five strategic goals and ten priorities. The strategic goals are to (1) improve leadership and governance in the digital health sector, (2) enhance customer experience through effective delivery of high-quality medical services, (3) enable managers and healthcare professionals to make decisions based on solid evidence, (4) continued accessibility to medical resources and lastly, (5) standardized information exchange (Ministry of Health, 2019, p. xii).

Some examples of the strategic priorities that ought to be met within the time period of 2019-2024 are:

- o To improve the coordination and execution of digital health activities, strengthen digital health governance and leadership

- o Enhance accessibility, effectiveness, patient safety, quality and continuity of care by digitally transforming the delivery of health services in an all-encompassing way

- o Enhance the technical proficiency of the health staff and employ technology to deliver specialized care to under-served facilities

- o Encourage healthy behavior by providing access to pertinent health information and by educating and communicating about behavior beneficial to the citizens' health

- o Improve the exchange of information in a secure manner

- o At all levels of the health system, improve illness prevention, surveillance, detection, reporting, response and control (Ministry of Health, 2019, pp. 14–15)

- Focus on mHealth

MHealth is not specifically named as a strategic priority or flagship project. However, it appears in several chapters along with telehealth and telemedicine. Hence, telemedicine and mHealth can be used interchangeably in this case, given that the document does not specify differences and solely focuses on the delivery of services through a mobile device which accounts for both telemedicine and mHealth. Tanzania's Ministry of Health is convinced that mHealth is able to improve access to high-quality health services. As mentioned by the chapter key lessons learned from the previous strategy, among other outcomes, the quality of health service delivery could be improved through various eHealth initiatives. However, the significance of mHealth for this improvement is not named specifically. Instead, several mHealth initiatives are mentioned among the eHealth initiatives, e.g., telemedicine infrastructure and services and a mobile health platform that is geared toward enhancing health education (Ministry of Health, 2019, p. 12). Moreover, the Ministry of Health of Tanzania appears to see the greatest potential in telemedicine for improving "health workforce competency and use of technologies to provide specialized care to under-served facilities" (Ministry of Health, 2019, p. 17). Telehealth services' potential is emerging quickly as a game-changing method for providing medical care and as a solution to the objective of reaching universal health coverage. The most common telehealth services include telemedicine like teleradiology, teleconsultation and eLearning. For instance, by contacting experts at specialized

facilities, remote health facilities can offer specialized care services, and remote health facilities can make it simple for employees to receive continuous education by using eLearning platforms (Ministry of Health, 2019, p. 17).

- Implementation plan

The national digital health strategy outlines certain strategic initiatives that need to be executed for each strategic priority. In the case of the objective "improving health workforce competency and use of technologies through telehealth", the strategic initiatives are:

- Create policies that simplify the operationalization and execution of telehealth services

- ICT infrastructure should be enhanced to support the provision of telehealth services

- Put telemedicine services in place

- Implement online tools for peer networking among health professionals

- Utilize knowledge management and e-learning systems to promote ongoing professional development

Successful implementation of digital health strategies requires robust governance and leadership. The Tanzania Digital Health Investment Road Map 2017–2023 outlines the need for resources to cater to diverse digital health initiatives, subject to periodic revisions aligned with action plans. Effective change management strategies are pivotal for a successful implementation, considering that sustained change and adoption predominantly hinge on organizational rather than technical factors. Consequently, comprehensive change management approaches facilitate the integration of digital health solutions into clinical workflows and administrative functions. Monitoring and evaluation are paramount, facilitated by a dedicated road map for the National Digital Health Strategy 2019–2024 that defines the indicators and corresponding targets for each of the strategic priorities and initiatives. One of the latter is to implement telemedicine services with regard to the strategic priority "Improve health workforce competency and equitable access to be specialized health care using telehealth". The indicator is the proportion of health facilities providing telemedicine services. Two targets have been defined for this initiative, namely (1) Telemedicine services provided by all hospitals by June 2024 and (2) Telemedicine services provided by 50% of health centers and dispensaries by June 2024 (Ministry of Health, 2019, p. 31).

- Legislation

The Ministry of Health, Community Development, Gender, Elderly, and Children (MOHCDGE) manages the Executive Agency called the Tanzania Medicines and Medical Devices Authority (TMDA), an executive agency. The TMDA is in charge of overseeing the security, caliber and efficacy of pharmaceuticals, medical equipment and diagnostics (Tanzania Investment Centre, 2023). The National Digital Health Strategy 2019-2024 of Tanzania does not provide insights into legislation that is in line with eHealth. However, a descriptive analysis of the eHealth regulations by Msumi (2018) offers an overview of the status of legislation. The Public Health Act 2009, the Mental Health Act 2008 and the Persons with Disabilities Act 2010 are only a few of the laws that govern Tanzania's healthcare system. However, these documents of law have few, if any, provisions pertaining to the privacy of medical records. The legal environment in Tanzania's health sector is still in its infancy when it comes to electronic health (Msumi, 2018, p. 375).

2.2.7 Comparison of Health Systems in Tanzania and South Africa

This section offers a short summary of the findings from the analysis of healthcare systems in Tanzania and South Africa that are relevant for understand the environment in which mHealth is being implemented.

The comparison of **service delivery** makes evident that the structure of South Africa's and Tanzania's health systems is relatively congruent. Similarly, the distribution pattern of health facilities in these nations follows a comparable trend, with higher densities observed in more densely populated regions and a paucity of facilities in rural areas, thus impeding seamless access to timely medical care. This is especially pertinent in the case of Tanzania, because 70% of inhabitants reside in rural areas (Kapologwe et al., 2020, p. 6). Conversely, the South African private health system is performing very well, yet serves only a small percentage of the population. All the while, the public health system suffers from insufficient funding, poor management and a shortage of resources (International Citizens Insurance, 2021). On the other hand, the Tanzanian private health sector provides a big part of health services, with FOBs being second largest provider of health infrastructure and even the largest provider of hospitals. Analyzing the holistic performance of their healthcare systems, it becomes apparent that Tanzania has a performance score of 50%, coupled with a markedly limited access rate of 33%. South Africa exhibits more commendable performance metrics with an overall score of 72%,

positioning it among the top-performing countries in Africa, accompanied by a robust access rate of 62%.

In the context of the **health workforce**, Tanzania has low physician density rates. In contrast, South Africa is able to meet the SDG index density threshold for healthcare professionals. Both countries display positive growth rates in various health workforce categories. Concerning digital health, each nation designates staff for eHealth support. However, the adoption of these technologies is confronted with obstacles due to clinicians' limited computer literacy and insufficient promotion. Tanzania encounters similar challenges with inadequate ICT skills among healthcare workforce, while South Africa is addressing its health workforce's capacity for digital health technologies through initiatives like academic courses and knowledge hubs (National Department of Health, 2019; Ministry of Health; WHO Regional Office for Africa, 2021).

In the context of **information systems**, an evaluation of the SCORE assessment reveals that Tanzania lags behind South Africa in terms of performance. Tanzania shows significant deficiencies, especially in areas related to data on births, deaths and causes of death, along with other categories showing a moderate capacity (World Health Organization, 2023b). This implies a fragmented and interoperable health information system characterized by limited data-use culture, suboptimal data quality and restricted ICT infrastructure (Ministry of Health, 2019, p. 7). Conversely, the South African SCORE assessment rankings indicate a sustainable capacity in nearly all evaluated categories (World Health Organization, 2023a).

The examining of the domain of **medical products and technologies** yields that both countries grapple with issues concerning the supply chain management and medication availability across their respective landscapes (Ruhago et al., 2022; Bvuchete et al., 2018). In terms of access to technologies, particularly mobile connectivity, which is pivotal for mHealth implementation, Tanzania is situated at an emergent stage, according to the GSMA assessment. Affordability and content and services pose as the primary challenges for the Tanzanian context. In contrast, South Africa exhibits an advanced level of mobile connectivity, boasting commendable rankings across various facets except for affordability, which registers at 54% (GSMA, 2022). Furthermore, only 13% of adults in Tanzania own smartphones, 62% have basic phones, and 25% have no phone at all. In South Africa, 51% of inhabitants own smartphones, 40% have basic phones, and 9% have no phone. This displays a barrier for the proliferation of technology and influences the kind of mHealth applications that can run on the mobile device (Pew Research Center, 2018).

A close look at the category **financing** shows that the Tanzanian healthcare is mainly funded by public sources and international donors, with government spending representing 9.4% of the total budget and 3.8% of GDP (WHO Regional Office for Africa, 2022, p. 97). Furthermore, Tanzanians face substantial out-of-pocket medical expenses, comprising 39.7% of total medical spending, and only 32% of the population having health insurance (World Bank Open Data, 2020a). In contrast, South Africa relies heavily on government funding (nearly 50% of the budget) for public health services, while out-of-pocket expenses are also high (Ataguba & Di McIntyre, 2018). Private health insurance, covering 16% of the population, plays a key role, with government spending on healthcare being at 13.3% of the total budget and 9.1% of GDP (World Bank Open Data, 2020b).

In terms of **leadership and governance**, examining the national digital health strategies reveals distinct priorities. Tanzania envisions improved health outcomes through a digitally enabled healthcare system, while South Africa shares a similar goal, aspiring to enhance health for all through person-centered digital health. In terms of mHealth implementation, South Africa appears to be more advanced, actively scaling up promising mHealth initiatives. In contrast, mHealth is less established in Tanzania, predominantly associated with telemedicine, and their emphasis lies with furthering telemedicine implementation. However, Tanzania defines clear objectives, while the goals in South Africa lack a clear implementation plan (Ministry of Health, 2019; Ministry of Health, 2019).

2.3 Implementation Science

The previous chapters provided detailed information concerning the digital transformation of the healthcare sector as well the specific challenges and opportunities the healthcare systems in Tanzania and South Africa are facing. This makes for the foundation of the following empirical part, which will investigate the success factors and barriers for the implementation of mHealth into the healthcare sector. This chapter offers insights into the framework that used to effectively identify the success factors and barriers for the implementation of mHealth. Both the adoption of health interventions in various contexts and the discovery of context-specific implementation success factors and barriers are topics covered by implementation science (Soi et al., 2018, p. 2). Success factors in the context of this thesis include enablers that facilitate the successful implementation of mHealth (Albers et al., 2020, p. 60). The definition of a barrier refers to something that divides one thing from another. A barrier makes it difficult to accomplish a particular objective, which in the case of this study is the successful implementation and realization of mHealth (Kruse et al., 2019, 2). According to the authors of

Implementation Science 3.0 up until today, society is still far away from successfully "implementing implementation". This is the case even though interest in this area dates back to the 1970s, where it dealt with success factors and barriers for the implementation of policies. Since then, it has been pushed to other fields like medicine, education, social welfare (Albers et al., 2020, p. 1). Implementation science entails the "the scientific study of methods to promote the systematic uptake of research findings and other evidence-based practices into routine practice, and hence, to improve the quality and effectiveness of health services and care" (Eccles & Mittman, 2006, p. 1). Over time scholars in this field were able to identify constructs relevant for the implementation which "were rolled up into implementation frameworks that attempted to capture both the elements and a process describing how they might be used together to understand and facilitate successful implementation" (Albers et al., 2020, p. 5). The three primary objectives can be distinguished in the application of theories, models and frameworks in implementation science: (1) describing and/or directing the process of putting research into practice, (2) comprehending and/or elucidating what influences implementation outcomes and (3) evaluating implementation. Based on these three overarching goals, five categories of theoretical approaches could be identified. Process models for aim (1), whereby aim (2) can be further broken down into the three categories determinant frameworks, classic theories and implementation theories and the category of aim (3) is evaluation frameworks (Albers et al., 2020, pp. 55–56). Figure 3 displays an overview of the aims and categories of theories, models and frameworks.
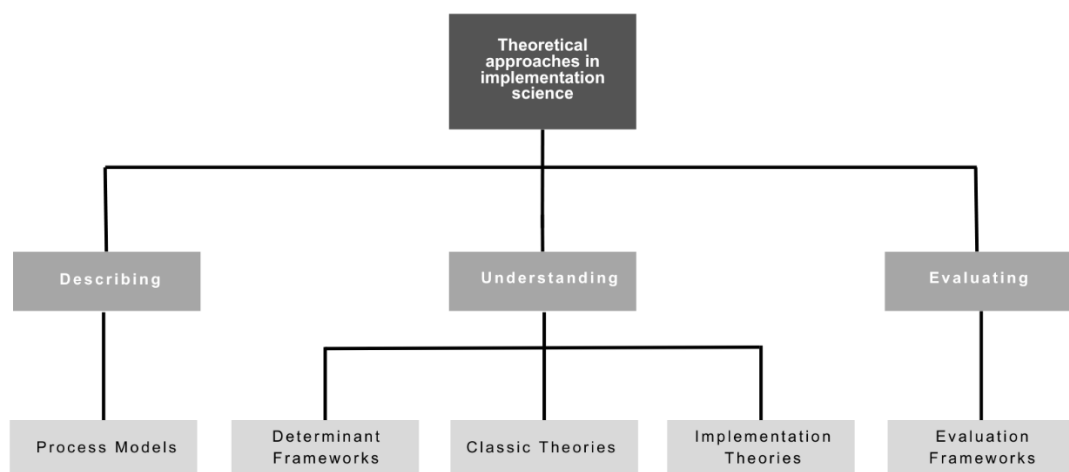
Figure 3: Three aims of the use of theoretical approaches in implementation science and the five categories of theories, models, and frameworks. Adapted from Albers et al., (2020)

Determinant frameworks will be used in this thesis, since they help to understand and/or explain what influences implementation outcomes. In other words, determinants and individual determinants which act as barriers and enablers (independent variables) that

impact implementation outcomes (dependable variables). Numerous frameworks exist that serve this purpose, including the Conceptual Model, Understanding User Context Framework, Active Implementation Frameworks and the Consolidated Framework for Implementation Research (CFIR), among many others (Albers et al., 2020, pp. 56–57).

<ins>The CFIR Framework</ins>

The framework used for this research is the updated CFIR framework. The CFIR framework was first introduced in 2009 and was updated in 2022 based on user feedback. The more recent version is applied in this thesis (CFIR, 2022). It offers a thorough framework for comprehending the variables that affect how complex interventions are put into practice. Given the complexity of mHealth initiatives, CFIR was chosen for its comprehensiveness and capacity to manage both breadth and depth of data. The CFIR framework is believed to be a helpful framework for determining the variables that affect the implementation of mHealth, given that it addresses a broad range of implementation-related topics. It deals with the requirement to evaluate and improve implementation efficacy within a particular environment and encourages approaches to new situations (Tilahun et al., 2018, p. 3). The constructs that comprise CFIR are arranged into 5 primary domains: innovation domain, outer setting domain, inner setting domain, individuals domain and implementations process domain (CFIR, 2022). The overall effectiveness and effectiveness of implementation are impacted by the interactions between these domains. The CFIR provides researchers with a common language to communicate implementation determinants as well as an extensive, standardized list of constructs that guides them in identifying critical variables for the implementation of a particular invention. CFIR can be used as a guide to design data collection tools like interview guides and codebooks as well as for assessing, interpreting and/or reporting implementation-related findings. The framework can be used at any stage of the implementation process (Albers et al., 2020, p. 84).

The CFIR is comprised of several constructs, which in turn are divided into the following five domains. A further description of domains and constructs is provided in chapter 4 that displays the results:

- Innovation domain dealing with characteristics of implementation objective through constructs like adaptability, evidence-base, design and cost

- Outer setting domain dealing with characteristics of the outer context through constructs like local conditions, partnerships & connections, policies & laws, financing

- Inner setting domain considering characteristics of the context by way of constructs like structural characteristics, culture, networks

- Individuals domain concerning characteristics of the users/adopters (e.g., health care practitioners) through constructs like knowledge & beliefs about intervention, self-efficacy, other personal attributes

- Implementation process domain considering characteristics of strategy or other means of facilitating implementation with constructs that are stages of implementation such as planning, assessing needs, engaging (Safaeinili et al., 2020, p. 2).

2.4 Research Gap

As shown in the previous chapter, mHealth has gained increased attention over the last decades, particularly in LMICs (World Health Organization, 2011, p. 21). Research in this field, particularly in Africa, has primarily centered on implementing specific mHealth applications to identify both success factors and barriers. For instance, MomConnect emphasized strategic partnerships, cost-effective technology, sustainable funding, local adaptation and policy frameworks as crucial success factors (Ezezika et al., 2022, p. 1). The WHO has identified the top six obstacles in the way of the adoption of mHealth, which are knowledge gaps, competing priorities in the health system and legal concerns (World Health Organization, 2011, p. 7). Existing research has taken a geographically broad approach to these factors across Africa, whereas this thesis will focus on comparing the healthcare systems and specific influencing factors for mHealth implementation in South Africa and Tanzania. Additionally, this study will offer insights for startups and recommendations for actions to overcome these barriers.

The following questions will be answered in light of the above:

The central research question is "What are the success factors and barriers for the implementation of mHealth in South Africa and Tanzania?" Therefore, several sub-questions will be answered:

- What is the status quo of the healthcare system in South Africa and Tanzania?

- What are the differences between the success factors and barriers for the implementation of mHealth in South Africa and Tanzania?

- How can the identified barriers be overcome?

- What recommendations can be given to startups that want to introduce mHealth in South Africa and Tanzania?

3 Methodology

This chapter outlines the methodology of this study to investigate the success factors, barriers and strategies for the successful implementation of mHealth in South Africa and Tanzania. The research design, data collection method, data analysis approach and quality criteria are presented in detail.

3.1 Research Design

Empirical research is geared toward results gathered through a systematic evaluation of experiences (Bortz & Döring, 2006, p. 2). Any scientific investigation is built on the research design. In order to be able to confirm the formulated hypothesis or research topic, this process entails responding to a number of questions. The quality and validity of the research findings depend heavily on the chosen research design. The research design selected for this study is qualitative research, because it offers an openness and flexibility in addition to describing, interpreting and understanding connections, establishing classifications or typologies and generating hypotheses. This approach is also known to provide deep insights into a topic (Berger-Grabner, 2016, p. 117). Qualitative research is characterized by a non-pre-determined, non-standardized approach that yields comprehensive information. Although qualitative research tends to be based on a rough thematic guideline, the sequence and design of the questions are flexible and the interviewees' response options are unlimited. This approach achieves a deeper information content of the results, without making representative and numerical statements (inductive approach). As a result, it is highly suitable for obtaining detailed descriptions of individual opinions and impressions, such as suggestions for improvement or the exploration of causes. A descriptive qualitative research concept is applied in the case, in its aiming to identify and describe the success factors, barriers and potential strategies on how to overcome the barriers for successfully implementing mHealth (Berger-Grabner, 2016, p. 117). The following section depicts the data collection method applied for the qualitative research.

3.2 Data Collection Method

Qualitative data is often obtained by analyzing existing texts (text analysis) or texts generated by interviews (transcriptions). One speaks of conversation-analytical procedures in this case. When qualitative data is obtained by observing situations or processes (observational analysis) or by interpreting man-made objects (artefact analysis), one speaks of observational and artefact analysis (Berger-Grabner, 2016, p. 132). The conversation-analytical procedures are applied in this research. Conducting interviews is one of the most widely applied methods in empirical research. Qualitative

interviews are an oral and personal form of questioning that can take on various forms. The advantage over quantitative, standardized interviews is that qualitative interviews are much more open, create a familiar conversational atmosphere and can go into greater depth due to the comparably small sample (Berger-Grabner, 2016, p. 132). Different ways of conducting qualitative interviews are possible, which differ primarily by the degree of standardization of the questions and by whether interviews are held individually or in a group setting (Berger-Grabner, 2016, p. 133). The type of qualitative interview used for this thesis is a guideline interview which is part of the individual interviews. The guideline interview is a semi-structured method in which a previously created guideline is used. This guideline is based on a theoretical preliminary analysis of the research topic and enables comparability. The researcher can use specific questions from the guide, yet this type of interview leaves space for spontaneous statements and questions. A frequently used format is the expert interview, in which persons with extensive knowledge or experience in a specific field are represented. Here, the aim is to comprehensively reconstruct their knowledge and experience (Berger-Grabner, 2016, pp. 140–141). This format has been chosen because it is highly suitable for the purpose of this thesis, namely to fully understand the various success factors and barrier affecting the implementation of mHealth. It provides the possibility to interview experts of various backgrounds to obtain a holistic understanding of the factors facilitating or impeding the implementation. In so doing, general aspects of wording have to be considered for the guideline. Some of these are to not use misleading and only unambiguous questions or to not ask multiple questions or question alternatives. Simple choice of wording should be used and adapted to the interviewees' vocabulary and manner of speaking. Furthermore, questions should neither be closed, nor judgmental (Berger-Grabner, 2016, p. 142).

<u>Interview Guide</u>

The CFIR framework has been used to provide guidance for the creation of the questionnaire or guideline. The CFIR can assist in tailoring implementation strategies to alleviate hurdles and capitalize on facilitators after completing a context assessment, in addition to identifying barriers and facilitators to deploying an innovation. This approach can also be utilized to improve implementation procedures throughout the course of implementation (CFIR Research Team-Center for Clinical Management Research, 2023). The different domains and a description of constructs is provided in chapter 4, Results. Each of these domains contain different constructs. There are over 30 constructs in total, which are most likely not possible to cover all constructs in one study. As a result, evaluations might concentrate on a selection of CFIR constructs, which is

also the case for this study. The domains and constructs of the CFIR Framework have been chosen based on the challenges and success factors identified in the previous literature review (CFIR Research Team-Center for Clinical Management Research, 2023). The guide is developed based on the research question, the preliminary theoretical considerations and the state of the art in existing research. This content is covered by way of 19 questions. Prior to introducing the content regarding the constructs, an introductory question is asked concerning the experience and position of the interviewees. Thereafter, experts are asked questions regarding the constructs adaptability and cost within the innovation domain. For a better understanding of the next domain which is the outer setting, questions are asked regarding the constructs policies & laws, financing, partnerships, connections and local conditions. Experts have been asked questions about the construct structural characteristics to cover the inner setting domain. The next constructs are need and capability within the individuals domain. Lastly, regarding the implementation process domain, the constructs planning, engaging and implications for startups have been included. The construct implications for startups has been added to include an open question that identifies additional success factors and barriers that startups might be faced with and add a section for recommended actions. A description of constructs and domains is given in chapter 4. The interview guideline can be found in Appendix 3.

<u>Selection of Participants</u>

Sampling is not carried out according to criteria of statistical representation, as is the case with quantitative methods, but according to whether or not the participants are considered suitable for harboring knowledge about the object of investigation. Theoretical saturation occurs for this type of research after a certain number of persons participate, meaning that saturation occurs when no significant additional gain in knowledge is achieved by adding more persons (= theoretical sampling). The required sample size is generally much smaller than is the case with quantitative methods. One also speaks of typical representatives (Berger-Grabner, 2016, p. 117). 8 experts have been interviewed for this thesis in order to gain insights into the success factors and barriers for the implementation of mHealth in South Africa and Tanzania, making for a total of 4 experts for each country. The expert selection is based on the value of the relevant experiences of the professionals to close the identified research gaps. Hence, the participants possess expertise and experience in the field of mHealth in either South Africa or Tanzania. Key stakeholders, including professors of digital health, healthcare practitioners, policy makers and founders of mHealth applications were identified and invited to participate in the interviews. Here, the aim was to achieve a diverse

representation of viewpoints and experiences, enriching the data collected. A detailed overview of the interviewees is provided in Table 1 below.

Table 1: Interview Partner

Expert	Country	Background	Interview Date/Length
E1	ZA	Professor of physiology, Member of Department of eHealth, served in government committees, Professor of Telehealth	03/10/2023 / 01:14:52
E2	ZA	Professor of Community and Health Sciences, Chair of Digital Health, PhD in telepsychiatry	06/10/2023 / 01:02:56
E3	ZA	Member of Health Information Systems Program of South Africa	26/10/2023 / 01:02:20
E4	ZA	Background in biological sciences, clinical chemistry and later worked as toxicologist. Worked in eHealth since 1995	26/10/2023 / 00:57:45
E5	TZ	Degree in the field of digital technology connected to medicine, participated in developing mHealth applications	05/10/2023 / 01:22:37
E6	TZ	ICT Lecturer & Consultant, Digital Health Expert	06/10/2023 / 00:54:39
E7	TZ	Medical Doctor, working on AI based mHealth interventions	06/10/2023 / 01:00:15
E8	TZ	Degree of health information system with connection to mHealth	06/10/2023 / 01:07:14

<u>Preparing and Conducting Interviews</u>

Preliminary conversations via emails were conducted with all experts, so as to enhance the understanding of the individual backgrounds and improve the preparation for the interviews. Moreover, these dialogues were used to satisfy the demand for additional information from an organizational and formal viewpoint. Furthermore, the thematic

competence of the interviewer also should be emphasized as a necessary prerequisite for a successful expert interview. This prerequisite was met through the previous thorough literature review on the topic on mHealth as well as the analysis of the healthcare systems in South Africa and Tanzania. Doing so was helpful in following and steering conversations and to ask precise follow-up questions when appropriate. Therefore, one pretest was performed to test the structure and formulation of the prepared interview questions (Buber, 2007, p. 454). This pretest was conducted with a fellow student from the researcher's university. This person was born in Kenya and studied health informatics in her bachelor's degree in Kenya. The feedback from this discussion was valuable in improving the practical understanding and preparation for the expert interviews. Questions that were formulated in too complicated a manner were rephrased in a more comprehendible way.

The interviews were conducted as one-on-one conversations to discover individual opinions and motivations. Moreover, the researcher used an interview guide, due to the semi-structured format of the qualitative interviews, allowing the interviewee to respond freely without predefined answers and explore new directions during the interview. Each expert was asked to sign a consent form (Appendix 4) prior to the interview, indicating that they agreed to be recorded and that this study would use their insights, which all experts agreed to (Doody & Noonan, 2013, p. 30). Due to long distances to the locations of the experts, all interviews were conducted and recorded via Zoom, an online video communication provider (Zoom, 2023). All interviews were conducted in English, because it was the language shared by both the interviewer and the experts. The section below describes how the interviews were analyzed.

3.3   Data Analysis

Text analytic methods involve the systematic collection and evaluation of texts of all kinds. These can include, e.g., textbooks, magazines, newspapers, various advertisements, historical texts and more. Texts also arise from the aforementioned qualitative data collection method, as conducted interviews generate transcriptions that need to be analyzed (Berger-Grabner, 2016, p. 144). As is the case for other qualitative interviews, expert interviews are best analyzed by means of a qualitative content analysis (Berger-Grabner, 2016, p. 142). The transcripts from the interview with eight experts form the basis of this study. The following paragraph describes the guiding principles that went into creating these documents.

Transcription

Transcription is the process of converting spoken language into a written version that can be used as a foundation for further interpretation. The software Trint was used for the transcription of the interviews. Different systems are on offer than can be applied for the transcription, which provide rules and guidelines on how spoken words have to be transferred into a fixed form. These systems are (1) literal transcription, (2) commented transcription, (3) content analytical transcription. These systems differ in their degree of precision, of interpretation and amount of text. Literal transcription was chosen for this thesis due to its simplicity and preciseness. Applying literal transcription signifies that the common alphabet is used to render the dialect or colloquial language. Thus, the peculiarities of the spoken language as well as deviations from the standard language are maintained (Buber, 2007, p. 660). These initial interview transcripts were then validated by listening to the records once more, so as to guarantee that all transcription rules were correctly and consistently applied.

Qualitative Content Analysis According to Mayring

After the interviews were transcribed properly, the next step entailed a qualitative content analysis. In summary, a content analysis intends to analyze communication as well as fixated communication. In so doing, the procedure should be systematic, according to rules and led by theory with the objective to draw conclusions about certain aspects of communication (Mayring, 2022, p. 13). The construction of categories lies at the core of data analysis. Categories and potential subcategories are essential to ensuring comparability of results. Standardized procedures are avoided, as they should be tailored to the specific study. Therefore, methods and the category system must be tested and documented in a pilot study (Berger-Grabner, 2016, p. 145). In order to interpret the material, three basic forms of interpretation can be applied, namely summarizing, explaining and structuring. These basic forms of interpretation can also be combined into mixed methods. One type of these mixed methods is called thematic analysis. This approach is suitable for open research questions, which is the case for this thesis. Two approaches exist for the creation of main categories – a deductive top-down strategy, which provides first main categories meaning main topics, and secondly, the material being interpreted and reduced per topic. The inductive bottom-up strategy first establishes categories inductively and thereafter summarizes the material per category. The deductive top-down strategy is considered the most suitable for this thesis, in light of the fact that the CFIR framework provides the main categories and allows the material to be structured accordingly firstly. However, this in and of itself is not enough for the purpose of this thesis, whose aim is to have a deep dive into these categories

and distinguish subcategories that reveal specific success factors, barriers and strategies (Mayring, 2022, pp. 66–67). The process model of thematic analysis can be found in Figure 4 below. Both the deductive and inductive thematic analysis are displayed, whilst the gray-colored fields display the deductive top-down strategy used for this thesis.
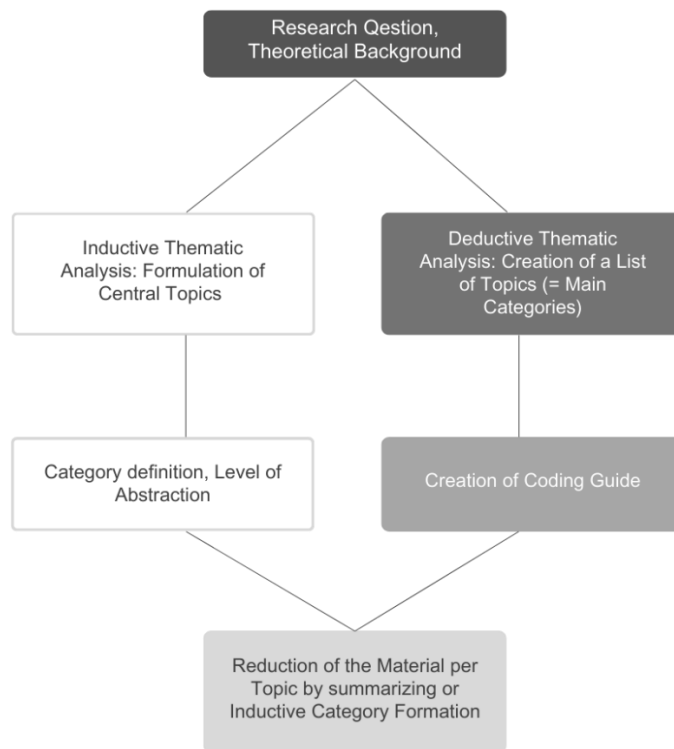

Figure 4: Process Model Thematic Analysis. Adapted from Mayring, (2022)

This process involves starting with pre-defined category definitions that are based on theoretical foundations, in this case the CFIR framework. Only constructions or main categories that are pertinent to the investigation are included from the CFIR framework, rather than all constructs. Furthermore, researchers are invited to stay open to new concepts that emerge from the data. These notions may enhance or improve the current CFIR constructs. As a result, completely new categories can be formulated (Albers et al., 2020). Constructs have been prechosen for the interviews based on literature review. However, these constructs were expanded by other constructs that could be identified during the interviews. Subsequently, the material is systematically reviewed and pertinent text segments are sought during the structuring of the content. When a text segment is identified that can be unequivocally coded, it is incorporated into the coding guide as an anchoring example. If an encountered text segment is not immediately clear in its categorization, an effort is made to render a decision and establish a boundary rule with regard to neighboring categories. Subsequently, this rule is integrated into the

coding guide. Gradually, the coding guide becomes more elucidate and comprehensive. Anchor examples and coding rules may not be necessary for categories that are self-evident and distinctly separable. Once the coding process stabilizes and no new coding rules are required, the time has come for a comprehensive review (Mayring, 2022, p. 97). After the structuring of content according to constructs of the CFIR framework, the material is reduced by way of summary or through inductive category formation (Albers et al., 2020). Here, the coding guideline can be found in Appendix 5. The software used for the qualitative content analysis is called MAXQDA. This software is specifically directed to the basics and techniques of the qualitative content analysis and thus, exceptionally applicable in this case (Mayring, 2022, p. 112).

3.4 Quality Criteria of the Research Process

In order to evaluate whether qualitative research has been conducted in a scientifically approved manner, basic quality criteria have been created that provide a benchmark for the quality of individual instruments and research design. Given that these criteria are met, a research concept can claim the status of a social-scientific research method; in other words, it can become widely accepted and relevant (Berger-Grabner, 2016, p. 129). Qualitative research places less emphasis on verifiability and replication, due to limited standardization. Instead, accurate documentation of the research process is important to foster traceability and assessment of the results (Berger-Grabner, 2016, pp. 129–130). The six quality criteria according to Mayring (2016) are explained below:

The quality criteria **argumentative interpretation** entails that interpretative assumptions should be justified argumentatively by the researcher. Therefore, both a theoretical background and a transparent argumentation need to be established. A theory-based interpretation is ensured through the profound literature review, which serves as a foundation for this research (chapter 2). Additionally, the interpretation continuously follows a transparent argumentation that is supported by direct and indirect quotations, providing argumentative interpretation proof (Mayring, 2016, p. 145).

The **criterion rule-based instruction** signifies that analysis must follow the previously defined rules. Simply put, the design must be clarified in terms of whether summary, explication or structuring is carried out, when planning the qualitative content analysis (Mayring, 2016, pp. 145–146). This criterion was achieved by clearly structuring the data analysis process into successive steps, shown in Figure 4 (Mayring, 2022, p. 97) and described in the methodology chapter. Additionally, a coding guide and the transcription and coding program MAXQDA2020 ensures transparency and traceability in the processing of the interviews.

Another criterion is the **proximity to the research object**. Therefore, a relationship of trust should be established with the respondent throughout the course of the research process, in order to minimize biases such as social desirability (Berger-Grabner, 2016, pp. 129–130). Furthermore, interviews should be held in a familiar environment and in a context that is relevant for the data collection (Mayring, 2016, p. 146). The interviews are conducted via Zoom, which provides a sense of well-being to the interviewees, due to their being located in a familiar environment. Moreover, the contact previous to the interview is a measure of creating trust.

A further criterion is **communicative validation**. Subjectivity might be an issue in qualitative studies, because much is based on the interpretation of the researcher. So as to prevent this, the collaboration with other researchers is recommendable, in order to review whether they would draw similar conclusions (Mayring, 2016, p. 147). This criterion could not be met due to time constraints.

Triangulation is another criterion which aims to minimize bias. Thus, different methods and data are used, in addition to interdisciplinary teams being employed. Method variation means using and adapting different methods during data collection. Data variation involves collecting data at various times, places and situations and from different participants. Interdisciplinary teams promote diverse perspectives and valuable complementations to discourse during the study (Berger-Grabner, 2016, pp. 129–130). Triangulation is fulfilled partly concerning the incorporation of diverse experts from different backgrounds with the topic mHealth. However, in light of the fact that the author of the entire study is one researcher, not all dimensions of triangulation are covered altogether.

The criterion **process documentation** implies that every step of the data evaluation must be documented. Qualitative content analysis typically starts with a transcription and ends with the chapter that discusses the results. Subsequently, the steps from the transcription to results should conform with the previously set rules and be documented (Mayring, 2016, pp. 146–147). This criterion is met, since all the steps have been documented in the methodology chapter of this study.

In summary, four of the six criteria are fulfilled completely in this study. The communicative validation and triangulation criteria are covered only partly. Therefore, the acceptance and relevance of this study can be assumed.

4   Results

This chapter presents the results of the study descriptively, prior to being discussed in chapter 8 by answering the research questions. The structure of this section is to give a description and summary of the constructs from the CFIR framework that could be identified from the previous literature review as well as from the interviews with the experts. The constructs identified in the literature review prior to the interview were expanded by adding new constructs mentioned by the experts during the interviews. These new constructs are Security, Design, Motivation and Innovation Evidence Base. The construct Needs have been merged with the construct Assessing of Needs, given that content was overlapping. Figure 5 below displays the five domains of the CFIR framework as well as the identified constructs. Each chapter will provide the summary of categories and subcategories entailing success factors, barriers and/or strategies to overcome said barriers.
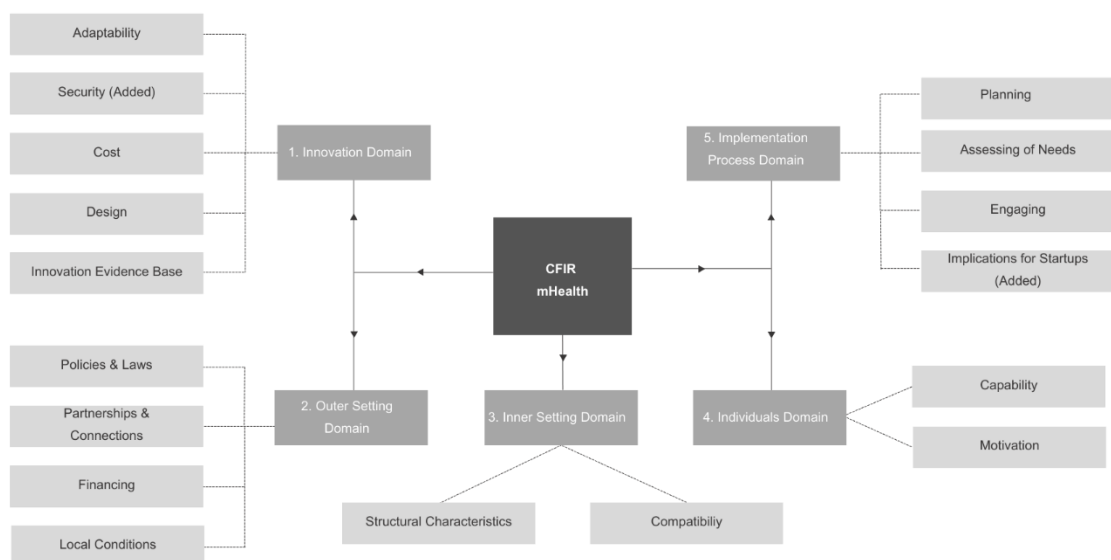
Figure 5: Relevant constructs for the implementation of mHealth. Own illustration based on CFIR (2022)

4.1   Domain 1: Innovation Domain

This domain thematizes the innovation being implemented, in this case mHealth. The constructs revealed by way of the literature and from the interviews are adaptability, cost, design and innovation base of the intervention (CFIR, 2022).

4.1.1   Construct Adaptability

The construct adaptability is defined as "The innovation can be modified, tailored, or refined to fit local context or needs" (CFIR, 2022). Adaptability, in the context of this study, refers to the ability of the mobile health solutions to adjust to and align with the

needs, preferences and constraints of diverse user populations and their specific contexts. Three subcategories could be identified which are described below.

4.1.1.1 Communication Tool

In summary, the interviewees from South Africa highlight the need for adaptability and flexibility with regard to communication tools within the mHealth context, as different users have varying preferences and access to technology. They should align with the daily preferences of users by, e.g., utilizing communication tools the user is already familiar with such as WhatsApp, SMS or social media. Additionally, the interviewees underscore the importance of personalization of these communication tools. In other words, users should be able to choose a communication tool based on their preferences and accessibility, e.g., voice messages or text messages and so on (Expert 2, 2023, Appendix 6.2). *"You have to really think about it and allow people to choose whatever mode is accessible for them to receive those messages."* (Expert 2, 2023, Appendix 6.2).

The experts in Tanzania have not specifically mentioned anything concerning the subconstruct communication tools.

4.1.1.2 Language and Culture

The interviews with South African experts have revealed the importance of considering linguistic diversity and cultural relevance when developing mHealth solutions (Expert 1, 2023, Appendix 6.1). Therefore, apps developed overseas will most likely fail, because of their inability to address local factors. This aspect can act as a barrier to the adoption and effectiveness of mHealth (Expert 2, 2023, Appendix 6.2). *"There is a cultural appropriateness of applications as well that can be a deterrent because if the application is not particularly developed and tailored for the population that they're supposed to serve, then people just lose interest in it as well."* (Expert 2, 2023, Appendix 6.2). A total of 12 official languages are spoken in South Africa and the people most in need, those living in rural area with limited access to education, may struggle to understand the concept of mHealth. Expert 1 gave the findings of a study that discovered that the term for telemedicine translated into the language of a rural community was lacking completely, making it exceptionally difficult to inform about mHealth. Furthermore, the cultural relevance of mHealth content is crucial (Expert 1, 2023, Appendix 6.1). For instance, an app developed in another country may encourage physical exercises that may not be applicable or culturally suitable for the local population (Expert 2, 2023, Appendix 6.2).

Similar to the South African experts, the interviews from Tanzania also stress the significance of considering the local context and cultural beliefs throughout the development of mHealth solutions in Tanzania. Some cultures may not even allow the usage of smartphones (Expert 8, 2023, Appendix 6.8). Another example made is that one intervention might provide education on safe sexual behavior, but communities might not support this due to religious beliefs. Therefore, the prioritization of culturally appropriate designs is crucial to enhance the adaptability and effectiveness of such interventions. Interviewees also mention the issue that applications developed overseas are not serving the local needs and therefore will not work (Expert 6, 2023, Appendix 6.6). *"We need a local solution for the local problem" (*Expert 7, 2023, Appendix 6.7).

4.1.1.3 Type of Mobile Device

In summary, these segments of the interviews with South African experts emphasize the need for mHealth developers to consider device accessibility, data costs and evolving technology when creating apps. Ensuring that mHealth solutions are compatible with a wide range of devices and user conditions is crucial for a successful implementation. Apps must align with what users are given and should not require them to buy a new device. According to expert 3, developers tend to develop advanced apps suitable for smartphones, yet as of now the reality is that the broad base of users cannot afford such a mobile device (Expert 3, 2023, Appendix 6.3). The applications might not function on these basic phones. Hence, developers should focus on developing apps that are adapted to the current settings (Expert 2, 2023, Appendix 6.2). However, they also mention bearing in mind adaptability to the future, e.g., through a version upgrade path based on the anticipated change. "*So there's a little bit of strategic thinking that needs to take place there because the devices users have in five years time are going to be different to the devices that they have now."* (Expert 3, 2023, Appendix 6.3).

The Tanzanian experts mentioned that a lot of people only have basic phones with limited connectivity with regard to the types of mobile devices. Therefore, the application must be able to provide offline solutions, in case the mobile phones lack access to internet (Expert 6, 2023, Appendix 6.6), in addition to being energy efficient (Expert 7, 2023, Appendix 6.7). Furthermore, "*there should not be more obstacles at the end of the day"* (Expert 7, 2023, Appendix 6.7).

4.1.2 Construct Security

This construct has been added, as it is mentioned by several experts and its importance was emphasized. Security, in the context of this thesis, refers to the measures and

considerations taken to safeguard the confidentiality, integrity and availability of health data and sensitive information within mobile health solutions. This includes addressing issues related to data privacy, informed consent ethical concerns, data hosting and secure access to mHealth applications.

The responses from South African experts underscore the critical importance of security, privacy, informed consent and ethical considerations in mHealth implementations (Expert 1, 2023, Appendix 6.1). These concerns need to be addressed to ensure the responsible and secure use of health data in the digital healthcare landscape. Another issue concerning this construct is that healthcare providers are already using their phones in practice, e.g., by sending images unofficially to each other or using WhatsApp for consulting which in theory is illegal but is happening anyways (Expert 3, 2023, Appendix 6.3). *"Now these concerns obviously around security issues and etc., But, you know, I always say to people as well, people are developing apps, people are just using WhatsApp anyways."* (Expert 2, 2023, Appendix 6.2). Expert 4 had a different opinion on this, he stated that people should care less about data and confidentiality issues (Expert 4, 2023, Appendix 6.4).

The input from the Tanzanian experts is very similar. They emphasize the importance of data privacy and security measures as well as a need for regular updates and challenges surrounding data security and privacy (Expert 8, 2023, Appendix 6.8). *"There is a patient consent and engagement like clear communication and like clearly communicating the benefits and the risk of using the mHealth apps to the patients... It needs a regular update"* (Expert 6, 2023, Appendix 6.6). Moreover, expert 6 mentions that this issue could be eased by not designing from scratch, but rather reusing and improving technologies that currently support privacy and security (Expert 6, 2023, Appendix 6.6). Additionally, as stated by expert 8, transparency through the communication of risks and benefits to users is crucial (Expert 8, 2023, Appendix 6.8). *"Privacy is a big challenge to us because there is not really clear information or a clear way on how you're going to protect your information "(*Expert 5, 2023, Appendix 6.5).

4.1.3 Construct Cost

The construct cost can be described in the following words: "The innovation purchase and operating costs are affordable" (CFIR, 2022). This construct deals with the costs that occur for the organizations in terms of developing, implementing and operating an mHealth intervention, alongside the costs for mHealth interventions' users, since cost is such a big barrier according to the literature and experts. Here, experts have also been asked for strategies for cost reduction.

4.1.3.1 Development and Post-Development Cost

The South African experts emphasize the cost barrier as a critical factor in the implementation of mHealth solutions, particularly when it comes to resource-constrained environments (Expert 3, 2023, Appendix 6.3). Developing and maintaining mHealth apps often requires a substantial amount of funding, which may not be readily available in resource-constrained settings. This poses a significant challenge for achieving broad-based adoption. *"And that is, I think why, you know, things like WhatsApp instead of a dedicated app has been more useful because…, the development of any applications are very, very, very expensive"* (Expert 2, 2023, Appendix 6.2).

The statements by Tanzanian experts also underscore the financial challenges related to mHealth implementation in their context, with an emphasis on development costs, funding sources, infrastructure, monitoring and user adoption costs (Expert 8, 2023, Appendix 6.8). These financial factors contribute to barriers in successfully implementing mHealth solutions in the region, in light of the fact that development costs are immense. *"Even we the developers we don't have money to do it. We have an idea but we don´t have money"* (Expert 5, 2023, Appendix 6.5). As a result, the search for funding is frequent. Yet this is a project-based endeavor and therefore funding stops after a certain timeline, with no plan on how to sustain it afterwards (Expert 6, 2023, Appendix 6.6). Furthermore, *"there are still costs for customization for tailoring them into the context that we talked about in terms of German context, Tanzania context"* (Expert 6, 2023, Appendix 6.6). The financial constraints also lead to the fact that *"even if you developed it, it won't be that much good compared to what you had in mind"* (Expert 5, 2023, Appendix 6.5).

4.1.3.2 Development and Post-Development Cost Reduction Strategies

The interviews with South African experts have revealed that developing complex mHealth interventions is highly expensive. Hence, one strategy to minimize these costs on the organizational level could be to develop a simple application which can be linked to other applications services already existent on the users' phone, e.g., SMS or WhatsApp (Expert 2, 2023, Appendix 6.2).

The strategies by the Tanzanian experts emphasize the importance of cost-effective approaches to mHealth implementation. The utilization of open-source solutions, community collaboration, government funding and user-centric development are highlighted as key strategies for reducing costs and ensuring the sustainability of mHealth initiatives (Expert 6, 2023, Appendix 6.6). *"I think one aspect as I've said is promoting the public digital goods so that it cuts down some costs in terms of initial*

development….communities of developers, where you can reuse and improve the existing one. This cuts down the cost, but also these pooling of funds where tools can be shared within the country other than having multiple systems for application" (Expert 6, 2023, Appendix 6.6).

4.1.3.3 Cost for Users

The interviews with South African experts provided insights regarding the challenges users in South Africa are faced with. Individuals have to cover the expenses for mobile devices, data and user subscriptions (Expert 4, 2023, Appendix 6.4). Mobile phones are largely purchased by patients themselves, and the cost of acquiring these devices can be a significant burden, which leads to the sharing of phones. *"So but the cost obviously is a major issue because if you don't have massive internet coverage, data is expensive….that you do, for example, get phone sharing that, you know, people might swap their sims in different phones, they exchange their phones"* (Expert 2, 2023, Appendix 6.2). Furthermore, the expense connected with data usage is a major concern, given that South Africa has one of the world's most expensive data environments (Expert 3, 2023, Appendix 6.3). The high proportion of monthly expendable income spent on data by low-income individuals highlights the financial strain for individuals, which often leads to sending SMS instead of WhatsApp (Expert 2, 2023, Appendix 6.2).

The cost for users of mHealth applications in Tanzania is elaborated by expert 6 in the following: *"In terms of daily use, users have to pay for data, bundles and all costs associated with accessing the system if it's not free and open source"* (Expert 6, 2023, Appendix 6.6). Some mHealth applications only require users to pay when they need a particular service or product, reducing the financial burden on the end-users, but a user subscription may need to be paid for some (Expert 6, 2023, Appendix 6.6). While the costs associated with using mHealth are lower than travelling to a health facility, affordability remains a challenge for many individuals, especially those with limited financial resources. *"Even though it is reduced. But it's not everyone. It's not every pregnant woman that can afford still the same cost"* (Expert 8, 2023, Appendix 6.8).

4.1.3.4 Cost Reduction Strategies for Users

The interviews with South African experts gave insights into possible cost reduction strategies that could be implemented on a regulatory level. While patients are responsible for purchasing their mobile phones, the provision of mHealth services should be funded through government resources, e.g., taxes and other means (Expert 4, 2023, Appendix 6.4). In terms of addressing affordability challenges, the government can play a crucial role by way of regulatory changes, including reducing data costs, particularly

for health apps with socioeconomic value, possibly through zero-rating. *"We need the highest level of regulatory change as well where incentives are created. And so I see it as very similar to a zero rating tax for certain food products.… So there's no VAT charge because they're regarded as, you know, basic requirements that poor people will need. And I think that similar kind of approach could be used in the regulatory space around health apps.… So tax free would be the real. Just a tiny improvement. But to ask big corporations to zero rate that I think would be a very easy thing for government to do"* (Expert 3, 2023, Appendix 6.3). Additionally, governments could legislate that some designated health apps should be free of charge, encouraging the corporate sector to find innovative financing mechanisms through their business models. Moreover, expert 3 mentions innovative approaches to financing mobile phones, citing the example of Rwanda, where the government initiated incentives for manufacturers and banks to collaborate to facilitate low-interest financing for specific mobile phones, driven by high-level vision and strategically led regulatory changes (Expert 3, 2023, Appendix 6.3). *"Some banks are starting to try and attract customers to their bank by saying that they will offer certain extra services like certain health guidance services at a zero-rated data where the bank covers the data costs"* (Expert 3, 2023, Appendix 6.3). This expert also emphasized that developers of mHealth applications should advocate organizations which could be interested in picking up these costs, such as insurance companies, banks and retailers. *"You know, a lot of different organizations trying to move into the digital space and trying to attract customers. So there are lots of different ways to find somebody to try and pick up these cost."* (Expert 3, 2023, Appendix 6.3). Furthermore, the goal is to match apps with users' already existing devices and the given data environments to minimize costs, especially for low-income users who spend a significant proportion of their income on data. Ultimately, the aim is to minimize the cost for the user as much as possible and thus ensure accessibility to health apps (Expert 3, 2023, Appendix 6.3).

The interview with experts from Tanzania yielded the following strategies: hybrid modalities, whereby, insurance payments are considered as potential financing methods. Some strategies involve offering freemium models to reduce costs for end users while developing and implementing mHealth interventions (Expert 8, 2023, Appendix 6.8). Here, the goal is to ensure that even individuals with limited financial resources can access some services free of charge, while premium services may be available for those who have the means to pay for them. *"We are trying to make sure that everyone, even someone who has no money to pay the service, can use some of*

the service will be free so as everyone can be able to do access it. But some of the service will be paid. That will be premium service" (Expert 5, 2023, Appendix 6.5).

4.1.4 Construct Design

The construct design can be explained in these words: "The innovation is well designed and packaged, including how it is assembled, bundled, and presented" (CFIR, 2022). Given the context of this thesis, it deals with the manner of design of the application in order to satisfy users. Two subconstructs could be identified which are described below.

4.1.4.1 Adaption and Integration

A topic that could be identified as relevant for the design of mHealth applications is adaption and integration. The interviews with South African experts stress the need to design mHealth apps that seamlessly fit into users' daily routines and technology environment, resulting in an increase in adoption and usability. Mobile technology offers various integration opportunities, such as utilizing location functionality, personal identifiers and other technical aspects already present on users' phones (Expert 3, 2023, Appendix 6.3). Furthermore, expert 2 emphasized the necessity to integrate mHealth applications with applications that end-users are already using on a daily basis. *"So when people go to their phones, it takes, I think, more effort to go to a separate application than it is to go to the applications that that you are using on a daily basis or people on a daily basis are using Facebook and WhatsApp and so that is what they use in preference to dedicated apps"* (Expert 2, 2023, Appendix 6.2).

Expert 6 from Tanzania mentions the importance of meeting users in spaces they are frequenting already, which could include popular social media platforms. Designing mHealth interventions that align with users' existing behavior can enhance the reach and effectiveness of such initiatives. *"Because some users may be using, for example, Facebook, Instagram and through the Facebook and Instagram, they are not specific mHealth application, but they also have health content where they can view for health education and the like"* (Expert 6, 2023, Appendix 6.6).

4.1.4.2 User-centered Design

The summary of the results from the interviews with South African experts concerning user-centered design is that usability is a critical factor, where simplicity and ease of use play a pivotal role. *"So, the first thing is that interventions need to be simple"* (Expert 1, 2023, Appendix 6.1). The success of mHealth solutions depends on the familiarity with the technology, minimal disruption of users' existing habits and a user-friendly interface.

Usability is tied directly to the simplicity and usefulness of mHealth tools, as overly complex applications with steep learning curves may deter user adoption and engagement (Expert 4, 2023, Appendix 6.4). mHealth necessitates the priority to offer straightforward interventions that require minimal changes and ensure that users can easily understand and benefit from these tools. *"In fact, ideally shouldn't change at all to be able to take on the assistance from the app. So that's the first thing, because people don't like to change, like to make adoptions. And when technology requires people to change, that's immediately a barrier"* (Expert 3, 2023, Appendix 6.3). With regard to the context of user-centered design within the mHealth domain, the common theme among the South African experts is the significance of addressing the actual needs and perspectives of the end users, particularly the patients or individuals in acute need of healthcare services (Expert 4, 2023, Appendix 6.4). According to expert 4, *"oftentimes we take it from the organization's perspective or the health care providers perspective, we're still not very good at taking it from a patient's perspective, although we often talk about"* (Expert 4, 2023, Appendix 6.4). Understanding and fulfilling their requirements and preferences are central aspects to the success and sustainability of mHealth solutions. Mobile health technologies should be designed in a way that aligns with users' existing relationships with their smartphones, highlighting user-centered and participative design approaches (Expert 3, 2023, Appendix 6.3).

The interviews with experts from Tanzania revealed a highly similar setting. In the words of expert 6: *"So the system has to be the perceived easy and easiness, user friendliness"* (Expert 6, 2023 Appendix 6.6). The experts also stress the importance of adapting a human-centered design approach for mHealth solutions (Expert 7, 2023, Appendix 6.7). Here, the goal is to ensure that the content is designed properly and presented well, so as to meet the specific health data needs of users. User satisfaction and acceptance are considered key factors in the success of said applications. Therefore, the focus lies with aligning technological aspects with user-centered design principles, in order to enhance the overall user experience (Expert 6, 2023, Appendix 6.6). *"If user designs are good, then the users will be satisfied and they will accept user needs"* (Expert 6, 2023, Appendix 6.6).

4.1.5 Construct Innovation Evidence Base

The following construct signifies that "the innovation has robust evidence supporting its effectiveness" (CFIR, 2022). The common theme among the interviewed experts from Africa related to "Innovation Evidence-Base" implies the importance of clinical evidence and research in the development and implementation of mHealth applications (Expert 1,

2023, Appendix 6.1). Several interviewees stress the need for rigorous research, to demonstrate not simply the general usefulness of mHealth apps, but also their specific clinical benefits and effectiveness (Expert 2, 2023, Appendix 6.2). Additionally, expert 3 voiced concern about the lack of evidence supporting mHealth interventions. *"A big aspect, which is a major failing in most mHealth apps is the fact that there is very little clinical evidence of trials"* (Expert 3, 2023, Appendix 6.3). In essence, the need for an evidence-based approach to mHealth is evident, especially when considering the applicability of these technologies to specific health worker categories. This could also address structural issues in healthcare (Expert 3, 2023, Appendix 6.3).

The interviews with experts from Tanzania did not reveal any concrete information for this construct.

4.2 Domain 2: Outer Setting

The following domain deals with the outer setting in which an intervention is being implemented and can be described as "the setting in which the Inner Setting exists, e.g., hospital system, school district, state" (CFIR, 2022).

4.2.1 Construct Policies & Laws

This construct entails information regarding legislation, regulations and recommendations, or accreditation standards that affect the delivery of the innovation (CFIR, 2022). The Construct Policies & Laws category encompasses findings in order to discuss the significance of government regulations, policies, legal frameworks and ethical considerations in the context of mHealth implementation.

4.2.1.1 Strategic Level

The interviews with South African experts revealed the importance of having a well-defined and comprehensive strategy whilst implementing mHealth initiatives. Emphasis is placed on a clear and effective strategy that is essential for guiding the use of technology in healthcare. This strategy should not be confused with tactics or roadmaps but should serve as a high-level plan that outlines where the prospective direction and motives of the healthcare system. This is not the case at present (Expert 4, 2023, Appendix 6.4). Expert 4 emphasized the necessity of a specific strategy for mHealth, stating specifically where mHealth is heading and why and then scaled to a lower-level roadmap and so on, with detailed steps on how to reach the established goal. *"We've got to understand what strategy is, and then we've got to have an mHealth strategy"* (Expert 4, 2023, Appendix 6.4). Expert 1 mentioned that South Africa has an eHealth

strategy, yet a policy is missing that enables *"legal and regulatory and ethical environment because we think right up that. In fact, doctors are naturally concerned about whether they will be held liable for doing something wrong"* (Expert 1, 2023, Appendix 6.1).

Expert 6 highlights that many governments, including Tanzania, have recognized the significance of digital health and mHealth as part of their digital health strategies. Nevertheless, potential challenges related to the effective implementation of these strategies continue to exist (Expert 6, 2023, Appendix 6.6). *"The challenge would be around how strong is the structure, how frequently they meet, how when an evaluation mechanism of governance, including the funding aspects and the structures are there. But operationalization may be evident with challenge"* (Expert 6, 2023, Appendix 6.6).

4.2.1.2 Policy Level

The common theme among the experts in South Africa is the following: *"Say they've got to step up to the plate and take responsibility and control"* (Expert 4, 2023, Appendix 6.4). The government has to intervene more extensively, by providing a policy that is not yet given (Expert 1, 2023, Appendix 6.1). Another suggestion by expert 3 was that the government requires a sustainability plan for mHealth interventions prior to being approved. It should not be compulsory per se, yet should be much like a quality certificate. This certificate would require a plan that, e.g., displays information concerning the distribution of funding to build the app, and information to ensure it is affordable for users in the long run (Expert 3, 2023, Appendix 6.3). *"The affordability for users should be a permanent plan. Whatever the approach is, it needs to be permanent. Then the grant funding is used to build the app to get it going, to get it up, and the sustainability has to be part of some other related plan that's in place from the beginning"* (Expert 3, 2023, Appendix 6.3).

The Tanzanian interviews primarily highlight the presence of a digital health policy and the incorporation of global standards into the national framework (Expert 7, 2023, Appendix 6.7). These aspects are considered essential for facilitating the successful implementation of mHealth applications and for ensuring alignment with international guidelines. *"Electronic government guidance standards that are put in place to ensure standardization of business processes and harmonization, business process engineering, while also applying this global standards into local settings or national settings like the SMART guidelines from the WHO. These are some of the policy that sets standards that can support the adoption"* (Expert 6, 2023, Appendix 6.6).

4.2.1.3 Regulatory Level

The interviews with experts from South Africa underscore the importance of government involvement in establishing clear regulatory frameworks, addressing the promotion of standards that ease some of the challenges for the implementation of mHealth, e.g., addressing data affordability, privacy concerns, record keeping (Expert 3, 2023, Appendix 6.3). According to expert 3, some promising developments are occurring, for instance FHIR (Fast Healthcare Interoperability Resources), which will help countries to adopt these standards. The latter should serve to improve the interoperability of applications and the POPI Act concerning the protection of personal information. However, more has to be done *"to help people who are uninformed about the importance of protecting their identity."* (Expert 3, 2023, Appendix 6.3). Expert 4 expresses frustration with the Health Professions Council of South Africa (HPCSA) and their lack of a regulatory common sense. *"I think there has to be greater awareness of those people who are making these decisions at the government or regulatory level about just what these tools are. And they have to give up and accept the fact that it's an inevitability. We're going to move in this direction whether we will like it or not"* (Expert 4, 2023, Appendix 6.4). The interviewees emphasize that the government must take more action in guiding the mHealth implementation and making it easier by way of regulations. *"Well, the first thing is that you have to have regulations. You need to have guidelines and ethics to both need to be very pragmatic"* (Expert 1, 2023, Appendix 6.1). Consequently, the experts proposed suggestions on how regulatory bodies can promote the responsible development and use of mHealth technologies. Expert 3 pointed out that the government should regulate data costs overall, in order to ensure affordability for end users using mHealth: *"I think there's a lot the government could do to regulate that and to create good reasons why the big data providers would zero rate certain health apps"* (Expert 3, 2023, Appendix 6.3). Furthermore, the government should encourage cross-sectoral collaboration for health application apps by way of providing incentives to investors, insurance companies and banks to collaborate with, e.g., technology firms so as to provide availability of cellular data and so on (Expert 3, 2023, Appendix 6.3).

According to the interview with expert 5 from Tanzania, a balanced approach in mHealth regulation is necessary that allows for innovation and progress; as of now, a lack of support lingers over the situation (Expert 5, 2023, Appendix 6.5). Expert 7 mentions that the mentality within the regulatory level is not encouraging, since there is punishment when something goes wrong, yet no reward to approve a mHealth application. Therefore, regulators harbor a reluctance. *"Like if you come with a new innovation mHealth intervention, it's very difficult for you to be endorsing in the system"* (Expert 7, 2023,

Appendix 6.7). Additionally, expert 5 mentions that *"It's one of the biggest challenges in regulatory compliance because of this the government systems which you need to pass before such implementing of mHealth"* (Expert 5, 2023, Appendix 6.5). The Tanzania Medical Devices Authority (TMDA), responsible for protecting and promoting public health, provides guidance, however one expert mentions that people developing mHealth are not consulting TMDA at an early enough stage, they do so only just before the registration, which often leads to non-approval (Expert 7, 2023, Appendix 6.7). Another challenge concerns *"the investment of medical devices and application, because they are currently not in the in the standard investment mechanism, but they are efforts to make sure this this is promoted"* (Expert 6, 2023, Appendix 6.6).

4.2.2 Construct Partnerships and Connections

This construct provides insights into networking activities with external entities (CFIR, 2022). Here, common forms of partnerships are described. Expert 1 from South Africa stresses the potential difficulty of a partnership in the private sector with the help of the example of NGOs setting up mHealth services or telemedicine services in hospitals, while local doctors do not make use of these services. *"NGOs have set up services with doctors coming from the states and actually working in the hospitals for a while and set up telemedicine services and local doctors seldom use them"* (Expert 1, 2023, Appendix 6.1). Expert 1 from South Africa highlights that they are always looking for private public partnerships within the state sector (Expert 1, 2023, Appendix 6.1). Expert 2 also refers to another approach for a strategic partnership other than receiving funding from the state: instead of developing a product for the state, what should be done is developing the specifications for the Department of Health and letting them expand on these specifications. Therefore, strategic partnerships with the state should align with state sector goals whilst implementing mHealth projects. This goes hand in hand with opportunities for scaling and impact, in addition to adapting to various priorities and timelines of the state sector (Expert 2, 2023, Appendix 6.2). "*So, they do their own development. So we to get anything integrated rather than just being a pilot, we have them involved as stakeholders, like right from the beginning and we have to tailor what we want to do in terms of their needs and their timelines so that what we're doing is helping them rather than doing an academic piece that is just sitting separately and is not being implemented"* (Expert 2, 2023, Appendix 6.2).

Expert 7 from Tanzania states that both the quality of the innovation and the ability to network and conjoin partnerships are essential for securing funding for digital health initiatives in Tanzania. Collaborative efforts and strategic connections within the digital

health community can significantly enhance the chances of success. Overseas partnerships that work on a similar solution can also benefit from collaborating with each other. *"Just to look for the people that are doing the same thing and you have this networking so that you can have that funding for your innovation"* (Expert 7, 2023, Appendix 6.7). The interviews for Tanzania also stressed the importance of responsible digital development, donor alignment with national priorities, regional collaboration and close cooperation with healthcare providers to foster the successful implementation of digital health initiatives in Tanzania. "*Work with health care providers to include mHealth solutions into their service and include the reimbursement options from issuer of the government program for mHealth services. Like you cooperate with these health providers because they're the ones who issue the mHealth solutions. So when you work closely to them and it helps these mHealth solutions to take place "*(Expert 8, 2023, Appendix 6.8). Prior to seeking a partnership, the organization must be fully committed to a strategy, with clear objectives and ideas on how to achieve these. Furthermore, partners that share similar goals, e.g., improving health services, will be more likely to collaborate and be willing to share risks and rewards (Expert 8, 2023, Appendix 6.8). Nevertheless, expert 5 mentions that the environment and infrastructure is not optimal, which makes it harder to find and form collaborations: *"we are developing an application maybe from our home, we don't have an office, so we don't have anything. So when we get to a partner, it's quite very hard to build a long term partnership because the infrastructure which you are, the environment is not supportive to trust you"* (Expert 5, 2023, Appendix 6.5).

4.2.3 Construct Financing

This construct deals with funding opportunities from external entities (CFIR, 2022). It provides information regarding the financing mechanism that affects mHealth interventions. The common problem in both Tanzania and South Africa with external funding is that the funding is terminated after a certain timeline. The aftermath of this is that the interventions tend to stop because of a lack of financial resources, infrastructure and processes (Expert 2, 2023, Appendix 6.2). According to expert 7, if the mHealth intervention seems promising, it is easier to attract funding (Expert 7, 2023, Appendix 6.7).

4.2.3.1 Government financing

One barrier emphasized by expert 4 concerns the need for a strategic shift in government financing toward mHealth implementation, advocating for a shift from extensive

investments in health informatics and interoperable electronic health records (EHR) toward mHealth and telemedicine. By redirecting financial resources to mHealth, healthcare accessibility can be substantially improved in South Africa, providing cost-effective means to deliver services to the general population. As of yet, funding mHealth is not functioning properly, due to the lack of a clear vision, policy and regulations in place as well as corruption which causes financial resources to be distributed unproductively (Expert 4, 2023, Appendix 6.4). It is also mentioned that, "*if mHealth is an accepted tool and we understand how it is to be used, where it's to be used and for what it's to be used, then it becomes natural to fund it, to sustain it. And so the government buys into it and so therefore is willing and able to put the funding necessary to maintain to sustain and grow scale these applications*" (Expert 4, 2023, Appendix 6.4).

Tanzanian mHealth interventions that are widely used are primarily initiated by governments or non-governmental organizations, typically funded through government budgets or grant sponsorships. *"There is research and innovation funds like government agencies and private organizations often provide funding and grants for mHealth interventions and innovations encouraging the development of new and improved solution"* (Expert 8, 2023, Appendix 6.8). Despite the presence of a ministry dedicated to health information and technology, a lack of substantial support prevails and poses challenges for young innovators in Tanzania, especially in the primary stages (Expert 7, 2023, Appendix 6.7).

4.2.3.2 Mixed Financing

Expert 4 from South Africa is skeptical about public-private partnerships, given that the expert detects a fundamental mismatch between the private sector's profit-driven motives and the public sector's focus on providing healthcare for the majority. *"You could say a strategic partnership between two such humanitarian organizations. They're going for one common goal. But how they want to get there and what they are willing to give up in order to achieve that differs and sometimes it comes down to dollars and cents. We don't want to spend our money there. We want to spend it here. So I'm still even sometimes questioning those kinds of ethical partnerships"* (Expert 4, 2023, Appendix 6.4). This being said, expert 2 mentions a personal experience with public-private partnerships, whereby a nonprofit organization provided housing for older people which was also supported by government grants. However, the challenge when working with NGOs entails the uptake and integration of the initiative into the public healthcare system, where initiatives actually have an impact because the public healthcare system improves 80% of the population in South Africa (Expert 2, 2023, Appendix 6.2).

Expert 6 emphasizes the importance of pooling funds and resources through different partners in Tanzania, so as to reduce costs and share tools and infrastructure for systems like mHealth initiatives. An example of such collaboration is the "unified community system," where different partners provide funding and support for the development and deployment of a certain system. These partnerships aim to leverage collective experience and resources, making it a sustainable approach to mHealth financing. *"Different partners come in and provide funding to deploy develop and deploy the system"* (Expert 6, 2023, Appendix 6.6). Moreover, it is also the case that private sector organizations come to sponsor health care providers to spread mHealth services (Expert 8, 2023, Appendix 6.8). However, expert 5 mentions that, despite their efforts to communicate with parties that provide funding, receiving support from private partners like telecommunication companies continues to be a challenge. Therefore, it should even be considered to seek partnerships and funding from organizations in SSA and overseas (Expert 5, 2023, Appendix 6.5). This being said, it must be kept in mind that, by the time funding stops, a business model must be in place that produces profits, otherwise the intervention will fail. *"So they have timelines like three year projects and then after that you don't have funding to scale up, funding to improve, funding to sustain"* (Expert 6, 2023, Appendix 6.6).

4.2.4 Construct Local Conditions

This construct deals with the "Economic, environmental, political, and/or technological conditions enable the outer Setting to support implementation and/or delivery of the innovation." (CFIR, 2022).

4.2.4.1 Ubiquity of Mobile Devices

Insights from the South African experts in the context of mHealth point toward the widespread availability and ease of use of mobile devices, particularly with regard to smartphones. These devices are distinguished in their familiarity and simplicity, reducing the need for extensive training (Expert 4, 2023, Appendix 6.4). *"They are becoming more common, shall I say, and more common for an unrelated reason or a reason unrelated to health. And I think that is one of their best features because people are becoming used to using them. There's going to be relatively little need for sophisticated training and introduction of people to technology"* (Expert 4, 2023, Appendix 6.4). Users typically carry their mobile phones with them, making them an integral part of daily usage. Yet while mobile devices are considered highly user-friendly and ubiquitous, mHealth apps tend to be viewed as complex and challenging to use. Improving the design of mHealth

apps to match the ubiquity and ease of use associated with mobile devices is essential for a successful implementation (Expert 3, 2023, Appendix 6.3). The experts also expressed that people's access to these devices differs, given that many individuals cannot afford smartphones or have limited access to sophisticated devices (Expert 2, 2023, Appendix 6.2). Hence, a significant number of people still has basic phones, which hinders the accessibility of mHealth services to the broader population, because applications might not be installable on basic phones. *"And that's largely to do with the types of phones that people have. So developers tend to like to develop apps for smartphones with a lot of sophistication, and those are wonderful and they can do amazing things. But your broad base of users tends to be people that don't have those funds. So that's your first obstacle to the smartphones are extraordinarily expensive"* (Expert 3, 2023, Appendix 6.3).

A similar situation can be found in Tanzania according to the interviewees, namely limited smartphone ownership and access to technology in rural areas being significant barriers. While a shift toward increasing smartphone usage is noticed, many people in Tanzania still do not own smartphones: *"so most of most of the people in in Tanzania, they don't have smartphones. They are not able to support google service even app store services. So it can become very challenging for us to implement mHealth services for them because they are using the they don't have a smartphone actually"* (Expert 5, 2023, Appendix 6.5).

4.2.4.2 Connectivity

According to the South African experts, connectivity continues to be a significant challenge for mHealth initiatives. Here, experts stress the high cost of data and limited access to affordable internet services (Expert 4, 2023, Appendix 6.4). The costliness of data creates barriers for users, particularly those from lower socioeconomic backgrounds, who may be reluctant to use data-intensive mHealth apps due to financial strain. *"So data is extremely expensive in South Africa. And that means there's a lot of resistance from users"* (Expert 3, 2023, Appendix 6.3). Especially rural areas, where access to healthcare services is even more difficult, frequently do not even have a phone signal (Expert 4, 2023, Appendix 6.4).

The situation relayed by the experts for Tanzania is comparable. Access to connectivity, particularly in rural and underserved areas, is identified as a significant barrier to the successful implementation of mHealth solutions in Tanzania (Expert 5, 2023, Appendix 6.5). Limited internet connectivity in some regions makes it difficult for people to access

and use mHealth applications that require an internet connection. *"They don't have a network. They don't have an internet connection"* (Expert 5, 2023, Appendix 6.5).

4.2.4.3 Economic Factors

According to the interviewees from South Africa, the economic situation of users is considered an additional barrier for the implementation of mHealth solutions: *"people have to bear in mind that in South Africa I think we're running at about 45% of our population is surviving under $1.90 a day. People are poor."* (Expert 1, 2023, Appendix 6.1). Additionally, a substantial proportion of the working-age population is unemployed. These economic challenges make it difficult for people, especially those living in rural areas, to afford or prioritize spending on healthcare services, including mHealth solutions (Expert 1, 2023, Appendix 6.1).

Economic factors in Tanzania also come with challenges for the implementation of mHealth according to the experts, as many individuals in the country have a limited income. *"In our country most of the people, the income is not much"* (Expert 5, 2023, Appendix 6.5).

4.3 Domain 3: Inner Setting

This domain can be defined as "The setting in which the innovation is implemented, e.g., hospital, school, city. There may be multiple Inner Settings and/or multiple levels within the Inner Setting, e.g., unit, classroom, team." (CFIR, 2022).

4.3.1 Construct Structural Characteristics

This construct looks at the structural characteristics within the healthcare system as well as the organization and leadership.

4.3.1.1 Healthcare System

The interview with South African expert 3 brought forth structural barriers that hinder integration of mHealth into the healthcare system. One of the issues is specified as the perception of mHealth as a separate entity, which creates a divide between traditional healthcare practices and mobile health technologies. The label mHealth implies something utterly separate from mainstream healthcare, which should not be the case per se. *"I think one of the problems mHealth is that it is defined as mHealth. I think that that somehow pushes it at arm's length. It's that if you're going to use a mobile phone or a mobile app, then it's an mHealth thing and it's somehow separate from everything else that gets done. So it's not well integrated"* (Expert 3, 2023, Appendix 6.3). Furthermore,

an additional barrier concerns the fact that once an mHealth application would be in place, *"then immediately they would try and find somebody with the title sort of mHealth official. They try and find somebody for me to put me to go have that conversation. But those people don't really exist"* (Expert 3, 2023, Appendix 6.3). Additionally, challenges related to the use of personal mobile devices in the workplace, commonly referred to as "bring your own device" (BYOD) policies, can lead to complexities when implementing mHealth solutions within healthcare institutions. A need prevails to address how personal mobile devices are managed and integrated into the healthcare workflow (Expert 3, 2023, Appendix 6.3).

The structural characteristics of mHealth in the Tanzanian healthcare system is characterized by several challenges related to infrastructure and organizational aspects (Expert 5, 2023, Appendix 6.5). One of the key issues concerns the existing infrastructure, which is not well-suited for accommodating new mHealth interventions. Convincing decision-makers to accept and integrate these solutions into the country's healthcare system often requires extensive efforts and persuasion. *"And so most of the time or most of the cases, we spend a lot of time in terms of like convincing the decision makers to accept that, to accept this, this kind of solution"* (Expert 7, 2023, Appendix 6.7). Another issue is the lack of harmonization of business processes, in other words, parallel workstreams that interfere with one another and issues related to data management and governance (Expert 6, 2023, Appendix 6.6).

4.3.1.2 Organizational Structure

This subconstruct delves into the organizational structure, thereby focusing on resources and interdisciplinary integration.

<u>Resources within the Organization</u>

The South African experts did not make mention of this topic.

The implementation of mHealth solutions in the Tanzanian context faces challenges primarily related to limited human capital with the necessary expertise, such as software development, engineering and data science. *"For the case of challenges, mine is in case of the human capital. The expertise to develop this is not that much promising"* (Expert 5, 2023, Appendix 6.5).

<u>Interdisciplinary Integration within the Organization</u>

Insights from the interviews with South African experts revealed the topic of a lack of transdisciplinary integration, particularly with regard to healthcare professionals and technology developers. Additionally, the issue of insufficient digital literacy among the

nursing workforce hinders effective communication and collaboration between these two essential domains. *"So I think that oftentimes there's not enough transdisciplinary integration"* (Expert 2, 2023, Appendix 6.2).

Expert 7 from Tanzania described a similar situation, with teams working in silos and the need for interdisciplinary integration. The interviewee stressed the challenges arising as a result of the separation of technical expertise from clinical knowledge, whereby solutions may be developed without adequately addressing clinical conditions. The need for collaboration between technical experts and clinical professionals is emphasized, thus bridging the gap between these two groups for more effective mHealth solutions (Expert 7, 2023, Appendix 6.7). Additionally, expert 7 mentioned the significance of breaking down silos and promoting teamwork among different stakeholders, including software engineers, medical doctors and investors, in order to advance mHealth interventions successfully: *"as IT specialist, medical doctors, we are in silos working on our solution. We don't really involve with patients on that matter "*(Expert 7, 2023, Appendix 6.7).

4.3.1.3 Leadership

Expert 4 from South Africa emphasizes leadership to be essential at all levels, be it national leadership, provincial health care systems or villages. "*And so the leadership goes all the way down, even perhaps to the village level where you have a village elder. If they don't want it to occur in their village, it ain't going to happen*" (Expert 4, 2023, Appendix 6.4). Additionally, expert 3 highlights the need for a structural approach to mHealth integration, as a result of which mHealth is made an integral part of job descriptions and responsibilities for healthcare professionals. This structural shift is crucial, so as to move from considering mHealth as a mere experiment to recognizing it as an essential tool in healthcare delivery. *"So we need to find a way to start integrating it and moving from mHealth being very experimental to using your mobile phone being a part of the job"* (Expert 3, 2023, Appendix 6.3). Another key strategy should prioritize educating and getting community healthcare workers involved with mHealth. "*But anyway, if we focus on those individuals because they're easier to access, more knowledgeable, then that will at least quickly, more quickly, I think, infiltrate mHealth into the psyche of both the healthcare workers and the patients*" (Expert 4, 2023, Appendix 6.4). As patients become more capable of accessing smartphones, community health workers can facilitate a smoother transition for them to utilize mobile health applications for their specific healthcare needs (Expert 4, 2023, Appendix 6.4). Here, CHW and nursers might need additional support: *"And again they in fact need support and they need the infrastructural support, and they may need technical support to bring forward*

the nature of the interventions" (Expert 1, 2023, Appendix 6.1). In other words, deep community involvement is essential for the government to take ownership. *"So you need to get the community to actually be wanting it and I've always said that the community should be saying to the government: If you don't give us telemedicine, we won't vote for you"* (Expert 1, 2023, Appendix 6.1).

Expert 8 from Tanzania highlighted the significance of leadership and visionary leadership within supportive organizational structures and cultures to foster the successful implementation of mHealth solutions. Leaders who recognize the potential of mHealth and who provide a clear vision of its implementation are more likely to succeed. Leadership is pivotal, because *"Most of places they're resistant to change. It depends it can be structural, it can be culture"* (Expert 8, 2023, Appendix 6.8). In some cultures, IT people are not valued sufficiently, in addition to training with mHealth tools not being provided (Expert 8, 2023, Appendix 6.8).

4.3.2 Construct Compatibility

This construct deals with the compatibility of the intervention with existing with workflows, systems and processes (CFIR, 2022). It encompasses the concept of interoperability and data integration, whereby mHealth technologies can communicate and share information with other healthcare systems and technologies.

4.3.2.1 Data Integration

Expert 2 in the South African context revealed that questions remain unanswered with regard to data integration in mHealth initiatives, particularly in terms of informed consent, record-keeping and sustainability. Here, one of the key issues discussed is the integration of text messages and patient data. As a result, questions arise about who is responsible for record-keeping and how to ensure the sustainability of these processes. The importance of resource availability and moderation in maintaining effective data integration is emphasized as well (Expert 2, 2023, Appendix 6.2). Overall, these segments make pertinent the complexity and resource-intensive nature of data integration within mHealth, emphasizing the need for sustainable solutions. *"It's not without its problems. The problem being informed consent and record keeping especially. And how do you integrate these text messages"* (Expert 1, 2023, Appendix 6.1).

Expert 6 from Tanzania also discussed the importance of data integration in mHealth initiatives and its potential to provide valuable data to stakeholders, particularly in terms of electronic medical records and decision support (Expert 6, 2023, Appendix 6.6). The

segments highlight the critical aspects related to data integration, e.g., its role in informing decision-making and improving patient care. *"For example, terms of usage of this system if its for electronic medical records for decision support, like as it provides indicators that will inform decision making"* (Expert 6, 2023, Appendix 6.6).

4.3.2.2 Interoperability

The experts in the South African context highlighted the challenges associated with interoperability in mHealth initiatives, specifically the difficulties in making electronic health records compatible and interoperable. Doing so requires significant efforts and investments. *"So we're spending our money, have been spending billions of dollars over the years on health informatics"* (Expert 4, 2023, Appendix 6.4). The interviews also touch upon the importance of adopting standards like FHIR (Fast Healthcare Interoperability Resources) to facilitate interoperability and streamline the development of mobile apps (Expert 3, 2023, Appendix 6.3). Additionally, the integration of mHealth into existing health systems and the need for interoperability with various information systems are raised as critical issues. *"mHealth in general is not well integrated into existing health systems, you know, because it's about the interoperability"* (Expert 2, 2023, Appendix 6.2). According to expert 2, the problem is that mHealth is "*sitting separate from the general health system and that the health promotion, that kind of work is not captured in the general kind of information systems and those that activity is not captured* "(Expert 2, 2023, Appendix 6.2).

The experts in the context of Tanzania also consider interoperability as a critical factor in mHealth initiatives. They emphasize a lack of interoperability among various mHealth systems and applications, hindering their effectiveness and integration into the healthcare sector (Expert 8, 2023, Appendix 6.8). The need for compatibility and interoperability between mHealth applications and other healthcare systems, such as electronic health records, is acknowledged as essential for streamlining information sharing and improving patient care. *"Like there's a lot of initiative around mHealth, but certainly most of them are not interoperable or like these systems they don´t communicate with each other. So if there would be interoperability all the way how people are working on this mHealth intervention that will be very much more appreciated"* (Expert 7, 2023, Appendix 6.7).

4.4 Domain 4: Individuals Domain

This domain deals with the characteristics of individuals that are going to or are using mHealth applications at present (CFIR, 2022).

4.4.1 Construct Capability

Capability refers to the interpersonal competence, knowledge, skills to using mHealth applications, therefore addressing digital literacy, among other domains.

According to expert 4, the COVID-19 pandemic pushed both healthcare workers and patients to familiarize themselves with and rely on mHealth solutions (Expert 4, 2023, Appendix 6.4). However, challenges related to digital literacy persist, especially among older individuals and those living in rural areas, but also in healthcare professionals such as nurses: "*So I think there's a big issue. I think that the workforce is not literate enough. I think the population is not literate enough*" (Expert 2, 2023, Appendix 6.2). Furthermore, expert 1 mentioned a study that revealed the following: *"Even though the Department of Health in our province stated we wanted telemedicine, the district managers had heard that somebody wanted telemedicine, they had no idea what that meant to them at all as to what they had to do. "(*Expert 1, 2023, Appendix 6.1). Expert 2 gave an example of what they had done to increase the usage of a mHealth application with older individuals who had been experiencing difficulties when using WhatsApp: *"But what we did with them was and this increased uptake is that we before we did the intervention […] We actually physically installed WhatsApp and in another project, Facebook on people's phones did some training with them, helped them connect with their family, you know, increase the usage of the application we want to use in general, and then hosted some projects on it"* (Expert 2, 2023, Appendix 6.2).

Experts in Tanzania highlighted a similar situation, where issues related to digital literacy persist, particularly in rural areas and among older individuals, referred to as "digital immigrants," who were born prior the digital technology age. These individuals may have difficulties using mobile phones beyond basic functions such as calling and texting (Expert 6, 2023, Appendix 6.6). However, among younger generations, referred to as "digital natives," who have grown up with digital devices, a higher level of digital literacy can be found. *"For the young generations a lot are trying. We get to know a lot of things"* (Expert 8, 2023, Appendix 6.8). In the context of strategies for mHealth adoption in Tanzania, comprehensive training and education programs for healthcare providers are essential to enhancing the comfort and competence in using mHealth solutions (Expert 8, 2023, Appendix 6.8). Lastly, the application should be designed in such a way that it requires minimum training: *"And there's guidance around to use even with minimum or without training, they can use it*" (Expert 6, 2023, Appendix 6.6).

4.4.2 Construct Motivation

Motivation signifies the commitment of individuals to fulfill the role, in this context the role being the attitude of users toward mHealth (CFIR, 2022).

The interviews with South African experts offered productive insights into the general attitude that users (both patients and healthcare providers) have with regard to mHealth. The general consensus contains various concerns and perspectives related to mHealth. These attitudes encompass a range of viewpoints, from questioning the need for privacy concerns to discussing the challenges associated with data costs, resistance among users coming from lower socioeconomic backgrounds and the unique challenges faced by individuals in rural areas when accessing healthcare with the help of mobile technology (Expert 3, 2023, Appendix 6.3). Not infrequently, the inhabitants of rural areas hardly receive any cell phone signal, have no means of charging their phones and do not want to make phone calls if this can be avoided (Expert 1, 2023, Appendix 6.1). These attitudes and considerations shed light on the complex landscape of mHealth adoption and signal the importance of addressing various attitudes and beliefs in the implementation of mobile health solutions. *"So this problem of confidentiality is an issue that has to be addressed somehow along the way. And I don't quite know how we do that, actually. I don't care. But other people do care. So what can we do about that? We're individuals "(*Expert 4, 2023, Appendix 6.4). Furthermore, the topic of mHealth goes hand in hand with the concern about additional workload for healthcare providers. During the COVID-19 pandemic, e.g., an initiative came into being using WhatsApp for appointment management, which resulted in a significant workload for healthcare providers and was the reason why it stopped as soon as possible. *"It's very resource intensive and so our work being done around chat bots to facilitate some of this activity…it requires a person to send those self-care messages to personalize it, to be useful and you know, and then you need to allocate somebody within a health service to do that"* (Expert 2, 2023, Appendix 6.2). The South African context reflects a significant informal use of digital tools for healthcare communication, such as WhatsApp, video conferencing, phoning, sending images, among health workers and with patients. *"But when sending a WhatsApp message is useful to the health worker. They do it without asking any questions, without asking any permission, and without asking anyone to pay for it. They just do it"* (Expert 3, 2023, Appendix 6.3). This would not be mHealth by definition per se, yet expert 3 would call it a mHealth success. In addition, insurance companies are effectively using mHealth to promote changes in behavior among users (Expert 1, 2023, Appendix 6.1). Furthermore, the overall adoption of mHealth interventions should be accompanied by change behavior theory that would ensure the

addressing of factors that could possibly hinder the change (Expert 2, 2023, Appendix 6.2).

The attitude toward mHealth adoption in Tanzania is a mixed perspective. People tend to be hesitant to embrace mHealth, due to a preference for traditional healthcare practices, mistrust in technology and concerns regarding the security and confidentiality of their health information. *"So most of the people here in our country, they are trying to use traditional ways in getting different health services. So when it comes to mHealth technology it is new for them so it's very hard for them to adapt"* (Expert 5, 2023, Appendix 6.5). Furthermore, a skepticism prevails that even if applications are offered for free, costs will arise at some point or other, which in turn leads to reluctance toward the application (Expert 5, 2023, Appendix 6.5). However, a recognition of a gradual shift in attitudes was mentioned, with increasing awareness and readiness among individuals and healthcare professionals to adapt to mHealth solutions. This trend could be promoted through education (Expert 7, 2023, Appendix 6.7). Additionally, resistance to mHealth adoption may be triggered by factors such as the fear of job displacement among healthcare professionals. *"They'll just tell you are trying to kill our job because they think maybe if you can use mHealth they're not getting paid through the application"* (Expert 5, 2023, Appendix 6.5). Despite this concern, according to Tanzanian experts, certain applications are gaining attraction and proving their effectiveness in addressing healthcare needs. Specifically, one application aims to connect people, including those in rural areas, with medical professionals by way of mHealth applications. Users have provided positive feedback and testimonials concerning the usefulness of these applications in accessing healthcare information and services (Expert 5, 2023, Appendix 6.5). Lastly, user-centered design plays a crucial role, addressing healthcare providers and end-users in the design and development of mHealth applications to ensure that the technology aligns with their given needs and preferences, in order to enhance the likelihood of adoption. Transparency regarding the collection, usage and sharing of patient data is emphasized to foster building trust among users and to address concerns and misconceptions (Expert 8, 2023, Appendix 6.8).

4.5 Domain 5: Process

This domain offers insights into "the activities and strategies used to implement the innovation" (CFIR, 2022).

4.5.1 Construct Planning

This construct is geared toward the following tasks: "Identify roles and responsibilities, outline specific steps and milestones, and define goals and measures for implementation success in advance" (CFIR, 2022). This thesis identifies two subconstructs that provide guidance within the planning phase, which are frameworks and the best practices.

4.5.1.1 Frameworks

Expert 1 from South Africa emphasized the significance of a comprehensive and well-informed approach to planning. According to the expert, several frameworks are in place for developing successful strategy, for assessing the e-readiness and so on. For example, a guide ensures the successful implementation of telemedicine by the WHO. Yet according to this expert, most interventions fail, given that these steps are not adhered to properly. "*So there's 17 steps of which planning for sustainability is a step. Turning the budget is a step. So because people don't follow well thought out and in fact researched methods, things fail*" (Expert 1, 2023, Appendix 6.1). Even if these guides are followed, *"you still have to be functioning within a government framework in terms of health policy, eHealth policy, strategies, etc.. And so those have to be brought together and in fact taken step by step to make certain that everything is in place to actually end up with a sustainable program"* (Expert 1, 2023, Appendix 6.1). If a framework is being used for development, it should be a user-centered development framework (Expert 2, 2023, Appendix 6.2). Nevertheless, expert 4 pointed out that merely adopting a framework or model is not a guarantee for successful implementation. Barriers and challenges can vary greatly, depending on the specific situation and location where an intervention is introduced. Therefore, circumventing oversimplification is essential throughout the planning process, alongside an openness to the possibility that additional issues may arise during implementation (Expert 4, 2023, Appendix 6.4).

The experts from Tanzania also stress the importance of careful planning and adherence to established principles when implementing digital health solutions. Here, the application of principles for digital development includes a set of guidelines for designing and implementing digital projects in a responsible way. It *"promotes designing with users so that you better understand their needs"* (Expert 6, 2023, Appendix 6.6).

4.5.1.2 Best Practices

The importance of adopting and fostering the best practices throughout the planning phase for implementing mHealth has been emphasized by the South African experts (Expert 3, 2023, Appendix 6.3). Expert 3 states that it is advised to avoid trying to

introduce entirely new approaches and instead focus on what is working sufficiently. This includes understanding the best practices in planning, implementation and especially sustainability (Expert 3, 2023, Appendix 6.3). *In other words: "Be very careful about trying to do something brand new and rather look at what's already working. Look at what people are already using out there"* (Expert 3, 2023, Appendix 6.3).

Moreover, expert 6 from Tanzania mentions that during the development phase especially, developers should aim to reuse and improve existing systems, rather than building from scratch, as is the case with digital public goods. *"Technologies that have been used everywhere, like not designing from scratch to reuse and improve these technologies"* (Expert 6, 2023, Appendix 6.6).

4.5.2 Construct Assessing Needs of Innovation Recipients

This construct focuses on collecting information about users' priorities, preferences and needs (CFIR, 2022). Three subconstructs could be identified which are described below.

4.5.2.1 Understanding User Needs

Understanding and addressing user needs when developing mHealth interventions is one of the essential success factors in South Africa (Expert 2,2023, Appendix 6.2), especially identifying the specific needs of patients and other users, focusing on what they need, rather than imposing solutions based solely on technological trends or abstract assumptions (Expert 4, 2023, Appendix 6.4): *"we're still not very good at taking it from a patient's perspective, although we often talk about this"* (Expert 4, 2023, Appendix 6.4). Successful mHealth applications are ones that directly address the needs and challenges users face, so as to make their daily lives easier and more efficient. It is important to "*build something that is targeting an exact need and then we build the solution with the user"* (Expert 3, 2023, Appendix 6.3). Also, engaging especially with users who may not be interested in technology initially is an essential strategy to gain insights into their unique needs and preferences, ultimately leading to more effective and user-centric solutions according to expert 3: *"but we choose the people that are excited about the technology anyway, and we should choose the people who are not interested in the technology…Those are the ones we should be speaking to"* (Expert 3, 2023, Appendix 6.3). Furthermore, another factor that has to be kept in mind when including users into the development process, namely whether they are part of the public or private health system: *" a nurse focus group in a private hospital with nurses and you'll have no relevant information for 80% of your nursing health workforce"* (Expert 2, 2023, Appendix 6.2).

With regard to understanding the needs of users, expert 7 in the context of Tanzania also mentions the importance of addressing patients' needs and actively involving end users, including healthcare providers and patients, in the development of mHealth interventions (Expert 7, 2023, Appendix 6.7). Demand-driven interventions should be prioritized that solve specific healthcare challenges and meet the users' requirements (Expert 6, 2023, Appendix 6.6). Not involving users in the planning and design phases can lead to solutions that do not adequately address their needs, in turn resulting in wasted resources (Expert 8, 2023, Appendix 6.8). Expert 7 mentions that, at the moment, most mHealth interventions "*don't actually address the patient needs*" (Expert 7, 2023, Appendix 6.7).

4.5.2.2 Adding Value

The importance of adding value to existing healthcare environments in South Africa when developing mobile health applications is another success factor (Expert 1, 2023, Appendix 6.1). Expert 3 puts it in these words: *"So I think it's about the most critical point is that you need to add value to people in their existing environment"* (Expert 3, 2023, Appendix 6.3). In order to successfully engage users, an app ought to provide a clear advantage and perceived benefit to both healthcare providers and patients (Expert 1, 2023, Appendix 6.1). According to the same expert, unnecessary changes should be avoided, yet given modifications, these should ultimately enhance the user experience and address their specific needs. *"So if there is a change, it better be a change that adds value"* (Expert 3, 2023, Appendix 6.3).

Additionally, expert 7 from Tanzania expressed the importance of placing the user at the center of mHealth solutions to ensure their relevance and impact. The goal should be ensuring that the solution is perceived as useful by the people who use it, while the reality is that "*it doesn't touch the people's life who are going to use them. So, I think that's the case for most of the solutions*" *(*Expert 7, 2023, Appendix 6.7).

4.5.2.3 Targeted Development

Expert 3 from South Africa, alongside other experts, mentioned that targeted development is a requirement with a thorough and realistic understanding of users' device limitations and capabilities, fostering the tailoring of app designs to work seamlessly on both smartphones and basic phones. *"So developers tend to like to develop apps for smartphones with a lot of sophistication, and those are wonderful and they can do amazing things. But your broad base of users tend to be people that don't have those funds*" *(*Expert 3, 2023, Appendix 6.3). Developers must identify their specific target audience, as a result of which the app ensures offering tangible benefits that align

with users' existing environments and needs (Expert 3, 2023, Appendix 6.3). Specifically, if high-end users are targeted, the amount of data is irrelevant; however, if poorer people are targeted, data amounts must be minimal without enforcing significant device or habit changes. *"So right from the beginning implementers need to be implementing the reality from the beginning"* (Expert 3, 2023, Appendix 6.3). The involvement of end users is pivotal throughout the development process, as it helps to gain insights into real-world constraints. *"They understand what users need, but they building apps for themselves. Yeah. Or they building for the, for the user that they imagine would love to use their app. So there's just this mismatch. They don't have an understanding of the real user and the real user constraints"* (Expert 3, 2023, Appendix 6.3). Furthermore, expert 2 confirmed a trend and prevalence of developing complex applications that surpass the digital literacy of users: *"I think that the technology has run away from the users"* (Expert 2, 2023, Appendix 6.2).

Successful development of mobile health solutions in Tanzania hinges on actively engaging end users throughout the process, fostering a sense of ownership and participation. Feedback mechanisms are crucial and developers should initiate dialogue with users. In so doing, solutions can be co-created that genuinely cater to their needs and preferences (Expert 7, 2023, Appendix 6.7). *"So involving them, that comes to the concept of humans centered design that are designed to involve them. When we were creating this kind of mHealth intervention we should have feedback from them, so let's involve them from the start"* (Expert 7, 2023, Appendix 6.7). Conducting pilot testing and trials makes possible concrete feedback, enabling refinement and optimization of interventions prior to a full-scale deployment, which potentially enhances the success of planning and development efforts in the country (Expert 8, 2023, Appendix 6.8).

4.5.3 Construct Engaging

This construct deals with the engagement between the organization and the stakeholder (CFIR, 2022).

Broadly speaking, expert 4 identified two groups of stakeholders: decision and policy makers who have to be on board and educated in terms of mHealth and, in the next step, the actual implementation: *"you can take it all the way down to the field, if you will which health care, which clinic are we going to put this in? Which village are we going to put this in? So even there, there's the necessity to identify the key and the key influential individuals, those key individuals who are going to be important if they're onside"* (Expert 4, 2023, Appendix 6.4). Once they are identified, keeping them involved during the whole process is essential, in addition to its being accompanied by change management

(Expert 1, 2023, Appendix 6.1). *"I think the something I think success factors is that you have to involve the stakeholders right from the beginning and that includes the users"* (Expert 2, 2023, Appendix 6.2).

According to expert 6 from Tanzania, the first step should be a mapping of stakeholders. "*So it all depends on where you are. And what is the structure of say the entity that is implemented or where the system is going to be used. So if you are in a district X you have your health governance structure. Those are the key stakeholders that you are going to involve, including the users*" (Expert 6, 2023, Appendix 6.6). The central focus should prioritize placing patients or clients at the center of said efforts. Clinicians are equally important, in light of the fact that their involvement builds trust among end-users and ensures the practicality of the solutions (Expert 7, 2023, Appendix 6.7). Beyond that, decision-makers, policy regulators, sponsors, funders and donors should be actively involved participants throughout the process. Their awareness and alignment with technological advancements and healthcare innovations are crucial (Expert 8, 2023, Appendix 6.8).

4.5.4 Construct Implications for Startups

This construct was added in order to provide startups with relevant recommendations to implement mHealth more effectively. A summary of the recommendations by interviewees in the context of South Africa is given below:

- **Answer a real need:** so as to effectively address healthcare needs and create value for users, organizations that are developing healthcare apps must challenge themselves to deeply understand user perspectives and behaviors, conduct thorough needs assessments based on actual end users, in addition to actively involving stakeholders and consumers throughout the development process (Expert 3, 2023, Appendix 6.3).
- **Provide a simple yet adaptable tool at low or no cost:** developers can minimize barriers and enhance app accessibility by providing simple, offline-capable tools that require minimal training and efficient data transfer processes with small data packets (Expert 4, 2023, Appendix 6.4).
- **Strategy**: developers should formulate a strategic plan that encompasses current user needs, while simultaneously considering the evolving nature of technology, aiming to release and regularly update the mobile app to stay up to date with users' changing aspirations and device capabilities (Expert 3, 2023, Appendix 6.3).

- **Stakeholder involvement:** engaging and informing policy decision makers is crucial, in addition to involving relevant stakeholders continuously from the start (Expert 2, 2023, Appendix 6.2).
- **Best practices:** focus on adding value to existing environments and understanding users better, rather than solely pursuing disruptive innovations, by plugging into what users already love and following known best practices based on insights (Expert 3, 2023, Appendix 6.3).
- **Privacy:** the handling of data in mHealth initiatives must adhere to ethical and legal standards, with considerations for data ownership, security and privacy (Expert 1, 2023, Appendix 6.1).
- **Evidence:** concrete evidence to substantiate your actions and claims is essential (Expert 3, 2023, Appendix 6.3).

The relevant aspects for startups in Tanzania according to the experts are:

- **Answering a real need:** developing mHealth solutions should prioritize addressing the actual needs of the people and the specific problems they face, taking into account the local context and user input (Expert 7, 2023, Appendix 6.7).
- **Provide a simple yet adaptable tool at low or no cost:** customized mHealth solutions should align with the specific needs and cultural preferences of the local population in a given area (Expert 8, 2023, Appendix 6.8).
- **Strategy:** the business model for mHealth interventions requires a clear definition, including payment methods, scalability, and sustainability strategies (Expert 6, 2023, Appendix 6.6).
- **Interdisciplinary teams**: building strong teams is pivotal for the entire process, be it ideation or implementation. Moreover, networking with local healthcare professionals and experts in a specific area can provide valuable insights and help identify requirements and challenges for mHealth solutions tailored to that region (Expert 8, 2023, Appendix 6.8).
- **Stakeholder involvement:** engaging with healthcare stakeholders, including providers, clinics and hospitals, provides understanding of the specific requirements and challenges for implementing mHealth solutions in a given society, in light of the fact that they have valuable insights from interacting with end users (Expert 8, 2023, Appendix 6.8).
- **Best practices & Privacy:** in order to enhance security and privacy, the focus should be placed on selecting, adapting and improving existing technologies, rather than designing entirely new solutions (Expert 6, 2023, Appendix 6.6).

- **Networking:** networking, seeking mentorship from those with detailed experience, and involving users in collaborative efforts (Expert 7, 2023, Appendix 6.7).
- **Understanding the ecosystem:** start-ups tend to lack a deep understanding of the existing healthcare ecosystem, thus the importance of comprehending local healthcare requirements and regulations for a successful mHealth implementation is stressed *(*Expert 6, 2023, Appendix 6.6).

4.6   Summary of Barriers, Success Factors and Strategies

The analysis of the various constructs derived from the expert interviews has led to the collection of several success factors, barriers and strategies on how to potentially overcome these barriers. An overview of the collected factors and strategies is provided in Figure 6 below. A further description and discussion of these is outlined in chapter 5, a discussion by way of answering the research questions. The figure displays the connection of barriers that can be conjoined into main barriers. Potential strategies are displayed in the center of the figure on how to overcome these barriers. Lastly, the right side displays the crucial success factors identified from interviews for the implementation of mHealth. Country-specific factors are indicated with the abbreviation of the country in brackets.
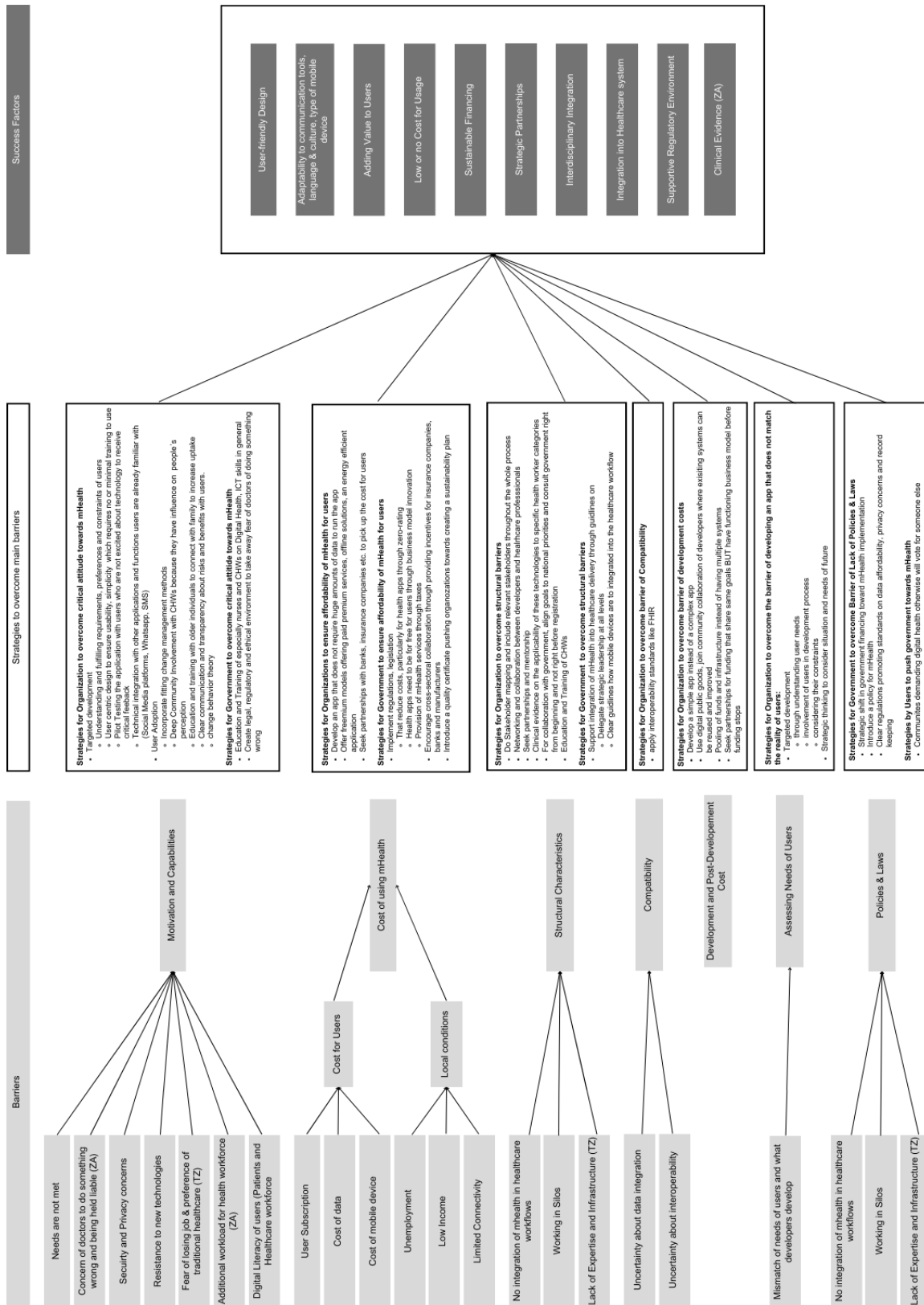
Figure 6: Success factors, barriers and strategies for the implementation of mHealth in South Africa and Tanzania

5 Discussion

The results of this study provide a comprehensive insight into the current state of the healthcare system, alongside success factors and barriers for the implementation of mHealth in both Tanzania and South Africa. In order to arrive at these results, firstly, the status quo of the healthcare sectors of Tanzania and South Africa was analyzed by using the WHO Building Blocks. The literature review revealed that the healthcare sector in both countries continues to face several challenges, such as limited access to healthcare especially in rural areas, a resource strained public sector, limited ICT personnel in the healthcare sector, difficulties with data management, affordability of healthcare services and limited connectivity among other influencing factors. The review of existing success factors and barriers for the implementation of mHealth in SSA in other empirical studies include the following success factors: collaboration, cost-effective technology, funding, adaptation to local contexts, policy support, political will, and a supportive regulatory environment (Ezezika et al., 2021, p. 1). Conversely, barriers include infrastructure limitations, equipment shortages, technology gaps, organizational and financial constraints, limited experience, the need for research and the importance of telemonitoring and evidence utilization (Kruse et al., 2019, 9). The purpose of this thesis was a distinct and in depth analysis of Tanzania and South Africa, by first analyzing the challenges in both healthcare systems and secondly, analyzing the specific success factors and barriers separately in both countries and comparing the results. In so doing, the research questions are answered below.

RQ2: What is the status quo of the healthcare system in South Africa and Tanzania?

The current state of the healthcare systems in South Africa and Tanzania comes with challenges and opportunities for improvement. Both countries face structural and distributional challenges, with a scarcity of healthcare facilities in rural areas, hindering access to medical care. This is the case particularly for Tanzania's predominantly rural population. South Africa's healthcare system is marked by a contrast between a well-performing private sector that caters to a limited portion of the population and an underfunded and resource-strained public sector. Conversely, Tanzania heavily relies on the private sector for the provision of health infrastructure and hospital services, without even considering this sector in the national health planning. In terms of overall healthcare system performance, South Africa outperforms Tanzania with a commendable score and better access metrics. At the same time, Tanzania struggles with low physician density rates, while South Africa meets international density thresholds for healthcare professionals. While both countries exhibit growth in various health workforce categories, the implementation of digital health faces obstacles, in light

of a limited computer literacy among clinicians. Efforts to enhance the digital health capacity are in place and proceeding in both nations. Comparably, Tanzania lags behind its counterparts with regard to the information systems, exhibiting significant deficiencies in data collection and management, indicative of a fragmented and limited data-use culture. In contrast, South Africa makes for a robust health information system with favorable assessment rankings. The supply chain management and medication availability pose challenges for both countries. Mobile connectivity, crucial for mHealth implementation, is more advanced in South Africa. All the while, affordability continues to be a concern in both nations, also leading to the fact that the prevalence of smartphones overall is rather low in both countries. Financing of healthcare in Tanzania predominantly relies on external funding sources, with high out-of-pocket expenses and limited access for many. South Africa heavily depends on government funding for public health services, yet is also dependent on out-of-pocket expenses, which is partially alleviated by private health insurance coverage for a small portion of the population. Their leadership and governance strategies differ, with South Africa taking a more advanced stance in scaling mHealth initiatives. Tanzania does not specifically mention mHealth, and instead emphasizes telemedicine with clear objectives, while South Africa's objectives lack a clear implementation plan.

The analysis for answering RQ1 built the foundation for responding to the following RQs, which revealed some challenges as well as opportunities for the implementation of mHealth that were highlighted during the interviews. The focus of this study is the factors that influence the implementation of mHealth. Hence, the main research question for this thesis is:

RQ1: What are the success factors and barriers for the implementation of mHealth in South Africa and Tanzania?

The crucial success factors that could be identified for **South Africa** within the innovation domain include the need for mobile health solutions to be **adaptable** in terms of its being matched to the local context, including the language, cultural appropriateness, personalization of communication tools to match it to the preferences, potential constraint of users and to the type of phone from basic phones to smartphones. Another success factor is the provision of a solution at **low or no cost**, so users can afford utilizing the service. A **user-friendly design** is another success factor that does not require the user to change or require training. **Adding value to the user,** by addressing actual needs from the perspective of users (healthcare provider and patient) is possibly the most significant success factor. Another success factor in South Africa entails having **clinical evidence** that proves the efficiency of mHealth. Success factors of the outer

setting would be to have a **favorable regulatory environment and policy** supporting the implementation and scale up of mHealth. An additional success factor is **strategic partnerships,** which also relates to the following success factor, **sustainable financing,** given that strategic partnerships can provide funding. A success factor in terms of the structural characteristics addressing the importance of **interdisciplinary teams between healthcare professionals and technology developers** and **integrating mHealth into the healthcare systems.** The crucial success factor throughout the implementation process domain is the **engagement and involvement of relevant stakeholders** during the entire process.

In order to gain a thorough understanding of the main barriers, these are divided into three groups, namely barriers on the user side, barriers on the organizational side and barriers on the governmental side. The main barriers for the implementation of mHealth related to users are, on the one hand, the **motivation and capabilities** for using mHealth and, on the other hand, the **cost related to using mHealth**. The barrier of motivation and capabilities is caused by users' several concerns. In terms of the practitioners' side, South African healthcare workforce is concerned of making mistakes while using mHealth and being held liable as a result, in addition to extra workload. Concerns about privacy and security that apply to both patients and users thematize that their needs are not met, the general resistance of change and using new technologies as well as low digital literacy of both patients and healthcare workforce. Additionally, the cost of using mHealth can be considered as another significant barrier. The latter is caused by the local conditions within the country, where the majority of the population is faced with high unemployment rates, low salaries and limited digital connectivity. Furthermore, in order to use mHealth, users would need to carry costs related to user subscriptions, the high cost of data, in addition to the cost of buying and maintaining a mobile device. The main barriers on behalf of the organization concerns the **mismatch of what users need and what developers develop.** Another barrier is the **high development and post-development costs** that organizations must carry in order to develop and maintain the application. The next major barrier evolves around **structural problems,** whereby mHealth is not integrated sufficiently into the healthcare sector and the developing organization is working in silos. Lastly**, compatibility** is a major obstacle, given that an uncertainty and no clear standards prevail regarding data integration and interoperability between mHealth and the healthcare system. In terms of the barriers on a governmental level, the **lack of guidance and involvement of the government** through regulations and polies should be mentioned.

Success factors for Tanzania also include the need for **adaptable** mobile health solutions that are tailored to the local context. Furthermore, offering an application **at no or low cost for the users** would increase the probability of having a successful mHealth application in Tanzania. A **user-friendly design** that aligns with user's current behavior, e.g., by being integrated into popular social media platforms, is another success factor. Furthermore, an additional success factor is to **add value** by meeting the needs of users. Success factors of the outer setting would be to have a **favorable regulatory environment and policy** that supports and fosters the implementation and scale up of mHealth. Another significant success factor addresses **strategic partnerships** with, e.g., regional collaborations as well as overseas. Additionally, the plan for **sustainable financing** is an additional success factor, instead of solely relying on temporary funding. A success factor connected to structural characteristics is the setting up of **interdisciplinary teams** between developers and healthcare providers and the **integration into the healthcare system**. The crucial success factor within the implementation process domain evolves around the **engagement and involvement of relevant stakeholders** during the whole process.

Taking a close look at the factors impeding the implementation of mHealth in Tanzania, the **motivation and capability of users** for utilizing mHealth make for the main barriers on the user level. This barrier is caused by the fact that digital literacy of both patients and healthcare providers tends to be low, which concurrently explains why the needs of users are not met properly. Furthermore, a preference for traditional healthcare services is prevalent in Tanzania as well a resistance to change due to new arising technologies. Moreover, users voice concerns regarding privacy and security of data. Additionally, healthcare professionals are concerned about job displacement and not being paid when offering mHealth services. Another main barrier on the user level is the **cost of mHealth**. Using the latter means paying for data, a mobile device and potentially a user subscription, all of which requires financial resources. Due to the local conditions of unemployment, low salaries and limited connectivity, this is oftentimes not possible. The barriers on an organizational level include the **mismatch of users' needs and which applications are developed** by the organizations, in addition to **significant development and post development costs.** Furthermore, **structural characteristics** are present that impede the implementation of mHealth, e.g., the fact that mHealth is not integrated in the healthcare system, that teams are working in silos and a lack of expertise in human capital and infrastructure in Tanzania to develop mHealth applications. An additional main barrier is **compatibility**, in light of the fact that, as of now, data integration and interoperability measures are not standardized, in turn

hindering the integration of mHealth into the healthcare system. Barriers on the governmental level are connected to policies and laws. Currently, a **lack of support through regulations** is noticed, in the way of innovation and progress because of a mentality of punishment instead of rewards.

After finding the country specific factors that affect the implementation of mHealth, the next step is the comparison of both results, covered by the following questions.

<u>RQ3: What are the differences between the success factors and barriers for the implementation of mHealth in South Africa and Tanzania?</u>

Comparing the success factors and barriers for the implementation of mHealth in South Africa and Tanzania reveals a very similar picture. Both countries face almost the same main barriers and crucial success factors. Only minor differences could be found, e.g., that Tanzania is struggling with finding the right expertise in human capital as well as the necessary to develop mHealth applications in the first place. Another difference deals with the fact that clinical evidence in South Africa is also considered a crucial success factor for the implementation of mHealth, especially for its integration in the healthcare system. Another slight difference is that, in South Africa, mHealth should not only be adaptable to the language and culture, as this is also the case for Tanzania, but should additionally be adaptable to the type of phone and the users' preferred communication tool. An additional difference occurs at the barrier of motivation to use mHealth. Both countries express similar concerns, yet the difference is that the concern in Tanzania is related to mistrust of users in technology, preferring traditional healthcare services, healthcare workforce fearing job displacement and not being paid for providing healthcare services through the means of mHealth. The concerns in the South African context evolve around additional workload that mHealth might cause for the healthcare workforce, in other words, who is going to take on additional workload. Lastly, healthcare workforce in South Africa is also worried about makes mistakes and being held liable for it, because legal and ethical measures taken to protect the healthcare personnel are not yet in place.

The identified main barriers for both countries are the motivation and capabilities for using mHealth, cost of mHealth for both users and the developing organization, not meeting the user's needs, structural barriers, compatibility as well as the lack of polices and laws. Experts were asked to provide strategies with regard to these barriers. In the context of this research question, a distinction between the countries will not be made, because the main barriers are identical and the strategies might be equally insightful for

organizations active in both countries. The results are covered by the next research question.

RQ4: How can the identified barriers potentially be overcome?

Strategies to overcome the barrier of motivation and capability of users:

What **organizations** developing mHealth can do to overcome this barrier is to conduct a specifically targeted development by involving the users into the development process, so as to understand the requirements, preferences and constraints of target group of users. User-centric design should be applied to ensure the usability and simplicity of using the app that requires minimal to no training. Additionally, pilot testing should be carried out with individuals who are generally not too fond of technology, in order to obtain critical feedback; if they can be convinced with the application, it is likely that others will be too. When developing the application, technical integration with other applications and functions that the user is already familiar with should be ensured, to make the application adaptable and increase uptake. Furthermore, another strategy that should be applied prioritizes user adoption. Organizations should incorporate effective change management methods to facilitate user adoption, have a deep community involvement with CHWs, given that these are the individuals who are more accessible and knowledgeable and can support a smoother transition to using mHealth services among the communities. Moreover, education and training are an essential strategy to increase uptake, alongside clear communication and transparency on benefits and risks with users to ease concerns. **Government** can prioritize the education and training of the healthcare workforce in terms of how to improve their ICT skills and create a legal, regulatory and ethical environment that alleviates the fear of doctors being held liable when something goes wrong whilst using mHealth.

Strategies to overcome the barrier of cost for users utilizing mHealth:

Strategies that can be applied by the **organization** include the development of an app that does not require huge bundles of data, so as to minimize data costs for users. Moreover, organizations should pitch innovative business models that take away the financial burden from users, e.g., by offering freemium models where premium services have to be paid whilst the rest is accessible free of charge. Offline solutions should be provided to tackle the challenge of limited connectivity as well as ensuring that the application is energy efficient. Another major strategy is seeking partnerships with banks, insurance companies and so on, in order to minimize the costs for users. Some banks are currently trying to attract new customers by covering the data costs for users related to certain apps. The **government** could encourage these cross-sectoral collaborations

between insurance companies, banks, manufacturers and investors to facilitate low-interest financing for mobile phones, tackle connectivity issues and making data affordable, e.g., by way of incentives. Another strategy is to creating regulations and legislations that reduce costs for users by zero-rating health apps. Also, a strategy could be to introduce a legislation forcing health apps to be free of charge and thereby encouraging innovative business models. Moreover, user subscriptions could be covered through taxes. Another suggestion is that government could require a sustainability plan for mHealth interventions prior to being approved. This should not be compulsory, yet a form of quality certificate that requires a plan that displays, e.g., information about the use of function during the building of the app, in addition to information that ensures its affordability for users long-term.

Strategies to overcome the barrier of developing an app that does not match the reality of users:

Developers often develop an application for the user they would like to have. However, the reality is different, which oftentimes leads to developers creating sophisticated, complex applications for a user who does not have the digital literacy, does not want to change and only uses a mobile phone, which leads to a mismatch. Here, for the **organization** include developing an application for the constraints, requirements and preferences of their user in reality, by applying user-centered design to understand and involve the user. This being said, the organization needs to keep in mind that the users might be at that point in a few years' time; in other words, they need to apply strategic thinking so the application can be upgradable in the future.

Strategies to overcome the barrier of high development and post-development costs for the developing organization:

The identified strategies by the **organization** for tackling the development costs are the development, firstly, of a simple application that meets the exact needs of users, rather than investing a lot of capital to create a complex application that users might be reluctant to use because of its constraining complexity. Another approach is to rely on open-source solutions, e.g., digital public goods and community collaboration of developers, whereby developers can reuse and improve existing systems for cost-effective development. Pooling funds and resources through different partners to reduce costs and share tools and infrastructure for systems like mHealth initiatives is crucial. One example is the unified community system, where different partners provide funding and support for the development and deployment of a given system. These partnerships aim to leverage collective experience and resources, making it a sustainable approach to

mHealth financing. Funding through partnerships with private sector organizations potentially even from overseas, with the government and NGOs is another strategy to finance the development. Nevertheless, funding is only project based and necessitates a functioning business model in place for the later stages.

Strategies to overcome structural barriers:

The strategies applied by the **organization** to overcome structural barriers such as working in silos and the lack of integration of mHealth into the healthcare system are firstly, to identify the relevant stakeholders and secondly, to include them in the entire process. A strategy to minimizing silos is to seek mentorship, carry out networking and collaborations between developers and healthcare professionals so as to merge their expertise and develop applications that have an impact. Additionally, providing clinical evidence concerning the effectiveness of mHealth as well as the applicability of these technologies to specific health worker categories can aid in integrating mHealth in the healthcare system. A strategy to optimize collaboration with the government entails involving them from the beginning and aligning respective goals with state sector goals whilst implementing mHealth projects. This provides opportunities for scale and impact, in addition to adapting to differing priorities and timelines of the state sector. Education and training is another key strategy, especially in getting community healthcare workers involved with mHealth. This should begin by including healthcare workforce into the development process. CHWs, e.g, are easier to access, more knowledgeable and can incorporate mHealth more easily into the daily life of both the healthcare workers and the patients. As the latter become more capable of accessing smartphones over time, the influence community health workers can facilitate a smooth transition for them to utilize mobile health applications for their specific healthcare needs. CHWs and nurses must also be provided with technical support, to foster the nature of the interventions in communities. Strategies that the **government** can apply includes delegating strategic leaderships at all levels from the national level to provincial healthcare systems down to villages. The support from the government to integrate mHealth into the healthcare delivery is paramount. Hence, clear guidelines must be put in place on how mobile devices are to be integrated into the healthcare workflow, starting with using mHealth as an integral part of job descriptions and responsibilities for healthcare professionals.

Strategies to overcome the barrier of compatibility:

A lot of uncertainty prevails about the data integration and interoperability between mHealth applications, with the healthcare system and so on. Strategies that can be applied by **organizations** entail the adoption of interoperability standards like FHIR to

ease data management. This will also ease the process of integrating mHealth into the healthcare systems.

Strategies to overcome the barrier of lack of policies and laws:

Another significant barrier is the unfavorable regulatory environment for mHealth. What the **government** should do is shift the focus of financial resources toward mHealth, so as to be able to provide proper funding for mHealth. It should intervene more, by providing a high-level strategy and guidance through the creation of a policy for establishing a legal, regulatory and ethical environment that is supportive of mHealth. A clear regulatory framework should be set up, in order to promote standards on data affordability, privacy concerns and record keeping.

Lastly, experts were asked what recommendations they would give to startups. These results are provided in the last question.

RQ5: What recommendations can be given to startups that want to introduce mHealth in South Africa and Tanzania?

As the recommendations are highly similar for both countries (detailed description can be found in chapter 4), recommendations account for both countries, unless indicated otherwise in the text. What is mentioned here is what the experts mentioned specifically as the most important takeaways for startups in both countries. The given recommendations respond to a real need and provide a simple yet adaptable tool at low or no cost, to have a clear strategy and a business model in place, interdisciplinary teams (only emphasized again by Tanzanian experts), continuous stakeholder involvement throughout the entire process, to follow best practices and development frameworks and ensure privacy and security concerns, to provide clinical evidence (only emphasized by South African experts), seeking mentorship (only highlighted by Tanzanian experts) and to fully comprehending the existing ecosystem (mentioned by Tanzanian experts). In following these recommendations, startups can increase their chances of successfully introducing mHealth solutions that cater to the specific needs and challenges of South Africa and Tanzania, while promoting accessibility, user trust and sustainability.

Theoretical Implications

The results of the expert interviews confirm the challenges discovered by analyzing the healthcare sectors as well as the results on success factors and barriers from previous empirical studies. All in all, the barriers that were identified in this study include the cost of using mHealth and a critical attitude towards mHealth among users, high development costs, the inability to properly assess and meet the needs of users, structural characteristics in the healthcare system and within the organization, uncertainties

regarding data integration and interoperability, a lack of policies and laws, in addition to limited network coverage and internet connectivity. The crucial success factors for the implementation of mHealth are simplicity, adaptability of the mHealth application at low or no cost for the user, while simultaneously adding value. Other success factors include sustainable financing, strategic partnerships as well as government support and compatibility for the integration of mHealth into the healthcare systems and continuously engaging with stakeholders. Several strategies could be identified during this study to potentially overcome these barriers, e.g., leveraging existing infrastructure, seeking partnerships with other organizations such as in the private sector and designing mobile health solutions that fulfil the requirements and preferences of users, creating a supportive regulatory environment, involving stakeholders throughout the entire process, among other factors. The strategies mentioned by the experts confirmed what could partly also be found by the analysis of the healthcare systems and added additional strategies. Specifically, the strategic interventions of the digital health strategy in South Africa actually cover a lot of the strategies that the government could apply which were also mentioned by the South African experts. For example, creating a national framework for digital health laws, policies and regulations or engaging stakeholders by way of collaboration and successful implementation (National Department of Health, 2019). In theory, the government knows what to do, yet it lacks action. Furthermore, the Tanzanian experts mentioned mostly the private sector with regard to finding strategic partnerships and solely mentioned a lack of support on behalf of the government. This also aligns with existing literature, because healthcare heavily relies on external donors and funding from the private sectors like FBOs (Africa Health Business, 2021).

<u>Practical Implications</u>

The practical implications resulting from this study outline pivotal success factors and impediments relevant to the implementation of mHealth initiatives in both South Africa and Tanzania. Additionally, the study provides strategies to minimize these barriers and delivers recommendations tailored to startups. These insights carry a significance for developers operating in both South Africa and Tanzania, providing a comprehensive overview of critical factors. Moreover, the study presents actionable strategies for practical implementation of mHealth, additionally rendering it pertinent to decision-makers. Collectively, these findings intend to facilitate the successful execution of mHealth projects, averting their stagnation at the pilot stage and subsequent failure. Lastly, the comparative analysis reveals that the disparities between the two countries are relatively modest, suggesting that the results may be applicable to other countries within the Sub-Saharan African region.

Discussion

<u>Limitations</u>

The analysis of the healthcare systems in Tanzania and South Africa through a literature review led to thorough insights into the healthcare systems in both countries regarding its challenges and opportunities. This provided information for RQ1 and was a promising base for conducting the expert interviews and comprehending their insights. The expert interviews provided information regarding RQ2-RQ4 and thereby of the specific success factors and barriers for the implementation of mHealth and strategies to potentially overcome some of the barriers. The insights from the expert interviews confirmed and complemented the previously discovered challenges of the healthcare system and the success factors and barriers for the implementation from other empirical studies. As a result, the research design is evaluated as appropriate for answering the research questions of this study. Yet the study is not void of limitations.

One restriction of this study is its limited opportunity of generalization. Since the findings are based on only four interviews for both countries, a generalization of the results should be treated with caution. The **second limitation** of this study concerns the collection of interview data. The selection of the expert groups and the individual interview partners may lead to biased results. The expert groups were aimed to ensure a wide coverage of different perspectives on mHealth in both South Africa and Tanzania. Thereby, the interviewed experts have a profound experience and relevant exposure to mHealth, an essential asset for gaining a comprehensive understanding of factors influencing implementation of mHealth. This being said, the interview process as a social interaction is susceptible to being influenced by the social and biographical backgrounds of the experts. The experts from South Africa have a background in the public health system, whereas most experts from Tanzania were medical doctors developing or being part of the development of mHealth. These two sides entail different perspectives and thus, this study gave mostly insight into the public sector and the strategies that can be applied by the government. The experts from Tanzania did not provide insights into such high-level strategies, which could be related to the fact that they adhere to developer side, where seeking private partnerships is prioritized. As a result, additional interviews with experts from different backgrounds might add further interesting answers to the research questions. A **third limitation** may be attributed to the potential biases in data interpretation. The subjective experiences of the researcher could lead to interpretation biases. Nevertheless, the nearly complete compliance with the quality criteria of Mayring (2016) moderates the data interpretation risk and thereby enhances the overall objectivity of this study.

6 Conclusion and Outlook

This thesis has analyzed the digital transformation of the healthcare sector in Africa, with a particular emphasis on the role of mHealth. Here, the primary aim was to analyze and compare the current state of healthcare systems in both countries, in addition to empirically investigating the success factors and barriers pertaining to the implementation of mHealth in both South Africa and Tanzania. In so doing, the aim of this thesis was to bridge the research gaps in these regions. The research methodology, which combined a literature review with expert interviews, has enabled the author to provide comprehensive insights into both the challenges and opportunities of the mHealth adoption in these African nations and the research questions could be answered.

The research concerning the success factors and barriers in South Africa and Tanzania revealed a range of factors critical to the successful implementation of mHealth. These include the simplicity, adaptability of the mHealth application at low or no cost for the user, while simultaneously adding value. Other success factors deal with sustainable financing, strategic partnerships as well as government support and compatibility for the integration of mHealth into the healthcare systems, in addition to continuously engaging with stakeholders. A country-specific success factor for South Africa is the clinical evidence accompanying mHealth implementation. Yet these opportunities are counterbalanced by significant barriers, ranging from challenges related to cost of using mHealth to a critical attitude towards mHealth among users, due to their motivation and capabilities, high development costs, the inability to properly assess and meet the needs of users, structural characteristics in the healthcare system and within the organization, uncertainties around data integration and interoperability, a lack of policies and laws, and lastly, limited network coverage and internet connectivity. This study's aim was to compare the factors that influence the implementation of mHealth in both countries. Nevertheless, significant differences could not be found between the success factors and barriers for the implementation of mHealth in both countries, nor with the success factors and barriers identified from the literature review for SSA. Some of the strategies that could be identified to overcome the main barriers in South Africa and Tanzania include education, training of healthcare personnel especially CHWs, stakeholder involvement right from the beginning, introducing regulations and standards set by the government, collaborations encouraged by the government to overcome barriers of affordability and connectivity and meeting the needs of user by way of user-centered design. The recommendations for startups provide an overview of the most important aspects to be considered when developing mHealth.

The critical review of the findings reveals several important insights. Firstly, despite some contextual differences, both South Africa and Tanzania face mostly analogous or at least comparable challenges and opportunities in the implementation of mHealth. This suggests that certain strategies to overcome main barriers may be broadly applicable across diverse African countries. This is confirmed by the literature regarding this topic, given that success factors and barriers for the implementation in SSA revealed a very similar picture among the countries. Secondly, research highlights the need for multifaceted approaches that involve collaboration among various stakeholders, including governments, developers, healthcare providers, communities and patients. It is evident that government intervention must be more substantial in facilitating the implementation of mHealth initiatives, especially for the integration of mHealth in the healthcare system. Simultaneously, developers should adopt a more user-centric approach, taking into account the current limitations faced by users. As of yet, this entails the creation of simple mHealth applications, prioritizing functionality over cutting-edge technologies, to ensure widespread adoption, given the prevailing constraints arising from limited user skills and tool availability.

Looking ahead, the outlook for mHealth in South Africa and Tanzania appears to be promising, driven in part by the accelerated adoption of digital health solutions during the COVID-19 pandemic. The study concludes that mHealth has the potential to significantly transform the healthcare sector in Africa, namely by addressing issues of accessibility, quality and affordability. All the while, substantial barriers must be addressed to unlock this potential, especially government support, a steadfast commitment to user-centered design and a forward-thinking approach are crucial prerequisites for success. Future research could build on and complement the findings of this study, by expanding the sample size of surveyed experts from different backgrounds, so as to gain a more comprehensive understanding of the landscape. Disparities were observed in the context of this research in the expertise and viewpoints of experts from South Africa and Tanzania. South African experts for this study primarily possess a public sector background, whereas their Tanzanian counterparts primarily have a developer community background. Subsequent investigations could achieve a more equitable distribution of expert participation, encompassing diverse sectors, thereby facilitating a comprehensive perspective on the implementation of mHealth initiatives. Additionally, exploring the role of private sector collaborations like with banks of telecommunication companies could provide paramount insights, given that the findings of this research mostly concern the perspective of developers and the public sector. Furthermore, this thesis focused on mHealth without specifying the target audience of mHealth

applications. Hence, it targeted the majority of population dealing with issues of affordability and digital literacy, yet the landscape may differ significantly for higher-income groups. Therefore, future research could distinguish between these user segments to provide tailored recommendations.

In conclusion, this thesis has provided valuable insights into the ongoing digital transformation of the healthcare sector in Africa, emphasizing the potential of mHealth to enhance especially service delivery. However, it simultaneously underscores the need for ongoing research and collaborative efforts to address existing and ongoing challenges in an effective manner. As the healthcare landscape continues to evolve, the lessons learned from this study can serve as a foundation for future endeavors that are aimed at leveraging technology to improve healthcare in Africa.

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Appendix

CV

List of Appendices

Appendix 1: WHO Building Blocks and Indicators

Building Block	Indicators
Service Delivery	Organizational Structure of health system
	Number & Distribution of health facilities
	Number & Distributions of hospital beds
	Health Service Index
Health Workforce	Number of Health Workforce per 1,000 population
	Distribution of Health Workforce per Category
	Annual Growth rate of Health Workforce per Category
	Digital Health Skills among Health Workforce
Health Information System	Overview of HIS
	SCORE Assessment
Access to medical products/technologies	Overview of Supply Chain for medicine
	GSMA mobile connectivity index
	Distribution of mobile devices per Category
	Availability of mHealth
Financing	Funding of Health systems
	General Government spending on health

	GDP spending on health
	Out-of-Pocket expenses
	Private and Public Health Insurance
Leadership/ Governance	National Digital Health Strategy
	Legislation impacting digital health

Appendix 2: Literature Review Summary Implementation mHealth SSA

Author	Framework	Objective	Findings / Success factors	Methodology
Ezezika et al. (2021)	CFIR Framework	Objective was to identify and assess the barriers and facilitators in the implementation and scaling of MomConnect from the perspectives of key implementers and partners.	Success factors are (1) strategic partnership and coordination across partner levels, (2) cost-effective technology and sustainable funding measures, (3) adequate adaptation of the innovation to local and national settings and (4) guiding mHealth policy and legislation frameworks.	Literature review and semi-structured interviews
Kruse et al. (2019)		Identify and synthesize barriers to the use of mHealth technologies in developing countries	To overcome the top three barriers (infrastructure, lack of equipment and technology gap) project leaders who wish to implement mHealth interventions must establish partnerships with local governments and nongovernmental organizations to secure funding, leadership, and the required infrastructure.	Systematic Reviews and Meta-Analyses
Aboye et al. (2023)		This study aimed to compare mHealth system availability and use in SSA and Europe in the above-mentioned context.	Most initiatives in SSA lack implementation depth, with only small-scale pilot tests or implementations.	A systematic narrative review

El Joueidi et al. (2021)	Stephani (2019)	Aranda-Jan et al. (2014)
CFIR	WHO Health System Building Blocks	SWOT analysis methodology
The objectives are: (1) to identify the facilitators and barriers to the implementation of WelTel in relation to scale up, and (2) to assess the experiences of using the mCFIR to collect and analyze data of focus group discussions, and to provide a guide for mHealth researchers how to use the mCFIR.	Aim is to assess the process of implementation and to identify the reasons for the lacking integration of mHealth interventions against NCDs in sub–Saharan African health systems.	What are the factors leading to successful implementation of mHealth projects? What are the factors limiting or challenging the implementation of mHealth projects? Why do these factors cause project failure or limit project implementation?
The thematic analysis produced the following themes: for areas of strengths, the themes brought up were timely diagnosis and response, cost-effectiveness, and user-friendliness. As for areas for improvement, the themes discussed were training, phone accessibility, stakeholder engagement, and literacy.	Inhibiting factors are the lack of specific action points by the governments, the lack of financial incentives and standardized workshops/guidelines and lack of good governance. The access to mobile phones is also inhibited by the poor electricity infrastructure. Enabling factors in many countries are numerous published eHealth strategies, constantly improving legislative frameworks and a growing technology.	Success factors are project design, technology and resources, stakeholder participation and involvement as well as integration to healthcare system Main barriers are related to coverage and accessibility, limited technical and expert knowledge, lack of secure funds for scaling up, potentially high set/up costs and unknown cost effectiveness, lack of evidence, a lack of guidance from Ministry of Health.
Qualitative and descriptive quantitative	Literature reviews and expert interviews	A systematic review of peer-reviewed literature

Article	Greve et al. (2022)	Hampshire et al. (2021)
Theoretical/Conceptual framework	Ground Theory	
Research questions/objectives	Identify response strategies that non-profit organizations (NPOs) can apply to overcome the barriers that hamper the sustainable use of mobile health (mHealth) interventions in low-resource environments (LREs), such as in Sub-Saharan Africa (SSA).	(1) What is the relative reach of 'formal' and 'informal' mHealth among community health-workers (CHWs) across the three countries? (2) How do CHWs use mobile phones informally in their work? (3) What are the perceived impacts of informal mHealth? (4) How are these practices and perceived impacts distributed,
Main findings	The collected data lead to a process model that identifies four aggregated categories of challenging areas that require response strategies (economy, environment, technology, and user acceptance).	Practical challenges, financial burdens and other threats to personal wellbeing; these appear to be borne disproportionately by the lowest-paid cadre of health-workers, especially those serving rural areas. Policymakers need to engage seriously with this emergent health system, and to work closely with those on the ground to address sources of inequity, without undermining existing good practice.
Used methods	Semi-structured interviews	large-scale questionnaire surveys, focus group discussions with CHWs

Appendix 3: Interview Guide

Construct of CFIR Framework	Questions
Personal	1. What is your position and background with mHealth and for how long have you been involved in this topic?
Innovation Domain	
Construct Adaptability	2. What specific features of mHealth interventions do you believe contribute to their potential success or challenge?
Construct Cost	3. What challenges related to cost arise for the implementation of mHealth and what strategies can be applied to succeed despite these challenges?
	4. Who is responsible for covering the costs related to using mHealth interventions?
	5. What strategies can be applied to ensure that patients can afford using mHealth?
Outer Setting Domain	
Construct Policies & Laws	6. What opportunities and challenges arise from the broader healthcare landscape for implementing mHealth solutions?
	7. How can regulatory and policy considerations be navigated to ensure compliance and smooth integration of mHealth?
Construct Financing	8. What strategies can be applied by organizations to achieve sustainable funding for mHealth?
Construct Partnerships & Connections	9. As seen from literature strategic partnerships are essential for the long-term success - How can organizations achieve this?
Construct Local Conditions	10. How do you perceive the overall climate for implementing mHealth solution I your country?
Inner Setting Domain	
Construct Structural Characteristics	11. What are the organizational structures and cultures within the healthcare systems that either support or hinder mHealth implementation?

Appendix

Individuals Domain	
Construct Need	12. Do you have information from participants (health workforce and patients) regarding their experiences with mHealth?
Construct Capability	13. What barriers will the individuals served by the organization be faced with to participate in the intervention and how could they potentially be overcome?
	14. How do you perceive the readiness of healthcare professionals and end-users in your country to adopt and use mHealth technologies in their practices?
	15. What strategies are there that can be employed to ensure that healthcare providers and end-users are receptive to and comfortable with using mHealth solutions?
Implementation Process Domain	
Construct Planning	16. What are the success factors and barriers in the phase of planning and developing mHealth interventions in your country?
Construct Engaging	17. Who are the key influential individuals to get on board with this implementation and how should these influential individuals be dealt with?
Construct Implications for Startups	18. Based on your insights, what are the key takeaways or recommendations you would provide to startups looking to implement mHealth solutions in our country?

Appendix 4: Consent Form

HNU
Hochschule Neu-Ulm
University of Applied Sciences

Participant Consent Form

Expert interview "What success and failure factors can be identified for the implementation of mHealth applications in South Africa and Tanzania?"

I _____, agree to participate in the research project titled "mHealth as an accelerator of the digitization of the healthcare sector in Africa - A comparison of the success and failure factors for the implementation of mHealth in South Africa and Tanzania" conducted by Sandra Blessing, who has discussed the research project with me.

I have had the opportunity to ask questions about this research and I have received satisfactory answers. I understand the general purposes, risks and methods of this research.

I consent to participate in the research project and the following has been explained to me:

- the research may not be of direct benefit to me
- my participation is completely voluntary
- my right to withdraw from the study at any time without any implications to me
- the risks including any possible inconvenience, discomfort or harm as a consequence of my participation in the research project
- the steps that have been taken to minimise any possible risks
- public liability insurance arrangements
- what I am expected and required to do
- whom I should contact for any complaints with the research or the conduct of the research
- I am able to request a copy of the research findings and reports
- security and confidentiality of my personal information.

In addition, I consent to:
- collection and storage of my socio-demographic data though an anonymized online-survey
- publication of results from this study on the condition that my identity will not be revealed.
- the interview being audio-recorded and transcribed.

Name: _____

Signature: _____

Date: _____

Contact details:
Sandra Blessing, M.Sc.
Neu-Ulm University of Applied Sciences
sandra.blessing@student.hnu.de

Appendix 5: Coding Guideline

Innovation Domain				
Code	Construct	Subconstruct	Definition	Anchor Example
1.1	Adaptability	Communication Tool	The innovation can be adapted to preferred communication tools	"You have to really think about it and allow people to choose whatever mode is accessible for them to receive those messages."
1.2		Language & Culture	The innovation can be modified, tailored, or refined to fit local context or needs.	"We need a local solution for the local problem."
1.3		Mobile Device	The innovation is adaptable to different types of mobile devise.	"So there's a little bit of strategic thinking that needs to take place there because the devices users have in five years' time are going to be different to the devices that they have now."
2	Security (added)		The innovation has adequate security and privacy measures.	"Privacy is a big challenge to us because there is not really clear information or a clear way on how you're going to

				protect your information."
3.1		Development and Post-Development Cost	The total costs carried by the developing organization related to the innovation	"There are still costs for customization for tailoring them into the context that we talked about in terms of German context, Tanzania context. "
3.2	Cost	Development and Post-Development Cost reduction strategies	The strategies that can be applied to reduce the total cost of the innovation.	"I think one aspect as I've said is promoting the public digital goods so that it cuts down some costs in terms of initial development. "
3.3		Cost for Users	The costs that have to be carried by the users to use the innovation.	"So but the cost obviously is a major issue because if you don't have massive internet coverage, data is expensive. "
3.4		Cost reduction strategies for users	The strategies that can be applied to reduce the costs for the user to use the innovation.	"So tax free would be the real. Just a tiny improvement. But to ask big corporations to zero rate that I think would be a

				very easy thing for government to do."
4.1	Design	Adaption & Integration	The design of the innovation fits seamlessly into the daily routines of the user.	"So when people go to their phones, it takes, I think, more effort to go to a separate application than it is to go to the applications that that you are using on a daily basis or people on a daily basis are using Facebook and WhatsApp and so that is what they use in preference to dedicated apps."
4.2		User-centered Design	The design of the innovation focuses on the users and their needs and provides usability.	"So the system has to be the perceived easy and easiness, user friendliness."
5	Innovation evidence base		The innovation has robust evidence supporting its effectiveness.	"A big aspect, which is a major failing in most mHealth apps is the fact that there is very little clinical evidence of trials."
Outer Setting				
6.1	Policies & Laws	Strategic level	The interference of the government on a strategic	"We've got to understand what strategy is, and

			level concerning mHealth.	then we've got to have an mHealth strategy."
6.2		Policy Level	The interference of the government on a policy level concerning mHealth.	"We have a strategy but that necessarily mean that we have a policy. "
6.3		Regulatory Level	The interference of the government on a regulatory level concerning mHealth.	"I think there has to be greater awareness of those people who are making these decisions at the government or regulatory level about just what these tools are. "
7	Partnerships & Connections		The common forms of partnerships organizations can build.	"NGOs have set up services with doctors coming from the states and actually working in the hospitals for a while and set up telemedicine services and local doctors seldom use them."
8.1	Financing	Government financing	The financing mechanisms of the government for mHealth.	"And so the government buys into it and so therefore is willing and able to put the funding necessary

				to maintain to sustain and grow scale these applications."
8.2		Mixed financing	The financing mechanism of a combination of partners for mHealth.	"Different partners come in and provide funding to deploy develop and deploy the system"
9.1	Local conditions	Ubiquity of mobile devices	The spread of mobile devices among the population in the focused countries.	"They are becoming more common, shall I say, and more common for an unrelated reason or a reason unrelated to health. And I think that is one of their best features because people are becoming used to using them. There's going to be relatively little need for sophisticated training and introduction of people to technology."
9.2		Connectivity	The state of connectivity in the focused countries.	"They don´t have a network. They don't have an

				internet connection."
9.3		Economic Factors	The economic situation of users.	"People have to bear in mind that in South Africa I think we're running at about 45% of our population is surviving under $1.90 a day. People are poor."
Inner Setting				
10.1	Structural Characteristics	Healthcare system	The structural characteristics of mHealth within the healthcare system.	"I think one of the problems mHealth is that it is defined as mHealth. I think that that somehow pushes it at arm's length. It's that if you're going to use a mobile phone or a mobile app, then it's an mHealth thing and it's somehow separate from everything else that gets done. So it's not well integrated"
10.2.1		Organizational Structure - Resources	The resources available for organizations in the field of mHealth.	"For the case of challenges, mine is in case of the human capital. The expertise to develop this is not

				that much promising."
10.2.2		Organizational Structure – Interdisciplinary Integration	The structural characteristics within an organization.	"So I think that oftentimes there's not enough transdisciplinary integration."
10.3		Leadership	The necessary leadership of mHealth within the healthcare system.	"And so the leadership goes all the way down, even perhaps to the village level where you have a village elder. If they don't want it to occur in their village, it ain't going to happen."
11.1	Compatibility	Data Integration	The data management of mHealth.	"It's not without its problems. The problem being informed consent and record keeping especially. And how do you integrate these text messages."
11.2		Interoperability	The innovation fits with workflows, systems, and processes	"mHealth in general is not well integrated into existing health systems, you know, because it's about the interoperability."

Individuals Domain				
12.1	Capability		The level of digital literacy and knowledge to use mHealth.	"So I think there's a big issue. I think that the workforce is not literate enough. I think the population is not literate enough."
12.2	Motivation		The individual(s) is committed to fulfilling Role e.g. general attitude of users towards mHealth.	"So most of the people here in our country, they are trying to use traditional ways in getting different health services. So when it comes to mHealth technology it is new for them so it's very hard for them to adapt."
Implementation Process Domain				
13.1	Planning	Frameworks	The use of frameworks for the planning phase.	"So there's 17 steps of which planning for sustainability is a step. Turning the budget is a step. So because people don't follow well thought out and in fact researched methods, things fail."

13.2		Best Practices	The use of best practices for the planning phase.	"Be very careful about trying to do something brand new and rather look at what's already working. Look at what people are already using out there. "
14.1	Assessing Needs of Innovation Recipients	Understanding user needs	The needs of users are understood and addressed.	"We're still not very good at taking it from a patient's perspective, although we often talk about this."
14.2		Adding value	The innovation provides value to the user.	"So I think it's about the most critical point is that you need to add value to people in their existing environment."
14.3		Targeted Development	The innovation is tailored specifically to the needs and restrictions of users.	"So developers tend to like to develop apps for smartphones with a lot of sophistication, and those are wonderful and they can do amazing things. But your broad base of users tend to be

				people that don't have those funds.
15	Engaging		The organization is encouraging participation in implementation.	"So if you are in a district X you have your health governance structure. Those are the key stakeholders that you are going to involve, including the users."
16	Implications for Startups (Added)		The recommendations that startups should follow when implementing mHealth.	"In most cases, the start-ups do not have in-depth understanding of the existing ecosystem. They may be coming out with an App that is not relevant to the context because these already establish similar service standards in there."

Appendix 6: Transcription of Interviews

Appendix 6.1: Interview Expert 1

I [00:07:30] Okay. Yeah, but I think we have the same understanding. Well, thank you very much for taking the time. I really appreciate it a lot. And so before we get into the content questions, I wanted to ask you what exactly your position is and your background with mHealth, how and for how long you have been already involved in mHealth?

E1[00:09:25] I am in fact, I'm retired. I'm a doctor trained in surgery and vascular surgery, but I actually stopped full time practice a long time ago and I got involved in benchtop science. I was very involved in injuries to infect skeletal muscle and determining and what a liberal one can one or two amputate limbs in patients with vascular disease. I became the fact I became the professor of physiology back in 2000. And then they started the Department of E-health for me, and so I became the first one and I retired at the end of 2020. I was involved in computing in medicine as far back as 1985. And we wrote interactive and educational software before the World Wide Web came into existence and I've served on a number of government committees, etc. over the years. And in fact, ran our own department. Educated people in both medical informatics and telemedicine. I think we've had 13 PhD students who have passed since 2010. Yeah. So I've been involved in the first national telemedicine program in South Africa which was as launched in 1999 and federal successes failed dismally So I´ve focused on the developing world and SSA especially.

I [00:12:02] So you already go a long way back with the topic of Telemedicine and mHealth. And so now we come to the first question, which is about what we talked earlier, like the specific features of mHealth interventions that you believe would contribute to the success or the challenge of implementing it?

E1[00:12:33] Am I supposed to answer this from within the context of an worldwide developed and developing world or just the developing world or just South Africa?

I [00:12:47] And it's just for South Africa.

E1[00:12:52] Okay. So the first thing is that interventions need to be simple. They need to be in fact low cost or in fact, no cost. They must be a perceived benefit either to the part of the health care providers or the patients or even better both. They need to meet acceptable levels of security, privacy, etc. We've been studying informal, spontaneous telemedicine services which have all arisen using instant messaging. And in effect, the doctors are picking up the costs without the state having to pick up the cost. So in fact, doctors are buying hardware and the phones, the funding, the communication, and the

patients are benefiting. And both the issuing doctors feel that they're doing something good for their patients. And in the instance in the example that we've been focusing on, the local dermatologist at our medical school are very happy because they have decreased the referral rate by about 80%. So they are seeing far fewer patients in their outpatients. And so they have a much happier day when they walk in and it's not jam packed. So there also are a whole lot of misconceptions about what the cost is of instant messaging. It is a fraction of what one USD sent. So depending upon if it's a text message, I mean, vs. a 5 minutes video call. So it needs to be simple. It needs to be cheap. Ideally there should be, as little training needed as one can give to our people using WhatsApp and the internet or using it anyway. In fact in the state sector, there is a second instant messaging service VULA. It requires some training and there are far more steps in the process. So things need to be simple and fast. So for example, with the instant messaging I think the permitted number of words is something like 13. And the number of images is two and a half, and the number of messages that go back and forth are, in fact around three messages each, and the whole thing gets sold seconds. So it's like that type of instant occurrence in medicine at a low or no cost, which is very simple. It's not without its problems. The problem being informed consent and record keeping especially. And how do you integrate these text messages in the example that I'm using? How do you keep a record of that? And who's supposed to keep the record? Is it on one side only or is it on both sides, etc.? So those are the features I said - perceived benefits of. A big aspect which is a major failing in most mHealth apps is the fact that there is very little clinical evidence of trials. I must say that I thought Germany, having now set up a register of apps that can be used, but they have to show actual evidence of some clinical benefit starting. That's my answer to that, except for the word that was used by you earlier about language. Certainly within Africa, there are a large number of languages. I think there are over 2000. In South Africa, we now have 12 official languages. So the people that need it the most. People in the outlying rural areas who are invariably good. The poor people, in fact, less educated people. They don't necessarily understand what it is that they are being told. So when we conducted a study here, we converted a consent form into the language spoken within our region. In fact, nobody understood the translated word for telemedicine. And within this language and culture, the word consent only a third of them understood that. To get informed, consent is an issue. An issue is that if the app doesn't work in the person's home language, if the patient's supposed to generate an earned health record shared and if the app isn´t in their language then it's exceptionally difficult. And it also makes the assumption that they can be read.

I [00:20:07] Thank you very much for the insights. If we now come to the topic of cost. My next question is what challenges related to cost arise for the implementation of mHealth and also what strategies can be applied to overcome or succeed despite these challenges?

E1[00:20:31] In fact the people are poor. If there's an expectation that it's the patient is going to generate their own health data and send it back via an app, that's not. In fact, connectivity is expensive. Having data on your phone and actually having your phone powered up and able to be used is expensive. And these are issues that people tend to forget, especially people from the developed world. So in fact connectivity, poverty, language. And I guess I go back to the point I made things that are in fact ubiquitous that are in everyday use are far easier to adapt and making people have to learn something new that requires training, etc. Also what tends to be forgotten also is that at the lowest level of health care within state sectors. You've got an important group of community health workers and you've got nurses. And again they in fact need support and they need the infrastructural support, and they may need technical support to bring forward the nature of the interventions.

I [00:22:24] And can you also think of strategies on how to overcome this?

E1[00:22:35] Very few implementations within the developing world have actually followed what are perceived to be the best ways forward. So, for example, I don't know whether, you know, these 17 steps or new momentum guideline for the successful implementation of telemedicine. So there's 17 steps of which planning for sustainability is a step. Turning the budget is a step. So because people don't follow well thought out and in fact researched methods, things fail. There is also all the work on e-readiness assessment. A PhD student came up with nine steps having in fact having reviewed everything that had been published on eHealth. Reading this assessment and again in among the steps are the costs, change management. Everything that needs to be done. But people don't do this and that's where things fail. I have an idea. I've got this modest idea. I can take people's blood pressure. That's not hard. This isn't how these things work. So the advice I have there is to look for best practice. And even then, if you've done that, you still have to be functioning within a government framework in terms of health policy, ehealth policy, strategies, etc.. And so those have to be brought together and in fact taken step by step to make certain that everything is in place to actually end up with a sustainable program.

I [00:25:14] Yeah. Then moving on to the next question. So in South Africa, who is most likely to be responsible for covering the costs related to using the mHealth interventions

are there for example, some there are insurances or something that can cover it? Or is it mostly do they have to pay it out of pocket or how is the situation?

E1[00:25:45] The in fact first thing one has to understand is how the whole system works. In South Africa above 85% of the population of some 64 million are covered by the State health sector. Some services are free other services are costing based on the person's income. Yes, there is some out-of-pocket expenditure. About 15% of people are in that hold. Private medical insurance or are self-funded only. And two completely different sectors. Two completely different markets, two completely different, but they are seemingly just in the way in which they are managed. Within the private sector, everything is for profit. In the state sector. How can we keep the costs down to being virtually zero? So you've got to two completely different approaches. And the example that I was describing to you about the use of instant messaging is what we're seeing within the state sector is because it's easy. The government has launched in fact a antenatal programme that extends into the postnatal period called Mom connect. So that's a text messaging service. And there have been a number of NGOs, external donors, funders who've funded behavioural change and text messaging across HIV, TB and in fact mental health or aspects of mental health. So you've got the state, you've got the individual and you've got NGOs and you've got donors in the middle. And as I understand it, in Tanzania, it was a large faith based grouping. So churches around the world are supporting certain hospitals. So yeah, that's the who is in fact responsible well it depends upon how much income you've got and if you've got a job as to you if a person is insured or if they are completely dependent on state.

I [00:28:44] Mm hmm. Thank you. Well, thank you. And, you know, can you also name anything interventions that are more affordable than other health services for patients?

E1[00:29:04] In fact instant messaging is actually a huge benefit. Let me just give you an example. I'm on the east coast of South Africa in Durban. There is a hospital on the border with Mozambique, which is about 250 to 300 kilometres up the coast. If a dermatology patient has to be referred to us in Durban, it is about a four day journey. It isn't because of the long because of the long distances they put together. The way the referral pathway works. They have to go to the regional hospital, which is about 70 or 80 kilometers away. Then they have to draw a patient card. They then have to be referred from there to Durban. They then did have to get to Durban. By the time they get to Durban, it's it's invariably in the afternoon or evening. They have to draw a card. They sleep on the floor. They are seen the next day they'd have to be in the whole process back. And it is on average a four day journey. And and in fact, during those four days, who's taking care of the children? All they're working, so their husband having to stop

work. So all of these are just for the simple act of sending a text message or even phoning because certainly during covid a significant amount of telemedicine. Significant amount of COVID related telemedicine was actually just a simple phone call and according to you that is also mHealth. That's why I began by asking you as to what you meant by mHealth. Is it an application or a voice. And so these are the examples that stuck with what I mentioned earlier, called Vula is being used in the Western Cape Province. It endorsed by the Department of Health. It's effective. I don't know how much the Department of Health is paying the people who in fact develop Vula. And apart from that, now within the private sector during COVID, there's there are a number of places that one can phone and get advice and some of them have an app linked to them. But I haven't I haven't taken much interest in the private sector. So I can't name it. But certainly in terms of behavioural change, I think South Africa's being almost a world leader. There's an insurance company called Discovery. And they're very effective in behaviour change. Examples. Well, I'll give you 3 examples. I insured the vehicle I drive with them. They fit a device in my car. And if I speed if I brake harshly, I get points taken off. If I meet their goals, I get half the money I spend on petrol back. If I get one quarter of the amount I spend on food that they considered to be healthy vegetables, fruit and simple. And that's a very effective way of changing people's behaviour. A least chance of accident, B I am eating more healthy. Third component if I exercise X amount every day. I, I get paid back insurance, so insurance becomes much, much cheaper. In fact, they understand that I'm lowering the chances of in fact having to spend and all of that is dealt with on the phone. Hmm. So that that is a different form of mHealth and it's a very effective form.

I [00:34:00] That's very interesting how you motivating the people to live a healthier life.

E1[00:34:06] I end up having to buy myself a fancy watch so that I can track my steps. I know how my heart rate is. I know everything and that goes directly to their App.That is also something else that one needs to to try to better understand. Richard Scott and I have written a couple of papers and chapters on this recently patient generated health data in terms of what the developed world sees. Health must be patient centric. That really equates to the patient controlling the data, the supply of data, the analysis of data. And that's got a whole lot of legal and ethical issues as well in terms of ownership, sale of data, etc., and all of these examples that I've been giving you about, in fact, Discovery Health. It is generating patient generated data. I'm generating it for them. Yeah. And that's that's actually going to be probably the biggest advance in telemedicine going forward. But virtually all mheath apps. In some way in fact required the patients to generate something.

I [00:36:06] Thank you and then the next question would be what strategies can be applied to ensure that patients can afford using and applications.

E1[00:36:24] Low cost or in fact no cost. That's the easiest answer to that. But just but people have to bear in mind that in South Africa I think we're running at about 45% of our population is surviving under $1.90 a day. People are poor. A third of our people on a third of our working age population have no jobs. And so you can't expect them to, in fact, spend it in health.

I [00:37:14] Okay, then moving on to the next question which what opportunities and challenges arise from the broader health care landscape and policy environment for implementing and health solutions?

E1[00:37:50] Well, I guess the first thing is you've got to have a policy. And you've got to have a relevant policy. We've got an e-health strategy. We don't necessarily have any health policy. Very few African countries have any health policy. They have e-health strategies and they aren't the same thing. So that's the first issue. It means that you've got to have an enabling legal and regulatory and ethical environment because we think right up that. In fact, doctors are naturally concerned about whether they will be held liable for doing something wrong. But there's certainly been increased phone use, increased cell phone coverage, and certainly increased access to care. But again, one needs to understand with the people most in need of access to care are the people in the most rural areas because they need to get to a specialist as outlined to you is a 4 day expedition. So it's those people who are most in need and they are on the edges of cell phone signals. They are poor, they can´t get their phones charged. They don´t want to make phone calls if they don't have to, etc. and these are some of the challenges. I've got a long list here, costs, ethics and the shortage of health care workers, the lack of policy and lack of clinical evidence that the mHealth apps work.

I [00:40:01] Mm hmm. How can the regulatory and policy considerations be navigated to actually ensure compliance and smooth integration of mHealth?

E1[00:40:28] Well, the first thing is that you have to have regulations. You need to have guidelines and ethics to both need to be very pragmatic. Taking into account the circumstances one needs to know. I haven't put these in any specific order the issue the device regulation. There's the issue of software as a medical device, and I think it affect what's going on in Germany is a is and certainly many other countries will refer to it as the issue of ownership and data privacy, security, record keeping, consent, etc.. All of those need to be addressed in a sensible way.

I [00:41:28] Thank you. And yet when looking at the funding plan and how can you think of strategies that can actually be applied by the organization to achieve sustainable funding for the application?

E1[00:41:47] This question is indicative of failure to have taken into account things like e-health, readiness, success and failure to take into account. Documents like the 17 steps for successful implementation of telemedicine. Just it just shows that people arenüt taking the in fact known information of things that work and that they should be doing into the concern. Way of developing e-health strategy. When we say e-health, this could be mHealth strategy. There are at least half a dozen frameworks for, in fact, developing successful strategy. So in the five case model, the green book. The exact framework developed by us. It's interesting. People are not. People develop health apps all the time. And it was an interesting paper probably, in fact, three years ago, which looked at how many apps were there for infected telemedicine. And there was by that stage several thousand. But how many of them were actually still on the app shop sites and how many were being used and how many continue to be supported? And that was a very small percentage of remote, which is just indicative of people said, I got this bright idea, I can do that. And they build it. They can build it. And yes, in fact, more recent. In fact, the development theories have got them talking to stakeholders and they make a product that's a bit better, but they still haven't thought out for how they going to go from development to being integrated. And if they integrated, they are in a sustainable.

I [00:44:05] Okay. That makes sense. Okay. And then moving on to the next topic, it's more about the side of the patient. Now, do you actually have information from participants like Health Workforce or the patients regarding the experience with mHealth, regarding whether the needs are actually met and whether it's actually helping them promoting their health?

E1[00:44:42] Going back to about 2005, 2007. That wasn't enough for me to focus in on any of. Instant messaging. We survey 22 of the 35 district hospitals in our province. And over 140 odd doctors took part in this survey. And that's about it's about 90% of, in fact, all the doctors. There were only in fact three of them who were not using instant messaging. So the reason they're using it is because they see some benefit added to themselves or to the patients in that. We had only surveyed doctors and nurses in the circus of doctors. And we asked the doctors what their perception was of what the patients felt about this. Over 80% of them felt that the patients were very, very satisfied with it. In a separate survey where we surveyed doctors, nurses and patients. It wasn't specifically about in mHealth, it was about telemedicine. Again, these are in fact, exceptions because if people had actually used mHealth or in fact, we're aware that they

had actually been practising telemedicine. So in fact actually have we've done it for video conferencing as well. And the patients are pretty satisfied with that. And I think what we've seen, certainly both within the instant messaging side and the literature during COVID is that smartphones allow all the conference calls. So video conferencing is effectively in everybody's hands and it is comparatively cheap. And so you're going to see far more of that in terms of mHealth, phone based video conferencing. There in fact is a downside to that. The downside is that the phone has to be a smartphone and you have to have sufficient bandwidth and you're then immediately excluding the poor people. And what we have always said is that when it comes to the developing specific apps or things like the use of mHealth with the developing world, always developing at least one phone layer down some types of smartphone. And that feature phone because the people in the outlying areas get the handed down phones, the stolen phones, it's different. So that's something we have always said it ought to be done. So things need to be kept simple and cheap.

I [00:48:46] Yes. Okay. Um. Now the next question is what barriers would the individuals served by the organization being faced with to participate in the intervention and how could they potentially overcome?

E1[00:49:09] I had some difficulty with the word organizations there. I didn't know exactly what is meant by an organization because if it´s the state is a state organization, if it's an insurance, is it an external donor funder?

I [00:49:27] And I know from the side of the company or whatever offering the mHealth application.

E1[00:49:39] What? Again, the next question there is, is this the company developing the app or was this the company implementing an app because they are a bit different.

I [00:50:04] Both.

E1[00:50:09] I guess I had difficulty with the question. The various organisations will be faced as well. In the state sector, for example, are going to be allowed to have their app used within the state sector. Is their app going to have to go past, as, as I said in Germany, some form of assessment? Are they going to have to show evidence that it works, that it does what it says it works. It features a certain order that in effect, has been answered in the earlier questions and how could they potentially have become more again that comes back to involving all the stakeholders from the point of view of conceptualisation to an ongoing evaluation and in fact one in order to ensure sustainability so that it is in fact the full spectrum.

I [00:51:26] Mm hmm. Okay. And then looking at the structure, characteristics and culture. The question is, what are the organisational structures and cultures within the healthcare system that either support or hinder mHealth implementation?

E1[00:51:50] In fact, in Jennifer Chipps PhD we looked at the readiness of the health department in our province. And one of the things that she did was surveyed the managers of the 11 districts. Even though the Department of Health in our province stated we wanted to telemedicine, the district managers had heard that somebody wanted telemedicine, They had no idea what that meant to them at all as to what they had to do. So I'm just hearing some of the examples there is. In word only at the top, and that never filters down. It's just really an organisational structure and there needs to be a policy in an organisation. It needs to be a strategy and then they need to be the various steps that have to be taken in order to have a higher chance of success. And I and I've said again, I introduce the example of the 17 steps for successful growth, including this statement. And the development of a strategy because really, the problem is that A) You have to define a problem that you're trying to solve. Then have to, in fact, look at all of the possible options, of which mHealth may be one of them, or that it may be better to actually do something else. If you choose an e-health one then you have to do an e-health readiness assessment of the full spectrum from law to are there enough computers, enough bandwidth or are there enough technicians. If you pass that test, you then have to actually do an audit of what it is that you've got, what it is that you need to do. You then have to develop a business plan, a financial plan, an implementation plan, and change management plan, monitoring and evaluation plan and then start. So the problem is people see this in far too narrow, simplistic way. I have an idea it can work, therefore, therefore it must be used. It is a great idea, but we now have to take your great idea past all of these tests as root to see and if it continues to be a great idea in the field.

I [00:55:04] And overall, if you look at the implementation climate, would you say, yeah, how do you in general perceive the overall climate for implementing health solutions in South Africa?

E1[00:55:35] I think I in fact touched on it when I talked about the health system or if it is the private insurers or the state. There isn't any doubt that mHealth will grow and is and is growing as a as I just told you about, instant messaging when everybody's doing it and when I talk to my friends in the private sector. They are doing it all the time. They are taking a photo of an ECG and they sent it over to a cardiologist with this patient in front of me. I don't know what the hell this is. And then they phone each other. So it in fact, won't be stopped. I think the term. I'll use a different example. We talk about tele this Tele that. The Dermatology TelePsychiatry. But in the developed world, nobody talks

about teleradiology. Why? Because everything is tele. It's become an integral part of everyday practice that radiology such that it is no longer termed tele radiology. I think the term is used within the developing world because people are taking photos of extras and sending them over. They scanning Xrays and sending them. I have never seen mHealth as a separate entity. As I said at the beginning, I see it as a as a convenient mode of communication and using both a communicator and a computer built into one and a camera. It is not going to be stopped because people are learning that they can generate their own health data and for generating their own health data it has to go somewhere. And so we're going to go into some type of application. It's not going to be stopped. It needs to be carefully looked at as to what are the implications of patient generated healthcare and the legal and regulatory issues related to that. So I'm not answering the questions in a way that I think you were hoping, because I'm not looking at it in terms of a commercial and such.

I [00:58:43] It´s a different sort of perspective. So I think that's good because I will be interviewing some of the experts and then I, you know, I can see it from a different perspective. And the next question would be as seen from literature strategic partnerships are essential for the long term success. How can organisations achieve this?

E1[00:59:18] I think, again, one needs to break this question up to include three components - the state sector, the donor NGOs sector and the private sector. And I think that within the state sector they're always looking for private public partnerships. And it´s certainly that holds for large ehealth projects but for mHealth you're dealing with a much simpler hardware, hardware need and infrastructure on the one hand and really the in fact, strategic partnerships are needed but as we've shown with this instant messaging, there has been no organisation at all. There is no budget. There is no plan. There is no framework. It. But it works well. What we're trying to do, this is a partnership from, in fact, academia with the local state sector is - how can we formalise this to make it safe? Such that there are records etc.. So, in fact, strategic partnerships. Then if you move it to the. Donor, NGO, faith organiuzations etc. in fact needs the interaction between them and the state sector on the one hand. And whoever has been assigned the funds to do something. As to how as to how they interact and always taking into account and especially with the African countries. Deep community involvement at the outset. But the in fact communities need to take ownership. It was a project that I was involved in Zimbabwe where the first thing the guy did, was he went to the Clinic in his rural area. It was sending the most cases and the most cases that didn't need to be sent. All right. So you went there and you spent a day with the community and they had a big lunch and

they talked and talked and talked. And he explained to them how this telemedicine link was going to work. Such that for the first couple of months the patients didn't want to be seen, but the nursing knew they wanted to only be seen by telemedicine. The sequel to that was that the nurse was learning all the time during all of these interactions. So her understanding and management have got better. In fact, number of cases went down over time, but the in fact number of transfers decreased significantly. So you need to get the community to actually be wanting it and I've always said that the community should be saying to the government: If you don't give us telemedicine, we won't vote for you. But within the private sector. in fact frequently overlooked aspect about telemedicine is that It increases access in general. However, you're making one person's problem, two people's problems. Because if I'm sitting in an outlayer hospital and I'm referring to you as the specialist, I would have just sent you a note, wave goodbye to the person at the door and I would probably never see them again. I now communicate with you, I'm taking your time. You send me an answer and the worst thing that can happen to me is that you tell me that I need to do X, Y, and Z because I´ve got to continue seeing that patient. I'm actually making extra work both ways. And there's some, you know, some in fact, doctors who do, in fact, actually argue that. And then you got a cultural issue, which I meant to talk about earlier. There were papers from some African countries probably ten years ago, 12 years ago. About why when there are telemedicine services and mHealth services and I'm just finished looking at dermatology, we're going to try to African where at hospitals where NGOs have set up services with doctors coming from the states and actually working in the hospitals for a while and set up telemedicine services and local doctors seldom use them. And one of the reasons being, as I said in some of the earlier papers is that in effect, admitting that they don't know anything in front of the patient and culturally, that in fact, is lowering their esteem. So there are these types of cultural issues that need to be taken into account. And also it isn't so much in South Africa where there is a bit of the I don't know about Tanzania, but certainly in the Muslim world, there are cultural issues. And in fact, regarding both female being seen by male doctors and males being seen by female doctors etc. and there are also cultural issues as to who can actually use the phone. And that's certainly showing up with inside Africa where it shouldn't be shown up in terms of text messaging. Who is this person sending these messages to? Is this your boyfriend who you've now got? And and, yeah, there are you know, there are these types of these types of concerns. Which through exhibits tend to be overlooked in the developer.

E1[01:07:13] I think that I've actually answered the next question about how do you perceive the readiness by going through and giving you the example of instant

messaging and by giving you the example of the people, the people in the private sector or practising their own form of instant messaging or giving you the example of how the insurance companies are forcing us to integrate behaviour change. Are there any solution or the strategies that can be employed to ensure healthcare providers are acceptable and comfortable using mHealth?Well same answer simple to use. No, or low cost. You need to have a supportive regulatory environment and you need to have actually looked at what the best practices in terms of planning and implementation that will become sustainable.

I [01:07:13] The next one and what are the success factors and barriers in the phase is planning and development?

E1[01:07:20] That's the same answer that I've given several times. It's failure to follow established best practice methods such as ehealth readiness assessment, the momentum construct.

I [01:07:50] Who are the key influential and how should these influential individuals be dealt with?

E1[01:08:13] It depends upon which sector you're talking about the state funders and the private sector. And all of these need to be taken into account because you've got to bear in mind that ultimately all health care falls under a government health act, which is the rule. You then have a regulatory authority for people with whom the doctors and nurses are in fact licensed. You then got ethical standards, some of which are dealt with by law and some of which are dealt with by the regulators. So all of these are important. They all need to be taken into account. Really all stakeholders need to have a voice somewhere in the process. What's often overlooked and forgotten is it in ehealth solutions in general ior mHealth or other aspects of telemedicine are in fact frequently decided at a certain level and are dropped in. The people in an organisation are forced to use it. As soon as you force somebody to use something. You will get resistance to change. So it's really getting everybody buying in. And so that's the, the, the vital importance of change management on the one hand, but functioning with in the in fact known environment of laws and regulations such that doesn't become an impediment.

E1[01:10:53] Implications for start ups. Well me and I've never been much interested in start-ups in the private sector. It must be simple. The least amount of training that's needed. It must be effective. And you must have all the evidence that what you're saying or doing you are actually doing and the data and need to be handled in an ethical and legal way. Ownership of data. Security. Privacy etc.. And based on the insights follow

the known best practices and function in an ethical way within the regulatory environment and have evidence that you're doing work that you say you do.

I [01:12:00] Thank you very much for taking all the time. I'm sorry it took a bit longer.

E1[01:12:10] And that's fine. My concern is that people tend to look at these issues from a business perspective without looking at things from a holistic viewpoint, taking into account that people are poor, they may have different faith, etc. And so all of these factors which in fact interact and certainly in terms of mHealth apps were far too many of them being made, far too many of them that are no worth to anybody, that aren't used. I'm still very sceptical about data ownership. Um, have you ever looked at the consent process for using an mHealth app? There was a paper that said that 93% of people don't ever read the consent form. So it was a second paper that they developed an app. And put it out on the market. But the study was to actually find out how many people read the consent. So in the consent section, and it goes on and on. If you use the app, you consent to having the next child born in your family named by the company. And over 95% of people accepted that. They didn't read it. Have you ever read the consent to, in fact, use Zoom? That's right. So consent is a huge issue. So is the device a device. Should devices be regulated? Consent to use the device storage and keeping on track records, ownership of data, secondary use of data. Have you consented to that? So within the EU and your EPR, it can be useful to be covered, but it's seldom covered. So all of these are issues that many people developing apps never think about.

Appendix 6.2: Interview Expert 2

I [00:13:55] Okay. So then the first question is about you. What is your position and background with mHealth and for how long have you been involved already with this topic?

E2 [00:14:08] So I'm currently a professor in the Faculty of Community Health Sciences. I have just been appointed as the digital chair for health in the Faculty of Community Health Sciences last year. So it's a three year process, a three year contract and after, I believe it´s an ongoing position. It will be funded by the Medical Research Council going on, but that's not yet confirmed. I've heard that. But, you know, it has to go through various processes. But in the field of kind of digital health, I have been involved in since my Ph.D., which was submitted in 2012, because in my previous life my involvement was not with mobile health, anything like that. I worked in Australia, but I was involved in informatics and establishment of of mental health outcomes systems, both in both in New South Wales Australia as well as in Auckland New Zealand. So I did work from about 2006 onwards, you know, in the field of mental health outcomes, but it was about

establishing sort of national statewide surveillance systems. But when I returned to South Africa, I did my PhD in tele psychiatry and since then I have been involved in digital health broadly. But as it has changed from kind of like telehealth to e-health to digital health, etc., you know, and as with the development of mobile health mHealth, you know, obviously I've had a number of students that I´ve supervised that have done some mHealth projects, although unfortunately I do have to say that most of the students that I have supervised are international students because that's the nature of our supervision. Some South African students, but mostly also because Nigerian students, Ghana students, Rwandan students, all doing kind of mHealth related projects.

I [00:16:23] That´s cool, then you have a really good overview of all Africa. Yeah, okay, then. Yeah. We can start with the first content related question, which is about the characteristics of the mHealth applications. So the question is what specific features of health interventions do you believe contribute to their potential success or challenge?

E2 [00:16:50] You know, one of the challenges, I think generally, and I think though it is specific to South Africa and I'll give you a few examples of that here as well. But I think it's broader than that is that I think it's very popular to develop applications, mobile applications, but that in fact what makes them popular in uptake at the moment, and this is very much been the case in South Africa, there's been like a grassroots uptake of applications, mobile applications that people are using already. So to give you an example, is that we have, for example, we have a there's an application that's used in South Africa. It's a mobile application. It's used within the health services. It is for referral. So it's kind of like a telemedicine purpose. So if you're in the middle of nowhere and you want to refer. Because a person or you ever need advice, you can use the app thats called VOULA. But what happened was, like while people were evaluating Voula and trying to embed it in the system, people were just using WhatsApp anyway. So there is an extremely high usage of WhatsApp because that is what people are using anyway. So when people go to their phones, it takes, I think, more effort to go to a separate application than it is to go to the applications that that you are using on a daily basis or people on a daily basis are using Facebook and WhatsApp and so that is what they use in preference to dedicated apps. Because, you know, I think that the context here is different in that, you know, there's a very big focus on personalized health and using apps. You know, so there's obviously a there's a plethora of this available in South Africa around, you know, any app that's available in any Apple store or Android store that tracks your walking or your running or your calories or, you know, noom, etc., you know, individually people are using this, but these are not who we are talking with of in within

the health system. So there's a whole personalized use of applications that people are doing on their own personal health area. But we have no input impact on that. And with health services, you know. Which is primarily what my focus is, you know, being located within community health. You know, the issue has been that the context, I think, is different. So when I get back to what you were actually asking me, what helps the uptake of these things? I think, number one, I think it needs to be needs driven, you know, applications that is being proposed. And I can give you an example of this as well. For example, they gave us a diabetic application developed for self care management in South Africa. And as part of the research, what the researcher was doing when she was actually interviewing and doing focus groups with people with diabetes, they were saying that they're not interested in having an application that is getting the right food to eat, managing their diet. So I think it's a very important thing to understand that. If you and I know it's hard to analyze these things after 1 billion people die. But, you know, in South Africa, it's important to understand that that probably less than 20% of people are in private health insurance. So 80% of the population is having to use the public health sector that is available. You know, so the context is quite mixed in South Africa. So you have kind of really first world population groups in South Africa that would be using Strava and Noom and all kinds of personalized help apps even within, you know, even like you know as in they kind of. I might for example, use like a phone app to monitor my mom's movement, who's 86 in our home to make sure that she moves. But this is very, very much personalized. There's a bit of encouragement by the private health sector that they've got a section called Discovery, Vitality Health. So they encourage a lot of health promotion, any type of activities. And you can use various apps to do that and they reward you for that. But that's in the private health sector. Mm hmm. People who access the public health sector generally, you know, there's not you know, they that, for example, if you look at patients with diabetes, you know, they're not accessing diabetes, self-care management apps. You know, their issues are around managing daily life. So I think that's one of the issues is that so, for example, a lot of mobile applications are not really applications that the use of WhatsApp or sms send messages to, to send messages of reminders of self management or to send messages of reminders of sending appointments, etc..

I [00:22:04] So it should be like really easy and simple to use, like really straightforward.

E2 [00:22:08] I guess it's easy, simple to use. That is what people are using in their daily life. Mm hmm. You know, so, for example, so there's been some Facebook groups have been used to support, say, for example, nursing students doing research. WhatsApp groups have been used to support nurse students who are in transition edges that are

starting to work. So not dedicated apps, but onward development of use is offered on WhatsApp. Now these concerns obviously around security issues and etc., But, you know, I always say to people as well, people are developing app, people are just using WhatsApp anyway. Mm hmm.

I [00:22:49] Okay. Yeah. Mm hmm. Okay. That and I think we can move on to the next question. Thank you for the insights. Um, yeah. So the next question would be related to costs. So what challenges related to cost arise for the implementation of mHealth and what strategies can be applied to succeed?

E2 [00:23:09] There are the lots of different uses of this as well. So but the cost obviously is a major issue because if you don't have massive internet coverage, data is expensive. And so when you look at studies that they've looked at mHealth usage, you find that there are a number of issues which are unique to not unique to South Africa probably, but does occur in South Africa and probably occur in other African countries as well as that you do, for example, get phone sharing that, you know, people might swap their sims in different phones, they exchange their phones. There is not wide access to Internet, so there's cost of buying data, you know, so the majority of the population would, if you look at the broad population would have like a minimum prepaid package. Mm hmm. And then, for example, they might just use sms. They might not even use WhatsApp. I think in the younger people, the younger people, they do use WhatsApp and Facebook quite a lot. So they but again, it is a. What younger people would do is that they would use what Internet is available so Internet at the university, you know, and then some prepaid. So cost, I think, is a major, major deterrent. I think a second thing is cultural appropriateness of stuff developed overseas because, you know, the content, for example, of diabetes, self-care management from the diabetes management app that you might get that has been developed for Germany, you know, it's not appropriate in South Africa. So, for example, you know, they might encourage people to do exercise as part of app, but in fact a lot of the people that have diabetes, for example, that might be they might be commuting every day, so they might be walking as part of their daily life quite long distances, you know, so they don't do extra special exercises to get exercise. So there is a cultural appropriateness of applications as well that can be a deterrent because if the application is not particularly developed and tailored for the population that they're supposed to serve, then you know, people just lose interest in it as well, you know. So that's another big issue around the deterrence of it. And then if it's, you know, obviously ease of use and usefulness is obviously big issues. If something is easy to use, people would use it. If it's useful and they can get something out of it, they would use it. But if it's complicated, then no. And so there are some of the issues around

security as well, because we've got a very complicated protocol to get into an application. People forget the password and then back into it. So that's sort of universal, I think. But I think the big issue is Internet coverage, because otherwise people have to pay for the data and and cost of prepaid. And then, you know, the quality of phones as well. I mean, you know, in some of the studies, you'll be surprised that many people still have basic phones and not smartphones. So if you have a basic phone, you know, applications won't really serve well on it because, you know, they don't host these applications. So therefore, sometimes we revert back to SMS. So there is an application, but it's obscuring an application, but it's being run on SMS and whatsapp. It's called Mom Connect. But you know, they send messages out by SMS and by WhatsApp. It's not a dedicated app. And it is, you know, to allow people to choose whatever mode is accessible for them to receive those messages. So you have to really think about it and then you know that also, I think. The issue of voice, sending sms or sending voice mails. You know, the personalization there is a level of personalization. There aren't maybe just, you know, de-identified messages. And it depends on individual people. Some people like just to get a message, but other people prefer to have kind of like a voice mode or feel like they have some connection with a human rather than just the message telling them something to do. Mm hmm.

I [00:27:50] Yeah. Mm hmm. Okay. Thank you. Then we move on to the next question. What strategies can be applied to ensure that patients can afford using those mHealth applications?

E2 [00:28:06] You know, are you talking specifically about affording so they can afford it?

I [00:28:11] Yeah, like the. So like in South Africa, like the end users. I mean, of course there are some apps that have like a basic version for free and then there's like premium or something. But yeah, like how can it be overall?

E2 [00:28:24] I mean. So again I, we do other kind of things, So for example, universities, zero rate applications that we use. So we negotiate with the providers that the educational mobile, you know, so for example, our learning management system, if there's a mobile version that it is zero rated so that they have access to it without needing to have data. So that's one of the strategies that is being used to zero rate some of the applications or sites so that people could access it if it is essential. And then then there are some very innovative projects. For example, there's a project in the Eastern Cape where they are developing like local community Internet modes. So they have got Akela, they set up community modes of Internet so that the local community can access a level

of Internet there. So because the Internet is, is obviously the cost issue is access to Internet and data. So there are projects that are like that. The problem with some of these projects are that the sometimes I mean, I know the one in the Eastern Cape, which I will tell you the name of the one, but I can't remember the name of now. It is in Duane or something. But I can look it up for you. They, you know, they get funded. It's a grant that happens and then they get funded and then there's kind of sometimes issues of ongoing in building these issues because if things are established, you know, with external funding, you know, you often get kind of like this pilot type of thing. I think it's your supervisor's favorite word pilotitis where, you know, you get some funding for it. But when the funding stopped, there is no infrastructure or any processes. It's not integrated for it to continue. Mm hmm. So that that becomes an issue as well. You know, I think a lot of people have like, you know, WhatsApp is very popular in South Africa. It's really the main thing that is used rather than applications. And and so people do kind of have like a basic package for WhatsApp, which can cover those kind of things.

I [00:30:47] And yeah, we also talked about the funding and that it stops at some point.

E2 [00:30:53] Apart from the funding that stops, oftentimes the projects that are done in mHealth often is about, except for mom connect a nurse connect, which now health worker connect I think those were national projects. So when these projects are not nationally or statewide adopted for health, for example, if it's a research like if I'm doing some project with some mHealth activity, if it's not integrated in some way within the institution where it is being hosted, it stops.

I [00:31:29] And how can you actually achieve that, that it gets like nationally.

E2 [00:31:34] You know, so as it is, you have to really from the beginning, I mean so we trying it's, I'll give you two examples. So one we did a, we did an intervention in a non-governmental it's a nonprofit organization for older people. So they provide different level of housing for older people. And it's nonprofit. So but it's a mixed kind of some private but also some supported by government grants. So we did a low intensity mental health intervention and we chose to use WhatsApp. So I think that the other issues and that I probably should mention in terms of challenges and you might have to take it back to is digital literacy, and I'll give you a few examples around that. So with the older people, obviously digital literacy was an issue and when we looked at phones, they had basic phones, hand-me-down phones. So this was done in KwaZulu Natal, hand-me-down phones from their children often. Most of the phones had very limited ability to even host WhatsApp. Then they also had difficulty in using WhatsApp. But what we did with them was and this increased uptake is that we before we did the intervention, we actually did

it twice in another project as well. We actually physically installed WhatsApp and in another project, Facebook on people's phones did some training with them, helped them connect with their family, you know, increase the usage of the application we want to use in general, and then hosted some projects on it. But this the work we did, they would have quite a lot of work with them to try and establish a support center within the institution so that they can support problems. And so one of the gentlemen took up the role. And, you know, you have to involve right from the beginning, you have to involve all the stakeholders. So we have met with our stakeholders right from the beginning, involved them in the project. And, you know, did a mapping of what is the landscape, what Internet they have, where you know, what phones people are using. And so they made recommendations for them on how to operationalize it. So. But even that, you know, during covid, the national organization that looks after depression and anxiety well said I picked up the project and did a similar kind of thing around depression and anxiety support for older people during COVID. And a project officer that was located in Durban participated in that project. But in other areas, I mean, you know, so we've got another project where we are extensively meeting with the Department of Health right from the beginning. We involving them, we're trying to align what we're doing with the work that they're doing and with the goals and the timelines, which is really challenging because they work on different time frames to us. And what we are doing, for example, is that because we are not developing something for them, because if you develop something for them and they see it is something that they've contracted and want you to develop for them, they will take it up or not take it up. But what we are developing for them is specifications.

I [00:34:46] What do you mean specifically by that?

E2 [00:34:48] And so we would. So for example, the project is actually looking at a digital dashboard. And so what we are doing is we're not developing the dashboard, we are developing the specifications for the dashboard. So we said, you are planning to do this. So these are the indicators that should be measured. These should be the purpose of what you're wanting to do with it. And so we do research on what is the need. What do the stakeholders want? What would they use? We look at all those factors and then based on that, we make recommendations that they could then use. So we try to provide information to the Department of Health that they can then use to develop what they need to develop. So the other the VOULA app that I talk to you about that is a personally developed app. This app developed by a medical doctor and he actually, so the Department of Health in that situation because and that's the other thing about uptake, if you've got something personally developed is that you need to have and this I would

imagine, is not to South Africa only you need to have the right climate, the right interest, the right somebody who's looking, wanting to look at something like that. You need to have the stakeholders in. The stakeholders so that they can understand what you want to do. So, for example, the VOULA app was taken up by the statewide government and then is being used as a referral app. But what they don't like doing. I'm doing that. And so and they're developing their own app in the interim, you know, So they they're using it but they are developing their own in the background. Okay so and so the thing is that because the government which runs the public health services, which is why I'm talking about them, is that they you know they have in the Western Cape is also different to the rest of the country because a lot of the other stuff are run by a sort of also like a nonprofit organization like aggregation of data and stuff. But the Western Cape is better developed and better organized. They've got a very clear strategic directive. And so they are looking. So they do their own development. So we to get anything integrated rather than just being a pilot, we have them involved as stakeholders, like right from the beginning and we have to tailor what we want to do in terms of their needs and their timelines so that what we're doing is helping them rather than doing an academic piece that is just sitting separately and is not being implemented.

I [00:37:26] Mm hmm. Yeah. Okay. I see. That's really interesting. Um. Okay. Then moving on to the next question would be, um. Yeah. How can the regulatory and policy considerations be navigated to ensure the smooth integration of mHealth?

E2 [00:37:48] I think it's some of what I was just talking about now. But you know that you have to kind of involve the stakeholders. It has to be based on the needs of the population. But, you know, one of the big issues here is that you know, there's not, you know, mHealth in general is not well integrated into existing health systems, you know, because it's a it's about the interoperability, you know what I mean? So if you are capturing data like in WhatsApp or if you're capturing data, you know, the system has to be integrated in a for example, if you take that the referral app which they're now developing, the one, they're developing a school case, but it's similar to the one that, you know, that they've purchased. But you know, they have to actually you have to ensure that it meets data standards and that is interoperable and that there is kind of operating procedures around the collection of it and the integration and where it fits into the various information systems that are there because, you know, so I think a lot of the challenges around mobile health stuff is that it is sitting separate from the general health system and that the health promotion, those kind of work is not captured in the general kind of information systems and those that activity is not captured. So I think that´s an issue with mHealth. I mean, I know that. The other thing is workload, you know, because I know

that during COVID, for example, one of the I think it might have been the oncology clinic, for example, they decided to use WhatsApp to manage some of the appointments, and it was an absolute, absolute, humongous workload. In fact, post when COVID was over, it was immediately stopped because the workload on managing the A mobile system. It is actually it's quite high. And in fact, I think it's a major problem that that we've had generally with the mHealth things is that and this is something like mom connect, you know, that is nationally endorsed, nationally developed, nationally integrated, sits within the national guidelines and what they want to do and they got big funding for that you know unless you have it nationally embedded the resources that is required to manage any programs unless it´s an application that is separately developed that it can run maybe with a chatbot or some assistance, is very, very big and you know so for example, most of the self-care stuff requires moderation. And so there is a person who is responding to the issues on the applications as well and responding to what people are doing on it. So there's high level of risk. So a lot of the mHealth projects we've done on WhatsApp, for example. It's very resource intensive and so our work being done around chat bots to facilitate some of this activity. But it's, you know, that's another consideration to think on how to get it integrated, because to integrate something you need, for example, the most of the mHealth that is being done it requires a person to send those self-care messages to personalize it, to be useful and you know, and then you need to allocate somebody within a health service to do that. So there is both technical issues and integration. They sort of like, depending on what the purpose of the application is, a level of moderation or control that needs to be done with it. You know, and then obviously, because Africa is generally in I'm not talking about a general point of specific ethical issues in terms of access, because if you're doing something like on an mHealth thing is that you can't run a program and everybody hasn't got the same level of access to technology and to Internet.

I [00:42:23] Okay. And then we will move on to the next question. Um, yeah, regarding the funding that we talked earlier, um, what strategies can be applied to achieve the sustainable funding? So I guess like you said, it's like a lot of involvement with the stakeholders from right from the start

E2 [00:42:45] Yeah, I mean, I think that it's a big problem that a lot of the funding comes for research. So people are, you know, wanting to do a research project to just develop an application and then, you know, these are if this is not within your public health sector objectives, you know, once that funding is finished, it, it stops. You know that remains an ongoing problem. And that is, I think why, you know, things like WhatsApp instead of a dedicated app has been more useful because, you know, the development of that is, you

know, it's not as big because, you know, the development of any applications are very, very, very expensive. I mean, we have one of my colleagues have developed an app for young men with HIV and it's a management app. And so the issue is these as well as that, I mean, a huge amount of funding had to go to the development of it. And she's busy testing the usability of it. And a side note, quite interesting, they have much lower digital literacy the young men in the focus group than she expected. She found to highlight in Facebook, for example, which was very unexpected, which is not the same, for example, as the researchers own kids was very different what you found. But the issue is that it's not that's not integrated any way. She's trying to work with non-government organizations for uptake for it. So it's expensive to develop, it's expensive to maintain and to keep up to date. You know, So and if you if you want this, what you're doing to be located not in the personal, personalized health, privately funded sphere, but in in the public sector where you want to improve the health of 80% of the population in South Africa, you know, these are major challenges. Mhm.

I [00:44:45] Oh I see. Yeah. Um. Okay. And then another question. It's more about the patients needs and resources. Yeah. Do you have information from participants like on the one hand, health workforce and patients regarding their actual experience with mHealth? Like, does it actually serve their needs?

E2 [00:45:10] I mean, I think in general I think that there is very, very low digital literacy and I think the digital divide as well. You know, so I think, you know, for example, I think if you're looking at older patients, you know, the level of digital literacy is lower. Everybody talks about the digital divide and if things are difficult to use, people just won't use it. You know what I mean? It's just the difficulty in using is a major, major barrier. You know, I said, you know, the nursing workforce, for example, I think is way behind the digital revolution and with Nurse Connect, for example. I mean, it is quite interesting. My personal opinion of nurse connect because I was a bit involved with the people who were developing it. They were developing it but you know, so they did use both SMS and WhatsApp because I would say most nurses have WhatsApp, for example, but they had an SMS version as well. But the issue was that they in fact, I don't personally know anybody who was using it. I would ask people, do you are you aware of Nurse Connect? And they would not be aware of it. And, you know, the challenge of that was and I'm sorry, this doesn't fit with your question, but it might be useful information for you. The challenge with the app was that I think it was externally funded. Mm hmm. They were paying developers to develop it. But there were very little consultation with nurses. I sat in front of nursing deans and I would ask them if anybody had been consulted, has any of anybody been approached to talk about it, to talk about what is our needs, what is it

that would work for us, what would be useful, what would be beneficial to put on something like Nurse Connect? But nobody had any contact with them. And so, you know, and the developers were not nurses, they were not nurses, you know, they had one or two nurse focus groups. But, you know, I mean, if you're doing, you know, you can do a nurse focus group in a private hospital with nurses and you'll have a you'll have no relevant information for 80% of your nursing health workforce. So they there was major challenges, I think, in getting actually real input in what is needed. And for example, I went on one of the stakeholder workshops because I complained about it and I had stakeholder workshops and then they were trying to identify what would the nurse, the needs of the nurses be and so one of the things that they were identifying as communication and I was getting irritated because, you know, communication skills are being taught from year one in nurse training. So for external people to think that that that they would that they would want to send messages to nursing qualified nursing staff on how to improve their communication skills if it's just missing the target, you know what I mean? So I think that oftentimes there's not enough transdisciplinary integration. I think that the nursing workforce is also at fault. I think, for example, they are not digitally literate enough to have conversations with people who are developing technology. Mm hmm. You know, so that is the problem on the other side. And then there's often externally funded projects and then we hear about these projects and then it's kind of running on the side and you kind of wondering what, you know, how did it even get there when there's been no consultation and no involvement? And so, for example, they want to develop, it's not mobile health, but they want to develop a nurse sort of record, an electronic digital one. But there's been no consultation and they haven't developed it, thank God, But there's been no consultation or outreach regarding that. So I think there's a big issue. I think that the workforce is not literate enough. I think the population is not literate enough. That's with my colleague, with the focus groups, with the HIV app that she's got to develop. She said that she was shocked that they were using Facebook more than anything else. And as I was saying that they did not have it was sort of an off remark. And she was saying that she would have thought they would have the same level of digital literacy than her children. Which they didn't have because these were young men in the rural areas. And then I think the other big thing is obviously, you know, is what I was saying about the diabetic app. You know, you have to I think, you know, I think there's a real, I mean, I like it as well, I mean, it's a fun thing with applications and chatbots and developing interesting thing and it's intellectually kind of fun to do. And, you know, and we were having conversations about including putting gaming into her app, too, and to test to see that is going to improve uptake and use of the app and but you know but the issue is that it needs to be needs driven. So, yeah, and it has to be

something that is that they're going to need. It's going to be useful for them to do it, and it's going to be easy to use. If it's not that, you will know that you're not going to get uptake and you know, the diabetic and the diabetic app and the person who developed it was a diabetic herself. She's a computer scientist and she was totally surprised when she did her interviews and then people were saying, this is not what we want. Mm hmm. We want assistance with getting the right food to eat. You know, that kind of support. You know, when your basic needs are not being met, then you're having an app to tell you how to do Self-care management might defeat the purpose.

I [00:50:53] Now, of course, then you're not going to use it. It makes total sense. Okay. And then, yeah. Moving onto the.

E2 [00:51:01] But on the other hand, obviously, you know, there's a whole lot of applications that younger people are using, you know, with access to Internet at the university, whether they're actually using personalized health apps, I'm not sure. I do know people that are using kind of some of the health apps that are available for personalized use that they're not within the health sector.

I [00:51:31] Mm hmm. You. Yeah. I guess the younger people. Yeah. You're not of course, you're focused on your health, but I think it's because we are pretty healthy, So we're not too focused on all of that unless we actually have a disease.

E2 [00:51:43] Yeah, I know. And, you know, I mean, so people might be more attracted to looking at like a message on Tiktok rather than a dedicated app to get information. You know what I mean?

I [00:52:01] Yeah. Okay. Thank you. And. So yeah. How do you perceive overall the climate for implementing the mHealth Solutions in South Africa?

E2 [00:52:17] You know, I think there are a few issues that we have to really deal with. I think one is the ethical issues. I do not know whether all the ethical issues surrounding mHealth has been addressed, you know, the issues of autonomy, of safety and confidentiality. You know, for example, you know, taking pictures for an app. You know, image based issues. In some of these absence of patients, confidentiality, the autonomy, I'm not sure all of those issues have been addressed and been thought through. You know, I mean, and then, you know, there´s even bigger issues, such as if you´re using an app where is this data hosted. You know, there's big concerns about, you know, data being hosted overseas, etc.. But I do think I think the big problem for me within mHealth is that maybe because a lot of the focus of mHealth, although there are apps in South Africa that are integrated with, you know, we've got, for example, an app where community health workers go out to the community and they capture patient data and it

gets linked into a system with whatever, you know. But it has to be it's, it's the sustainability of it, the resource intensiveness of whatever you are using, whether you have the resources to either moderate it or to, you know, have community health workers going out, collecting data, using mobile applications. And then how do you ensure that is sustainable? So how did it become integrated into existing systems and linked to other patient data? And how do you address all of those things with privacy and confidentiality. So I think this I'm not sure that we've progressed very much beyond Pilotitis. There's been projects on mHealth related issues and people have been wanting to develop apps. But apart from the VOULA App purchased by the Department of Health and it was developed by a doctor who was frustrated by the issues around referrals. So that had a high utility and then it got taken up by the government and then is being used, you know, and nurseconnect got funded outside, but it was funded. Then the National Department of Health got funded and they developed it. Mom connect. You know, apart from those, there's not been a huge proliferation of it. And I think it is because of the issues of sustainability, of resource intensiveness and then the interoperability of it into existing systems.

I [00:54:50] I think. Um. Okay. And. And yet regarding like the beliefs about the intervention, how do you perceive the readiness of the health care professionals and users in their country to actually use the technologies in their practice?

E2 [00:55:11] We have a project at the moment where we are going to do a big digital literacy assessment because I think that the workforce so a century earlier I think that the workforce and the end users there is this digital literacy issues. You know, I think that, you know, just anecdotally, you know, we've got we've got about 106 staff in our school and the digital literacy is not high, you know. You know and their knowledge in the in the standing of the latest issues, even on such things as artificial intelligence is very, very, very limited. You know, and I think the very nature of some of the healthwork stuff being very hands on and very practical, you know. You know, in some of the rural areas, for example, the nurses might be functioning in the rural area. There's not enough Internet connectivity, there's not enough computers to have access to some of the issues. You know, if you want to use mobile apps, you need to have a phone. And so people are talking about a framework where they want to get people to use their own phones. Well, because are you going to provide information to you know, because you have to think about where people are actually, you know, they have to have Internet access. They have to have a phone with the right level of connectivity. We can't provide phones to everybody, it's a massive cost. So they are looking at strategies to use people to use their own phones. But then you also have to think about issues of privacy and

data standards and and those kind of issues. And so I think there's a lot of developments thinking about those things at a planning level. But I think on an end user level, I think there is low digital literacy level. Well, I think there's a massive process around to get the workforce digitally literate and then, you know, with endusers as well. You know, the end users are also it's varied. And that's why I was saying to you earlier that, you know, you have to use, depending on what phones they have and what Internet connectivity they have. So it might be that you planning a wonderful intervention. At the end of the day, you might have to revert your intervention to sending SMS. And then even if you send SMS, then you need to think about where will the SMS be hosted. How will it be sent out? Who will send it out? You know, whose responsibility it is, what is the resource implications of that. But yeah, so those are the issues I think. I think I think there's major challenges in literacy. I think that the technology has run away from the users.

I [00:58:11] Okay. So far already, I think so far it's too far. Okay. And yeah, like when we think about the face of planning and developing a mHealth interventions, what would you say other like the main success factors and yeah, like the barriers we talked about it a lot already, but maybe also.

E2 [00:58:33] I think the something I think success factors is that you have to involve the stakeholders right from the beginning and that includes the users. They have to determine their needs. You really need to have a clear idea as to what is the health need and their needs and whether that is that then the appropriate solution. You know, So it might be that you think it's the right solution, but it might not be the appropriate solution. You know, and then obviously, I think that, you know, the development of interventions, that's an area we haven't really touched on. But I think it's an area for me that is of concern is that whatever gets developed needs to be evidence informed. You know, so for example, the loneliness intervention we've done. I mean, we did a systematic review of effectiveness of interventions for loneliness. We did a systematic review of the effectiveness of electronic interventions for loneliness in older people. And then based on that, we highlight identified two interventions. The one was psychoeducation. And then the second intervention was low intensity cognitive behavioral therapy. So the decision for the intervention were most based on extensive research. I think I'm concerned about the level of evidence supporting interventions offered by mHealth and whether this kind of rigor is happening before things are being implemented. You know, and then obviously, any kind of interventions developed on mHealth should be informed by, you know, change behavior theory. How do we change people behavior? What are the factors that stimulate change and hinder change, You know? And it's the same behavior change and challenges that we have, for example, in providing health education

or in those things. So I think that those things have to underpin mHealth. And then so you have to have a body that's responsible, ensuring that. So I think a big issue is the process of deciding which digital mHealth interventions or tools that you want, what applications that you want to use, have they been evaluated, you know, and against a framework for digital health and, and application and evaluations, You know, we have to evaluate and look at material. But, you know, because there's a plethora of applications and they might not all be useful, beneficial, needed, etc..

I [01:01:06] Okay. And then one last question as a summary. Based on your insights, what are the key takeaways you would provide to startups when they're looking to implement mHealth Solutions in South Africa?

E2 [01:01:24] You know, I think it's I'm repeating some of the things that I've said before, but in summary, I think that they would have to do a needs assessment. The needs assessment should be based on the actual end users. And, you know, it is you know, I mean, I know that people are talking about using development frameworks that when you are developing applications, you must use a user centered development framework. But the process of stakeholder and consumer involvement in these have to be a very active process and not a token process. So I think that there has to be a needs assessment, there has to be involvement of the end users. It also has to be involvement of the stakeholders within the system, which you want to look at it because I think you have to I think you have to plan with sustainability in mind. So yes, you can do a proof of concept, but you have to, within your proof of concept, look at the factors that are going to look at sustainability in those things are integration. You know, integration into existing systems with interoperability and feedback loops. Mm hmm. Okay. Yep.

Appendix 6.3: Interview Expert 3

I [00:04:48] Thank you. Yeah. Okay, So, yeah, the first question is more about you. Can you tell me what your position is and also what your background with mHealth is like how long have you been involved?

E3 [00:05:02] Yeah. Okay. So I'm currently the CEO of the Health Information System Program of South Africa, which is an NGO. We work in South Africa because that's where we were founded, but we are actually working a lot of other African countries as well, providing information systems. My background I´m a medical doctor with a master's in Medical Informatics, my Ph.D., focuses on the investment appraisal of digital health so developing an investment appraisal framework for digital health. Mm hmm. So Africa and I've been in this space for about 20 years.

I [00:05:50] Okay. So I guess a lot of experience in that area then.

CLI

E3 [00:05:55] Well, seen, seen lots of failures.

I [00:05:59] But hopefully I can learn something from that for my thesis. And the following questions I would ask you to just respond in relation to South Africa. So I'm not sure Africa, but just for South Africa. Okay. So the first question is yeah, about the characteristics of the mHealth interventions. And then I wanted to ask what specific features of mHealth intervention interventions do you believe contribute to their potential success or challenge?

E3 [00:07:39] So I think it's about the most critical point is that you need to add value to people in their existing environment. So users shouldn't have to change too much. In fact, ideally shouldn't change at all to be able to take on the assistance from the app. So that's the first thing, because people don't like to change, like to make adoptions. And when technology requires people to change, that's immediately a barrier. The second thing is that it has to provide an advantage. If there isn't an advantage to using the app, it's very hard to get people to use that. Those are sort of foundational principles. You know, don't don't make people change and add value. So if if there is a change, it better be a change that adds value. I think that's absolutely critical in designing any of these any of these kinds of technologies. And then mobile creates a lot of opportunities to to do that really well. So. And starting point is people usually have their phones with them anyway. They have a relationship with a phone anyway, so you don't need to help somebody build a relationship with the technology. That relationship already exists, so you can then build on that, on that relationship and then design approaches, you know, user centered design and and participative design approaches work really well with with mobile health, particularly because the user already has this relationship with their with a phone and a particular way of, of wanting to work with the phone. And then from that what one can build at a technical level integrating with that kind of technology that's already on the phone is very helpful. Integrating with location functionality on the phone, integrating with other aspects of the phone identifiers and personal identifiers. There are a whole lot of opportunities that then become available. But let me stop there. I'll be moving in a useful direction.

I [00:09:56] No, no, the answers are really good. Yeah, I like them.

E3 [00:10:00] Okay. Super. Okay, I'll let you direct me. Yeah.

I [00:10:05] Okay, then. Yeah. We can move on to the next question. So. Yeah, so the next question is more about the cost part. And the question is what challenges related to cost arise for the implementation of mHealth and also what strategies can be applied to succeed despite these challenges?

E3 [00:10:28] Okay. Yes. So this is a massive barrier and it's for several reasons, the cost issue is something that from a First world perspective or is a the wealthier perspective seems like not such a big barrier. But the reality is if you're trying to get broad based adoption in any African country, including South Africa, this is probably your biggest barrier. And that's largely to do with the types of phones that people have. So developers tend to like to develop apps for smartphones with a lot of sophistication, and those are wonderful and they can do amazing things. But your broad base of users tend to be people that don't have those funds. So that's your first obstacle to the smartphones are extraordinarily expensive. The second obstacle is the data. Most app developers do not develop apps that optimize for so low bandwidth settings or even optimize for high bandwidth settings with data is really expensive. And South Africa, unfortunately has one of the most expensive data environments in the world definitely compared to other if you compared to Tanzania, more expensive in South Africa in real terms. But if you if you weigh that up in terms of what's the economic term, the value of money, if you if you find a comparator to measure what money is worth in South Africa compared to what money is worth elsewhere, that makes it even worse. So data is extremely expensive in South Africa. And that means there's a lot of resistance from users who are at a lower socioeconomic level, a lot of resistance from them to use anything that's going to have debt implications for them. So there's a there's huge barriers upfront. Now, there are a lot of ways that we can work around that. So if we start from the start from the top, but the regulatory space is elected government can do to put regulations in place to reduce data costs overall. But in particular to reduce data costs for apps that have socio economic value like health apps, zero rating apps. I think there's a lot the government could do to regulate that and to create good reasons why the big data providers would zero rates certain health apps. They could make money in a ton of different ways, just not on the health of people. So so that's the is the regulatory space. There's some real opportunities there. I also think that there are innovative ways of approaching financing for the handsets, and a country like Rwanda is a good one to look at for examples of how to do innovative health financing where, for example, there was an initiative driven by the president to create incentives for large manufacturers and banks to work together to make it easy to finance, to give people really low interest financing to to buy certain types of mobile phones. So there's that. And that's really government driven, led by the president in Rwanda. So it needs it needs that kind of high level vision and strategically driven regulatory change. So that's the one aspect that in terms of how developers build these apps, if they give attention to this from the beginning, there's a lot that can be done offline with a careful balance between what gets processed in the cloud and what gets processed on the device. Again, is a really difficult trade off. Yeah, because the more

sophisticated devices which can do more locally are also more expensive. So it's a very difficult tradeoff. But developers need to think deeply about this and then to really have extremely small data packets transferred in the in the data transfer processes and to get that down to an absolute minimum. And that's just about software discipline. Software developers are able to build software where the data packets are much smaller. And so there's a lot of discipline that can be played. The other aspect if we just look from a user point of view, what we can do there is to have a better understanding of what users are wanting to have anyway and to align with that. So there's a little bit of strategic thinking that needs to take place there because the devices users have in five years time are going to be different to the devices that they have now. So to have a staggered strategy for that mobile app so that you're releasing an app that people can use now, but that you're going to be planning version upgrades on a regular basis every 6 to 12 months, because the apps that people have in their hands are going to change dramatically every 6 to 12 months, I'm guessing. But definitely every year, the kinds of devices people have will change. And if the developers have some idea of those users aspirations, what is a user working towards? What would they love to have? And what are they going to be working in their own lives in the next year or two. And then you make sure that your apps version upgrade path, then match is what users are doing. And so to have that really clear sense, what's the reality now built for that but then anticipate the change and build along that pathway. I'll stop there.

I [00:15:58] Mm hmm. And so as of now, it's more that the developers. They develop something without like taking a close look at what the users need?

E3 [00:16:11] They understand what users need, but they building apps for themselves. Yeah. Or they building for the, for the user that they imagine would love to use their app. So there's just this mismatch. They don't have an understanding of the real user and the real user constraints or, or maybe they're thinking they're in South Africa, but maybe the app will be so great and it'll be used globally. So they it's an it's an easy mistake to make. They building apps for a world that in reality doesn't exist yet in huge numbers in South Africa. So I guess it's targeting for them to be very, very clear who are they building this app for and what kinds of handsets do those people have today? And then how are those handsets likely to change? Now, I have heard some developers say things like, well, I'm building for a high end smartphone because soon everyone will have them and that's not false. But let's define soon. And what is the pathway? And so I think developers need to be very, very precise about that so that they're much more targeted in what they develop. And then it will be a much bigger uptake. At the same time, they shouldn't dumb it down so much that it is of only value on a feature phone. So it's about understanding the

realities building for that, but making sure that you're still to go back to the very first question. We're still adding value. You have to add very specific value, otherwise no one's going to use it. And that's what makes building mobile apps, I think, challenging and interesting in this environment.

I [00:17:53] Mm hmm. You know, some really good insights. Thank you. And so the next question is. Yeah, who is responsible for covering the costs related to using mHealth interventions? Like, is it like, do some insurances cover some part of it? Or if people want to use it, they have to pay it out of pocket or.

E3 [00:18:19] Currently there's a mixture of that and what I've been seeing over the last year or two is progressively more and more innovative approaches to, to this. So for example, even some banks are starting to try and attract customers to their bank by saying that they will offer certain extra services like certain health guidance services at a zero rated data where the bank covers the data costs. So this is a very rapidly evolving space, and I think that's the right thing to happen. And what we need to see is advocacy at every level along the spectrum. So if we go back to that developed for being very targeted, it needs if we take it from the developers side, if a company is going to build an app that's very targeted to a certain type of user for them to then advocate for who are the other potential organizations that could be interested in this. So insurance is one, banks are another, retailers are another. You know, a lot of different organizations trying to move into the digital space and trying to attract customers. So there are lots of different ways to find somebody to try and pick up these pick up these costs. But again, it's not only that level. We need the highest level of regulatory change as well where incentives are created. And so I see it as very similar to a zero rating tax for certain food products. So in South Africa, there's a there's a basket of food products like bread and milk and eggs that don't carry VAT. So there's no VAT charge because they're regarded as, you know, basic requirements that poor people will need. And I think that similar kind of approach could be used in the regulatory space around health apps. So one has to be delicate or it has to be handled delicately because sometimes the corporations get into the space and we shouldn't be using taxpayer money to subsidize big corporations to make huge profits. But if it's an NGO, a nonprofit space, trying to build apps that are going to help the health of people, then that seems like a really good item to include in this basket of tax free items. So tax free would be the real. Just a tiny improvement. But to ask big corporations to zero rate that I think would be a very easy thing for government to do. And that becomes part of the social benefit strategy for those big corporations. So that's on the one end. The other is if we look at the user, it's to just match the apps better to what users already have. So the way to use your app is not a step up. It's not that the

user has to go and buy a new device. You matched it to the device they already have. And to understand their data environment. So that then any of these data benefits match that data environment so that really the cost to the user should be zero because as soon as there's a cost to the to the user, especially the low base. There's some studies you may have seen that look at the proportion of monthly expendable income people spend on data and in the low income levels, it's an extraordinarily high percentage. So they have very, very little spare money and they spend almost all of it on data. So if we're not asking them to spend another portion on data for a health app, they just won´t, it's not going to happen. So we've got to find a way that the cost to the user is zero again. But it goes back to the targeting question who we targeting? If we're targeting high end people, then really it doesn't matter if you're going to add at a portion to my data, I don´t care, in fact, I've got limitless data anyway, so it makes no difference. But if we're looking if we're targeting to a base of people where the big numbers are, where we can make an impact, those are largely much poorer people and it has to be zero. Otherwise they're not going to use that. Yeah, I think I'm drifting off your topic a little bit. Let me stop you.

I [00:22:36] It's really good. I find it really interesting. And then yeah, the next question, I think we already covered that. It's about how they can afford it. But you already named like a lot of strategies. And yeah, so the next question is like about the regulatory side, but you already talked a bit about can you maybe go a bit more into detail to that? Like the exact question would be how can regulatory and policy considerations be navigated to ensure compliance and smooth integration of health?

E3 [00:23:29] Yes, it's quite a there's quite a lot that can be done here. And it's just let me think a little bit about how to structure this. Okay. Right. I was starting to talk about the technology level. I think. Creating regulations on standards can be really helpful. So in the in the evolution of interoperability standards globally, there's a real strong move towards FHIR. So I'm not sure if you're familiar with standards, interoperability standards. Okay. So you can look that one up. It's part of FHIR (Fast Healthcare Interoperability Resources). So FHIR for developers is emerging as a really important standard frame for interoperability, not only for mobile but across the whole environment. And organizations like Google are actually developing resources to support that. There's something called the open Health Stack OHS that's being built by Google, and it's going to support using FHIR standards to build Android apps. So that's something that's quite a lot happening at the at that interoperability layer. And it's for countries to adopt those standards will be very helpful because then more people are building apps that are going to interoperate a lot, a lot better. So there and that what it does is it speeds up the time taken to build an app. And it also makes it easier to expand the app and then easier for

different apps to talk to each other, which really decreases the cost of building these kinds of technologies. So that's one piece of the technical level. And at the identity, privacy and identity level, there's already quite a lot happening in South Africa, particularly around the POPI Act. It is a piece of legislation. Mm hmm. It stands for Protection of Personal Information. It's very similar to the European GDPR and General Data Protection Regulation. I'm sure you're familiar with that. So it's the South African version of that. And that's quite new. That came into effect a couple of years ago, two years ago. And that's done quite a lot to improve the space. But I think more needs to be done. And some of it can be regulatory where regulations can help to enforce people in the right direction. But more needs to be done to help people who are uninformed about the importance of protecting their identity. So at the moment, if you're not well-informed, you might easily accept the disclaimer on an app and end up handing over a lot of personal data that's that you really should not be handing over so easily. And this in particularly in South Africa, and particularly, I think at the lower economic levels, if an app was seen as an advantage, then people would not really care about protecting their personal. A very clear and visible way. What they're doing.

I [00:28:49] Um, I think that's good. And. Okay. Yeah. I also wanted to ask a bit more because earlier you said like that the government can do a lot. Can you go more into detail in that area?

E3 [00:29:09] Sure. So both these examples I've given I think should come from a government level. I think government should regulate the standards and I think government should regulate more around privacy and the conditions around the privacy. I think government can do a lot of the costs as well. So, for example, designates certain types of apps as needing to be free because then the business model of the corporate sector will figure out how to handle the business model. This is a very good at finding out different ways to pay for things and that it's very easy to just make the user pay. But if government could legislate that, that certain types of apps and we can have certain conditions around them should be free. And then it forces businesses to be a bit more innovative in their thinking about how they finance these things. So I think that that that's the sort of government network that could take place and in a similar way government could lead, could create some incentives around collaboration. So if investors, insurance companies, banks would have some incentive to collaborate with technology firms that produce handsets. Data firms that make cellular data available. I think their government could, from a regulatory point of view, create some incentive for them to collaborate more around health apps.

I [00:30:38] And as of now, the government, they are not really doing a lot in that direction?

E3 [00:30:48] A little bit is being led by companies. Some companies are getting into this already a little bit, but there's very little collaboration between different kinds of companies and cross-sectoral collaboration. I'm not aware of any of that taking place that would need a government lead because these companies tend to not work together very easily. I think they need to be encouraged to do that. Government could do can do that.

I [00:31:15] Mm hmm. Okay. Yeah. Thank you very much. And. Yeah. So I also yeah, I read a lot that yeah, those mHealth interventions that they had got like funding but then it stops and then they're, they, you know, they confiscated up, they can't continue. Um, so yeah. Can you think of some strategies that they could apply to achieve the sustainable funding?

E3 [00:31:48] Maybe some other point, I think that those, those may help and those are really big framework kind of changes. I think an easier issue would be to insist that any new effort is to have a sustainability plan before it will be approved. Now, there isn't any kind of approval process in place at the moment. You could just put your app out there and the market decides whether they usable. So I think that's where government could step in and there could be some. I wouldn't want the gatekeeping to be too much, but it could be along the lines of confirming that the app adheres to certain principles. If there was some certification of some kind I could get, part of that certification could be around interoperability and meeting standards. Some could be around personal protections like the POPI Act, that yes, those issues would be dealt with. So a certification of some kind could be really, really useful here. And one of those certification issues could be have sustainability issues being addressed. And so, for example, if the funding is being used to build the app, but there's some other approach to making sure that it's affordable for users, and the approach around affordability for users is not using short term grant funding. The affordability for users should be a permanent plan. Whatever the approach is, it needs to be permanent. Then the grant funding is used to build the app to get it going, to get it up, and the sustainability has to be part of some other related plan that's in place from the beginning. Because you're absolutely right. What tends to happen is grants come in, they get something going, and then when the grants finished, everything collapses. Now, that's a very common story.

I [00:33:38] And how could they like what could like a sustainability plan like that? Look at what could it look like?

E3 [00:33:47] So it's about the developers or the implementers was thinking about the long term issues from the beginning. So as we've been discussing now, how do we make this affordable for use? How do we set up the app from a technical point of view and from all the relationships? And how do we set it up in a way that it's going to be affordable. Now, if we are not forced to do that, then we'll say, Well, it's fine. I've got grant funding for the next six months. Affordability is not an issue. Don't worry, we have this high end app to give everybody. We ran a pilot with 100 people. We give them all smartphones, we give them old data plans. We use this high end app. We build a clumsy app that moves mass data packages back, back and forth, and at the end of our pilot will say it was a huge success. This should be rolled out everywhere and then we disappear. So that's not acceptable. So right from the beginning implementers need to be implementing the reality from the beginning. And these issues around sustainability need to be addressed from the beginning. Enforcement is the problem. So even if we said that's a great rule, you and I think it's fantastic, why would anybody follow that rule? And this is where we need some degree of this quality certification. And that's where the government could step in to say in South Africa, if you want to launch a health app, you need I guess it could be something as compulsory, but government could offer it and it not be seen as an advantage in the marketplace so that if I can get my app certified by a government stamp. Yeah, it's a certified app. That might be an advantage for me in the marketplace. So I think something along those lines could be helpful.

I [00:35:39] MM Yeah, yeah. It's also a really good idea that it pushes them to think long term. If we, uh, like, look at the organizational structures more, the question would be what are the organizational structures and cultures within the health care system that either support or hinder the implementation.

E3 [00:36:14] So let's talk about hindering first. I think one of the problems mHealth is that it is defined as mHealth. I think that that somehow pushes it at arm's length. It's that if you're going to use a mobile phone or a mobile app, then it's an mHealth thing and it's somehow separate from everything else that gets done. So it's not well integrated. It's we don't have a situation at the moment where in our daily lives in the health sector, we use all available tools, including our mobile phones, in an effective way. That sort of integrated approach would be far more useful. Remember our phones first became available, then we realized we could do interesting things in the health sector. We called it mHealth, and that became this sort of excitement throughout mHealth. But it was very niche. To majority of people mHealth meant nothing and that that was perhaps necessary ten years ago, I think is becoming a problem now. And I think we need to motivate for not so much looking about mHealth. We're talking about health utilizing all available

tools, including the mobile phone. How do we use the mobile phone in health and to somehow find a way to get it more integrated? I think that's become a real structural barrier to our thinking so that even if I went to a hospital or to district government to say, Hey, I've got this new idea of how to use this app, then immediately they would try and find somebody with the title sort of mHealth official. They try and find somebody for me to put me to go have that conversation. But those people don't really exist. So I think that's a real structural barrier to our thinking. Related to that is even outside of the health sector, I think there's still a bit of a struggle around how to deal with the bring your own devices in the workplace. The concept of BYOD, you know, bring your own device. But the idea that when you go to the workplace and this applies to almost any industry, your work will generally give you a laptop. And that laptop will be extremely controlled by the work environment. They'll have their own antivirus software on. It is probably some sort of a tracking tool that allows your company to control your device. If you open up your mobile phone in your work environment, the same controls don't apply. And so many companies don't know how to deal with mobile phones. And the various attempts of some companies then say, well, no, the company will give you a mobile phone and it will be the same as your laptop. They will control it. They will manage it. It's a company phone. So they see it that way. Other companies say, well, no, you can use your own phone, but you have to buy. So I was. I was busy explaining the complexity around trying to use your mobile phone in a work environment. So companies have tried different things, but it's still quite difficult. It's still quite a messy approach. And so then if we now go into the health environment, which is in some ways just like any other business, it's very easy for the Department of Health or the hospital that's in charge of you to manage your laptop. But it's quite difficult for them to manage how you engage with your phone. And so this ends up being a little bit of a barrier is should they give you a phone that's in the company's phone? Should you use your own phone? If it's your own phone, how does that how is that going to be managed? How's that relationship going to be managed? And so I think that's a little bit of a barrier that's more than simply around the cost or the utility of the act. It's actually a structural thing. Is this part of your job or isn't it part of your job? And that then is related to this point I started making is that mHealth is still seen as this thing that's on the side. It's experimental, it's not mainstream, it's not part of your job. So I think that's currently a massive barrier and it can be quite easily fixed by simply saying that part of the workflow, part of the way you do your job will involve this app and start actually making it part of the workplace. Yeah, let me stop there. I've actually not forgotten what the question was. Do you want to help redirect me?

I [00:42:37] Yeah, it was about the organizational structures that support or hinder the impulse implementation.

E3 [00:42:45] Okay. Yeah, that's the main one is that at the moment it's not part of the structure. So the answer is there has to be a structural approach. How does it fit into the structure. And that will get down to basic things like the job description. What, what, what is the job description of a nurse? What is the job description of a doctor or if you´re an administrator. What's your job description? Community health worker. What's your job description? How does that work? And how are you supposed to fulfill that role? Now, if the word mobile phone never appears anywhere there, then it's going to remain a structural problem. In fact, it's not part of your job and you should actually ignore it. So we need to find a way to start integrating it and moving from mHealth being very experimental to using your mobile phone being a part of the job. Now, the difficulty, how successful the experiments have been and where have we proven that a certain app is essential to the health workers environments? And and that, I think, is a little bit missing. So it's almost like we need to evolve the studies that are taking place in the research environment to start now demonstrating this, not just that, yes, it's useful app, but is this a useful tool to be applied to a certain health worker category? And if we can show some research around that, then that might lead to more productive or more progress around fixing these structural issues.

I [00:44:20] Mm hmm. And do you have, like, any experience or do you know about, like, the readiness of the health workforce and the patients?

E3 [00:44:42] So I'll use the example of WhatsApp. So health workers and patients are already using mobile tools in every part of their lives. And I believe that patients and doctors and all kinds of health workers are already using WhatsApp to fulfill their role as health workers. They're already doing it. They're not allowed to. So strictly speaking, they should not be doing it from a somewhat legalistic point of view, but they are doing it. So I think that that makes the point that when an app fits into their lives in an easy way, then there isn't a question of, you know, are they okay? Do they want to use it? They just use it and they don't think about it deeply. So in terms of readiness, yeah, the readiness of the individuals is there. It's the readiness of the environment that's the problem. What's the quality of our apps? What's the ubiquity of their use? What's it going to cost them? What's it's going to mean structurally? What it how does it fit the rules of their particular profession? Those are all the things that need to get sorted out a bit. Readiness. Yep. They're already doing it. And, and they're actually, interestingly enough, when I'm sure you've seen some of this research in South Africa, there's been a little bit of research that very good or very big studies, but it's been a little bit of research around the use of

WhatsApp. But when sending a WhatsApp message is useful to the health worker. They do it without asking any questions, without asking any permission, and without asking anyone to pay for it. They just do it. And I think there's a really important lesson in there, and that's that because there are a few things that are fundamental there. One, they're very familiar with the technology. They don't need to learn anything new. It's extremely easy to use really extremely, extremely easy to use. They don't need to go and be trained how to use it. And it's ubiquitous. It's already it's a really familiar environment. Therefore, they use it, even if it is a small extra cost to send that message. They're using a little bit of data and they'll do it anyway because they're familiar with it. And so if we compare that to most mHealth apps, most mHealth apps are quite difficult to understand. Not very user friendly, quite complex, and require almost a user guides to have a full grip on what's actually required to use them well. And all of that is quite heavy lifting for a user. And you you may have had some experience yourself where you've downloaded an app that looked interesting. You swiped once or twice and just decided, No, this is a piece fish and you've and you've just dropped it. Now in the mobile health world. Imagine you're now being told by somebody. No, you have to use it. So your resistance is going to be incredibly high. You'll start saying no, but you're not paying for it. And why buy my data and this and that and you come up with all kinds of excuses. What it comes down to is just wasn't part of your life. It wasn't an easy, fun, interesting part of your life, because if it was, you would have used it anyway. No one would have had to tell you to. So I think this is a fundamental part of how we think about mHealth. And there again, the label can sometimes be a problem that we're describing something that is over there, something different. Instead of just saying, well, human beings use mobile phones every day. I don't call my wife and say, we're having a mobile conversation. We just having a conversation. So it's isomehow there's this separation that exists around mHealth that's not helpful to us. And we need to find ways to break down that separation. Well, and some would and some would argue that in some ways it already is the standard because doctors are phoning each other, nurses are phoning each other, and community health workers are phoning each other to talk about patients. They're also sending images via WhatsApp. They're doing it. We don't call that mHealth because it's not the right app. It's not approved, it's not legal. It's in South Africa that's actually illegal. You're not allowed to do that because it's not authorized. It's not controlled. It's not protected. But they're doing it anyway. Yeah. Yeah, exactly. All of those issues, they're doing it anyway. But we don't call that mHealth because it doesn't fit our definition of mHealth. I would actually call that an mHealth success. Now the question is, how do we understand what is succeeding there? As much as we say we don't like certain aspects of it, what is succeeding, and

how do we replicate that in more ways with other parts of the mHealth that are maybe not succeeding? Back to you. Okay.

I [00:49:49] And if we look at the overall climate for implementing mHealth Solutions, how would you perceive it?

E3 [00:50:14] Yeah. So I think the difficulty here is the question is too broad and in in people's minds if you ask anybody. That kind of a question, that individual wouldn't really know what you were talking about. So if we use the WhatsApp example, what's the climate for people using WhatsApp? It's extremely good. Everybody practically is using WhatsApp. And what's the climate for communicating with their colleagues about health cases on WhatsApp? It's extremely good. They're doing it anyway. So the question would need to be, well, what's the climate around a specific app? And then it would depend on the app. And so I think that's the difficulty, is that the I think we need to separate the issues out. I understand what's the climate for using mobile phones generally? What's the climate and what's the penetration of different types of mobile phones. That'll give you a sense of who's using it. And then if these mobile phones are being used extensively by lots and lots of people, but they're not using certain types of mobile health apps. And the question has to be asked why? So it's not a climate issue. So I think this question needs to be separated a little bit into those different pieces. What's the climate around using your mobile phones? Extremely high. What's the climate around using apps to communicate in the health industry? Extremely high. What's the climate around using specific mHealth apps? Well, very complicated, and it would depend on which app. And largely all the issues we've been talking about up to now come to play. And it's largely how well has it been designed? Does it speak to the users needs? How much is it going to cost them to use it? And all of those questions come into play across a wide range of apps. But it gives us it gives us a chance to talk about the issues. But I think those those are the issues then, and it's about separating out the question. We're not saying I don't think there should even be a question. Would health workers like to use their phones? Absolutely. They are. They are doing it already. But what would they like to use their phones for? And has there been enough work done to ask them what they would like to use their phones for? What are their barriers? What do they find difficult in their work and how could their phones be used to address the things that they find difficult in their work? That sort of targeted work was done so that when we build the solution, we build something that is targeting an exact need and then we build the solution with the user. Then I think we'd have a lot less trouble. But that tends to not be the way apps get built and. So the most successful apps are definitely built that way. They're answering a need that lots of people have and is answering that need in a very, very simple way. Now, if

we started doing that in the health space, I think we'd make better progress. But we tend to we tend to respond to what some techie thinks is the cool idea, which often is technically very, very cool. But it's not going to be so great in the real world and all the other things we respond to the people that have the money, whether it's government officials or donors, or because they've decided what they think is the right idea. And that's where the power lies. That drives the development of a lot of mHealth apps. I think that there's not enough of it done to understand what users are actually struggling with and where they'd like some help and where they'd like to use their phones to do that.

I [00:54:36] Okay. And then the last question is more like a round up. So, um. Yeah. Based on the insights, what are the key takeaways or recommendations you would provide to start ups when looking to implement and have solutions in South Africa?

E3 [00:55:01] Yeah, we actually got there quite naturally, didn't we? I think what we're talking about in this last piece, it actually loops back nicely to where we started this conversation. Really understand what value you're giving a user. And I think that that's something where they need to challenge themselves to say you think you're doing this, but are you really? Are you challenging yourself to actually say, I think I'm doing it, but maybe I'm not doing it enough? Because almost every startup that I've spoken to. What I was really trying to say is that the organizations that want to develop these sorts of apps need to be challenged to really think a lot more deeply about what that individual's view is. So sometimes we can scientifically make the case to say that's the need, that's how we're addressing the need. This is the case for change. This is how we benefit the entire health system. Isn't that wonderful? Let's go build the app. But users are human beings sometimes don't agree with the logic and don't agree with the science that humans beings behave in different ways. And I think we need to work harder to understand what's that human behavior going to be like and actually talk to those individuals that we see as the users and get really deep, deeply involved in talking with them. And ideally, those should be users that are not that have no insights into the technology at all, because that's the other mistake we do is we talk to users that are from the cohorts that we see as our users, but we choose the people that are excited about the technology anyway, and we should choose the people who are not interested in the technology. In fact, don't even want to talk to us. Those are the ones we should be speaking to. So I think I think that that would that would really fundamentally change how we build these sorts of things. And the other thing that I would challenge startups on is. Be very careful about trying to do something brand new and rather look at what's already working. Look at what people are already using out there. I use the WhatsApp example. So is there some way

to connect an added value into an existing environment that users love working in? I think we don't do enough of that. And there's a little bit of a Hollywood mentality, or I could just call it Netflix mentality. So everyone wants to be the next billionaire. Everyone wants to be the next unicorn business with $1,000,000,000 in Africa. And every young developer is trying to think of the cool idea that they could do that's going to get out. So that means we have thousands and thousands of developers building things that actually are never going to be that. Hmm. So instead of saying, Hey, let's first, figure out what's going to work, understand the user much better than they do at the moment and see how we can plug into an environment which users already love, already using it by using and connect much, much more closely to the real world and not see everyone get too excited about wanting to bring about massive change. Those real disruptive moves happen very, very rarely and infrequently. So I guess that would be my advice to the startups, since they are very excited with kind of just be a bit more practical and see what you can learn, see what you can learn about understanding your users better, plugging into what things that already exist and see what you could learn. And along the way you might have some success that you can then build on. And maybe those successes will be some failures and some successes. And some failures may be the thing that helps you realize enough insights to then become the next unicorn billionaire. MM Yeah.

I [01:00:09] Yeah. Thank you. I think your answers were really helpful. Like a lot of got a lot of nice insights also like different from the other interviews. So that's really nice. And yeah, like, do you have any comments or questions you want to make before we finished the interview?

E3 [01:00:30] There's no questions just to say thanks. This was fun. It was nice meeting you. And I look forward to seeing the results. So please share the publication with me. I'd like to see that. Yeah. And it's great to have people interested in this space. They get to see people that find this interesting and exciting and. Yeah, please stay in touch.

I [01:00:52] Yeah. Thank you. I would definitely do that. Yeah. Thank you very much for having taking the time for me. And yeah, I also really enjoyed it meeting you.

Appendix 6.4: Interview Expert 4

I [00:06:09] Yeah. Okay. So, um, yeah, the first question, it's more about you. Um, can you tell me a bit about your position and your background with MHealth?

E4 [00:06:21] Okay. So yeah, some of this you will probably not need to know, but sketchy history. As a commando helicopter. Pilot in the Royal Navy went on to university and did a basic degree in biological sciences. I thought I wanted to do something to help people. And so I went into clinical chemistry. I always had a fascination with drugs and

poisons that specialized in toxicology. And from there was working as a toxicologist quite happily. And somebody approached me who was working in this funny thing called telemedicine. She was from the University of Calgary in Canada, and I was intrigued by this and thought that would be an amazing way to go in the future. And that was probably, I don't know, around about 1995 maybe. And then I was invited to go and join the University of Calgary. And so I went over there, family moved over there, and we started working. Since that time, worked in telehealth, telemedicine, e-health, whatever, you know, digital health now, whatever you wish to call it. And as I was working, my interest fell towards developing countries. South Africa, of course, is a bit of a developed developing country all the way around. So it's a bit of a mix. But nonetheless, started traveling to various locations, did some work in Asia, South America and also Africa. And the focus bubbled to the top in terms of mHealth. Although I despise the word ubiquitous, everybody says, Oh God, cell phones are ubiquitous, which is rubbish. But, you know, we've got a hell of a lot of cell phones out there that are basic and so can't do anything. Feature phones or the smart phones. And so I was frustrated by that and wanted to calm people's expectations, if you will, and yet try to get them to understand how they could facilitate the use of mHealth in a sensible fashion in developing countries. And as I say, one of the focused areas was Africa. And I ended up working, as I think I said a minute ago, living and working there for a year to sort of try to work through that.

I [00:08:55] Mm hmm. Yeah. Really cool. You traveled a lot also, then. Many different countries, many different perspectives.

E4 [00:09:05] Yes. And I'm sorry. I apologize. I know you're focusing on South Africa, but you will find that perspective comes in.

I [00:09:12] Yeah. It's all good. Yeah. Okay. Thank you very much. And yeah, then we can already start with the first. Um, yeah, well, content wise question. And, yeah, it's about the, um, health implications, about the features. So, um, what specific features of mHealth interventions do you believe contribute to that potential success or challenge?

E4 [00:09:41] As I implied a moment ago, I think their success is obviously the fact that they are becoming more common, shall I say, and more common for an unrelated reason or a reason unrelated to health. And I think that is one of their best features because people are becoming used to using them. There's going to be relatively little need for sophisticated training and introduction of people to technology. Obviously you've got to take into consideration the specific locale where you wish to implement, but nonetheless, in general terms, they're becoming useful for communication, entertainment reasons, and therefore they will not be. It will not be a huge leap to get people to use them more

and more for health care purposes as well in terms of challenges. The concept that indeed, oh, I can take my cell phone to the medical of middle of South Africa and still get connectivity is, as you will appreciate, rubbish as well. So one of the biggest challenges is still connectivity, which of course for a company, a large communications company is a challenge because they do not wish to spend the money that is necessary to get true connectivity and by true connectivity I mean something where you're not holding your phone up in the sky and trying to get the borrows increasing on your phones and then being able to carry out a useful conversation or exchange communications in other ways with somebody else for healthcare purposes. So its potential still lies in its common availability, increasing availability and its ease of use. But the challenge remains the connectivity.

I [00:11:52] Okay. Thank you very much for your answer. And, um, when a like cost is, of course, like a big area for M Health, so the next questions are in regards to that. So the first one would be what challenges related to cost arise for the implementation of mHealth and also what strategies can be applied to succeed despite these challenges.

E4 [00:12:20] And this may show one of my biases, but it's always debatable. But you can consider ehealth, and I tend to still use e-health rather than digital health, which is a far more complex topic that you can still use or consider e-health to be comprised of health informatics. So getting health information together and sharing it and storing it somewhere. Telemedicine, or which would include mHealth, which would be the sort of the pointy end where actually having an interaction with a patient as well as education, which is an important one. Or mlearning e-learning, whatever you wish to call it. And then finally, also e-commerce, because this is often forgotten about, but in the end, health care costs and some of these got to pay. So if we look at it in that fashion, I would like to say that people begin to prepare a strategy. And for the biggest challenge in terms of cost in my mind is refocusing people's attention and getting them away from health informatics. We have been trying for years to make eRecords compatible and interoperable. And they said in Canada in 2001, I think it was that within five years we will each individual will have a health record, electronic health record. And of course, that's not happened. And although I keep hearing of promising individual things within South Africa, I don't believe it's happened in South Africa either. And it's not going to happen for a hell of a long time until everybody is using one platform and agrees on a whole variety of things. So we're spending our money, have been spending billions of dollars over the years on health informatics. So a strategy, a major strategy in my mind, is to try to get the policy and decision makers and even industry to refocus their attention away from health informatics and the dream of having an interoperable EHR or EMR or

PHR and get them to focus on mHealth telemedicine a little more broadly for mHealth, I think in particular. And so that would be the strategy. And I think when you consider the amount of money that we spent on trying to establish E records of one sort or another, spending a dribble of that amount of money on mHealth would dramatically change the scene in terms of the availability of health care to the average citizen in South Africa and any country. So biggest challenge is getting people to change their mind. But it would reduce the costs that we have to pay in order to achieve our end goals.

I [00:15:27] So what strategies can be applied to ensure that the patients can afford using mHealth?

E4 [00:15:54] From here. This may sound a little bit counterintuitive. I don't know. But as as I've been doing the work, I've sort of felt that we often talk about community health care workers at all different terms applied for that same thing activity. And if we could actually pay attention towards those initially, A, I think they would be more aware of and able to use phones, which are bound to change. You know, as we've mentioned, the basic, we've got the feature phone and we've now got smartphones. Everything is moving towards the need to use smart phones to achieve the neat things that we wish to do. And we'll speak to speak about that a little later on, I'm sure. But anyway, if we focus on those individuals because they're easier to access, more knowledgeable, then that will at least quickly, more quickly, I think, infiltrate mHealth into the psyche of both the healthcare workers and the patients. And then as the patients become more able to access the necessary smartphones, it will be an easier transition for them to start using it more and more for health care. That's a little bit of a side answer, I suppose, but in the end. It depends what country you're in. And I know you're focusing in on South Africa, but a lot of people look towards the states. That's an insurance driven country. Canada is more public health oriented. And so we all have coverage. They shouldn't say this theoretically, but South Africa has the same thing. So public health care is available to every South African. But the reality is, in the end, I think. The facility in terms of the cell phone, mobile phone, whatever you wish to call it, will be bought by the patient. And so they'll have to incur the cost of that because they're using it for other things. But the actual service provision, I would like to hope, is still provided through taxes and necessary other means by the government of the country.

I [00:18:25] But, I mean, it's not the case right now no?

E4 [00:18:29] No. Right. Well, no, it's not. Because at this point in time, there's very other than patchy things, my understanding from South Africa, in South Africa is that there's only patches of mHealth activity. I know we've been struggling with one to get it. You

know it's happening. You've probably heard about WhatsApp and the quiet, surreptitious use of that illegal tool. But unfortunately, you've got Voula. I suppose that's been formally accepted, I guess. So there are aspects, but it's not across the country and they're not the government is not providing the mobile phones for those people to use those tools. So still an actual fact, I don't think that's available to patients. So still, at this point in time, the individual patients have their phones. So they need to actually access healthcare services is somewhat out of pocket, but it shouldn't be in my mind. It should be through the government.

I [00:19:42] Okay. Yeah. Um. And, um. Yeah. Like the next question. It's about the, like, about policies and so on. So the question would be, how can regulatory and policy considerations be navigated to ensure compliance and smooth integration of health?

E4 [00:20:07] Shooting the people at HPCSA. I think there has to be greater awareness of those people who are making these decisions at the government or regulatory level about just what these tools are. And they have to give up and accept the fact that it's an inevitability. We're going to move in this direction whether we will like it or not. And I could bore you with another aspect that we're probably not going to touch on whereby I think that perhaps we should not. But anyway, we are moving in this direction. It is going to happen. We have to accept that and we have to find better ways by which to use these tools. So from a regulatory policy perspective, it's a matter of education, making people aware. Using these tools, I suppose, or mHealth, as an educational tool to actually allow people to become familiar with them and actually use them and apply them. But get the right people with the right knowledge in the right place to allow the proper policy moving in the direction of applying mHealth and regulatory. In other words, the legal ability to use these tools so we can move forward.

I [00:21:43] Mm hmm. Okay. Thank you very much. And, um, yeah, so. But I also read a lot. Was that the, um, how, like, they start an mHealth application and they get funding in the beginning, but then after the funding stops, Yeah, they don't have the money to scale it or anything. So the question would be what strategies can be applied by these organizations to achieve a sustainable funding for their health application?

E4 [00:22:14] Obviously, South Africa is no different to any other African country, no different to any country in the world in the sense of limited resources. I don't know of any country where there's unlimited money available for whatever you want to do. But I think it's a matter for that of as I was hopefully explaining in the in response to the earlier question, if mHealth is an accepted tool and we understand how it is to be used, where it's to be used and for what it's to be used, then it becomes natural to fund it, to sustain

it. And so the government buys into it and so therefore is willing and able to put the funding necessary to maintain to sustain and grow scale these applications. So I think it almost follows on automatically and you won't have to force it. So you will have heard the term. That I've now forgotten. But never mind. There's a limited part for you. What if you take the money from here? Then you can't use it there. So there's got to be a shift beyond a shadow of a doubt. And I think this is where the powers that the government has to have faith and a clear vision of what we want to achieve and how they're going to achieve it. If they see the end goal and they see that in the end that will save them money, then they will be able to find a way to finance things in the interim to achieve that goal. If they don't understand or have the clear vision and policy and regulatory material in place to allow it to occur, then they will always be anxious and bothered holding back and won't be funding things properly. So it's really a matter of, in my mind at least again, actually I'm going to use that term again because I liked it so much having the right people in the right place with the right notes to do the right thing, and we don't have that. South Africa doesn´t have that at this point.

I [00:24:26] So the government has not yet like really realized the potential of like mHealth and other things, I guess.

E4 [00:24:40] Yes. And I just I will mention this in passing and how you, how much you want to pay attention to it is obviously up to you. But speaking of South Africa and actually most countries, it's just more subtle. In my country where I live, there's corruption and so much of the money that we need is not finding its way to the right locations for the right purposes. So and I don't know how on earth you tackle that way out of my experience area and way above my pay grade, too.

I [00:25:16] Mm. Yeah. Difficult topic. Yeah. No. Okay. Um, and then moving on to the next questions. Um, so what barriers will the individuals serve by the organization be faced with to participate in the intervention? And how could they potentially be overcome? Like in the beginning, of course, you said, like with the connectivity and so on. But yeah, maybe some others as well.

E4 [00:26:03] Even in general terms, you use terms such as. Well, such as organization there and whereas another and use of the term startups. I don't know if this was your intent, but this sort of seems to me to suggest a bit of a commercial industrial approach. When you say organization, where we've been speaking a lot about patients to this point in time, well, they're not an organization. So who is the organization? Is that industry and how they're trying to influence mHealth? Is it is it large mHealth care organizations structured as insurance companies? Is it private organizations rather than the public

health care system? Just want to try to understand where you're coming from in this regard.

I [00:27:01] M Yeah, it's yeah, it's actually includes all of them, like in general, like any kind of organization that yeah, wants to implement. M Health, whether it be Yeah, like an insurance company or whether it be, you know, a start up, it's yeah, I didn't specify it here more. It was just very general.

E4 [00:27:27] Okay. Personally, I'm always a little bit anxious about as I already, I suppose, implied. I'm more of a public health person than a private health person simply because living next door to the US, I do not see a very good example set of how a private system insurance system should work. So most of my comments and actions and thoughts come from the public health side of things. So getting back to your question, which was number nine, did you say you are the president of Health Care Workers regarding experiences? Oh, from their experiences. If I get this question correctly, it's from the patient's perspective. In other words, their experiences. In the work that we've done. And this may come in in response to other questions as well, I'm not sure, but simplicity is the greatest thing. And two things, actually, will boil it all down to two things. One is having an absolute need. Because if you are answering the patient's need, oftentimes we take it from the organization's perspective or the health care providers perspective, we're still not very good at taking it from a patient's perspective, although we often talk about this. But if we're answering a need for that patient or that the tribe, shall I say, or that small, small area, then they naturally want to sustain it and scale it and keep it. So it's encouraging them to do what is necessary in order to achieve that. And so from their perspective, it's got to answer a need. And then I suppose the other thing is, well, if you offer them as an mHealth solution, they've got to be able to use that need. So it's simplicity of the tool of the solution, whatever that may be. So for me, I guess the answer is need give them a simple tool by which to address that.

I [00:30:25] Mm hmm. Okay. And.

E4 [00:30:28] Yeah. Sorry. I'm just saying, a health care need. You can answer a lot of needs using em. Tools of one sort or another, but focusing purely here on health care. Mm.

I [00:30:40] Yeah. And. And I think that this was now question eternal, like with the experience and yeah, like the question with the barriers. What barriers?

E4 [00:31:06] Yeah. Agreeable number ten? Yes. No. Yes. No.

I [00:31:10] So, like the barriers that the individuals are faced with to participate.

E4 [00:31:22] Right. And this is going to sound like a bit of an obtuse response, I think. But it's important, especially when you're thinking about your model, to see the CFIR model or any model in actual fact or framework that you want to employ. The barriers will depend upon the situation, which is not a terribly helpful response. But what I want to try to get across from my perspective, and I'm hope maybe I'll just say it now and then it's out of the way because I think it touches on a number of other things. You can't just use a framework and say, Oh, check. Yeah, they've got that problem check. They've got that problem. No, they haven't got that problem. Oh, yeah, they've got that one. You can't do that. It doesn't work in practice because we don't know all of the issues. The model does not cover all of the issues that are pertinent to why something is working or is not working. And furthermore, and this is something I don't think that people fully appreciate - the importance of different aspects on your checklist changes again by the location where you're trying to implement something. It may be, you know, language is a big issue in South Africa. So it may be it's a major problem here. Not a problem at all there. You know, so if you got a list, you know, you can't just simply check them all off. And it may be more complex than that because, okay, it's not a barrier for the more can I say the more affluent individuals in that location. But it's a hell of a barrier for those people who have little education and little knowledge. We want to reach everybody. Not just those who can afford it or who know what it's about. So the barriers, as I say, will change. And the importance of those barriers will change. So it's almost and this sounds a terrible thing, but it's almost like you've got to go to every little village, every little oak, and carry out a complete assessment. And to some degree, it is like that. It's just, you know, not like that in and in an absolute fashion. But the people who are implementing have to constantly keep their minds open about the fact there may be something else. What is it? What you know, what's the problem here specifically? They've got to pay attention to that. And I don't think we do that very well because we think we know we've got this framework that identifies 90% of the issues, but it could be the other 10% that screwing things up. So you've got to be, as I say, constantly aware of that possibility and that issue and be alert as an implementer, as a decision maker to that possibility. So anyway, I can't be too specific about what the best. And if I may send you back to the, um, if I may come to one of my earlier answers, if you've chosen, if you, if you are answering a real healthcare need and you've given them a simple tool by which to address that need, there won't be any barriers. Well, not true there will still the barriers, but it will be minimal.

I [00:34:56] And I guess there will be the motivation to.

E4 [00:34:59] Absolutely.

I [00:35:04] Mm hmm. Okay. Thank you for the answer. And, um, yeah, the next question, it's more about the structural characteristics. So the question would be what are the organizational structures and cultures within the health care system that either support or hinder the implementation of mHealth?

E4 [00:35:28] Yeah, I think we've almost already touched on that in response to the earlier question. But leadership beyond a shadow of a doubt. If you don't have people who believe in the solution and mHealth solutions and understand what it can do, then they're not going to be vociferous leaders. They're not going to be out there doing mHealth. And so there's no there's very little motivation for us to move in that direction. So I think leadership is very important and has got to come at all the levels because when you implement something like this, it's not just, you know, the president waves his magic wand. And there we've got mHealth. There's all of the provinces and the provincial health care systems that have to understand also and believe in. And so the leadership goes all the way down, even perhaps to the village level where you have a village elder. If they don't want it to occur in their village, it ain't going to happen. So the leadership, the understanding of what is trying to be achieved is necessary at all levels. Culture may be another issue, and I only I've not had the experience of going out to individual villages and speaking to a village elder, but I have heard of all sorts of issues. Actually, there is a study one time whereby just simply the language people have different interpretations or there's not a word for that in their language. So how do you explain to them what is going to happen and why it's a good thing for it to happen? So there are issues like that. But I think if people can be educated to understand, and that will naturally lead on. The leadership will move things in the right direction. Other cultural aspects, again, something I've heard of, but not I cannot say I've experienced it is fear of photographs, taking photographs of people. And another thing that now is not for those and this is a terrible thing to say, I'm sort of putting people in compartments which we tend to do as human beings anyway. But those people who are less educated, they will not understand the implications of sending my sensitive health care information across the waves to somewhere to that magic cloud above and wondered where that cloud is. But they will not understand the potential of that in terms of harmful events other people accessing it and things of that nature. So those security confidentiality issues in there that that some people will be concerned about and probably those people who are slightly more educated but don't really understand what's going on. Can something be attacked? My understanding I don't have the skills myself, but my understanding is absolutely doesn't matter what it is. Somebody sometime is going to come up with a solution and will be able to hack it. You know, it's a game to some people, so there are a hell of a lot smarter

than me. But do we really need to worry about that? I'm going off a bit of a tangent on this question, but I wish people were if we were more open, if we didn't really care. You know, I'm sorry I've had a hell of a lot of operations. I don't really care if people know what operations I've had. I, you know, I've, I've been exposed to a whole bunch of things. Okay. Actually, no, I apologize. Getting off on a tangent here, and I do that a lot. In the US and actually, this is appropriate for South Africa too. But when AIDS was an issue, a major issue, it still is. But when it was a major issue, people were afraid to admit, and I know there is still some of that around less so, but there's still some of it around. So they didn't want other people to know they had AIDS. Well, if that information is available and it gets out, then they could be viewed differently by their local village, their friends, family, everything. So there are still some important aspects. But if we didn't care about that. There wouldn't be an issue. So this problem of confidentiality is an issue that has to be addressed somehow along the way. And I don't quite know how we do that, actually. I don't care. But other people do care. So what can we do about that? We're individuals. But what am I trying to say I still think that kind of thing is a bit of a barrier. And I don't understand how we can get around it or avoid it because we are using technology to send sensitive information to who knows where sometimes. And there's nothing we can do about that because that's the way it works. But we've got to get into our heads that the possibility of it being obtained and used for a nefarious reason is pretty small. And we've got to relax. I think about this because if we didn't care, then there would be no reason for the people who want to break the code and sell the information. They wouldn't have anything to sell anyway. There's a bizarre response to a pretty, pretty important but small issue. Hmm.

I [00:40:57] Yeah, it's interesting. And yeah, I totally get it. In Germany, also really afraid of our data, like spreading it. But then of course, if you use certain apps and or so much data, yeah. Gets shared. But yeah, I guess a lot of people don't know. Maybe you. Yeah, you would need to educate them more.

E4 [00:41:21] Yeah, using something we've already shared about ourselves on Facebook. You know, if people wanted to build up a profile of an individual, a heck of a lot of people could build a profile could be built up purely by what they're freely giving away on a daily basis.

I [00:41:37] You Yeah, I think people are just not aware that they're already giving away a lot of data.

E4 [00:41:43] Yeah. Yeah.

I [00:41:44] Yeah. Okay. And then looking at the next question. So this is also like a pretty general question about the implementation climate. How do you perceive the overall climate for the implementation of mHealth in South Africa?

E4 [00:42:06] I think better. And you will have heard this from other people. Covid did a great favor in the sense that it forced health care workers to become more aware of and more used to using mHealth solutions. And I think I think it did also the same thing for many patients as well. Not everybody. There's still some people who are getting it, but I think because of the side effects, for want of a better phrase, have covid, it is a great big favor. And so I think that in general terms, the atmosphere, the setting is more prepared for moving in the direction of mHealth than ever it could have been if that had not occurred. So I think putting the lack of regulatory common sense to one side, again, because of HPCSA and their one sided approach. If that goes to one side, I think in general terms, probably patients and health care providers and some decision makers, policy decision makers are more on side and more aware. So I think it's clear the setting is better than it has ever been for many, many a year.

I [00:43:33] COVID really moved the digitization up, accelerated it. Well, okay. And then the next question would be, as seen from literature, strategic partnerships are essential for the long term success. And how could organizations achieve this?

E4 [00:43:56] Yeah, I think this was the question where I became a bit worried about which angle you're coming from in terms and when you say strategic partnerships, we hear a lot about public private partnerships have for many years, and I still don't really know what they are. There's a fundamental mismatch in my mind. I'm sorry. Private - They're in it for the money. Public - We're doing the best thing we can with what we've got for the majority of people. There's a fundamental discourse there, and I don't often understand how that can be bridged. So I'm sometimes very skeptical of public private partnerships. Yes. As I said earlier on, when it comes to reality, the health costs department, health care costs so somebody has got to pay. But I don't think you should pay to give somebody else a profit margin for them to enjoy. In the public health care system you don't make a profit so all of the money is being used to provide the health care. In a private system that's not the case. There's a profit margin. So that indicates to me not all of the money is being used for the right purpose, and that is delivery of health care. So I have that fundamental mismatch in my mind when it comes to public private partnerships and strategic partnerships, even when it comes and this is going up on a little bit of a tangent as well. But even when it comes to humanitarian organizations, they each have their focus. And yes, you could say a strategic partnership between two such humanitarian organizations. They're going for one common goal. But how they want to

get there and what they are willing to give up in order to achieve that differs and sometimes it comes down to dollars and cents. We don't want to spend our money there. We want to spend it here. So I'm still even sometimes questioning those kinds of ethical partnerships. Ethical strategic partnerships. So I apologize I'm a bit wishy washy on this one because I'm not that convinced that they always work. But the reality is, having said that, the reality of life, as we all know, no man is an island. You can't do it all yourself. So you have to have some kind of partnerships in order to achieve the end goal. I just don't understand exactly how they work and whether or not they are necessary for long term success. I always come back to the fact if you give if you're trying to solve the right health care need with the right tool, it will happen naturally. Well, naturally. Is there such a thing? It will tend to happen.

I [00:46:57]. So I guess for you, it's more like if you want, like, long term success you need the government, I guess?

E4 [00:47:11] Say they've got to step up to the plate and take responsibility and control. Control only if they're the right people in the right place, with the right knowledge for the right purpose. Because if they're ignorant, then it's going to be a mess anyway.

I [00:47:26] Okay. Thank you. And the next question is about the knowledge and the beliefs. So one question is how do you perceive the readiness of health care professionals and end users in South Africa to adopt and use the mHealth technologies in their practice?

E4 [00:47:45] I'm sorry, I'm going to fall back on COVID 19 again because I think, you know, it's changed. So I think yes, at this point in time, I think they are more ready than they ever have been. You've still got some stick in the mud, but they'll come around in the end anyway, or they will die off and a new generation will come along. I think awareness and training education and say training is something very specific, but education so people understand and are accepting, you know, that there are not the zealots that exist as far as mHealth are concerned, are not unaware of the fact that there are problems and that mHealth cannot possibly be used in every clinical situation. So we're not idiots. We understand the limitations, but we know that they're 90% of what we need to do can probably be done in this virtual fashion. So I think trying to raise the level of understanding and education of the masses, masses of healthcare providers, masses of patients, and they're going to need slightly different approaches in terms of how they are educated. But education I suppose, would be a major strategy to try to raise people's awareness and understanding. Mm hmm.

I [00:49:29] Okay. Thank you very much. And the next question What are the success factors and various in the face of planning and developing mHealth? I think, yeah, we covered quite a lot already. Because you said, of course, you have to go to the regions and get like all of the. Yeah. That, that really fits their need but other maybe some other factors you can think of.

E4 [00:49:55] Well this is a personal passion of mine and so I will raise it here. And that is strategy. And a lot of people don't quite understand what strategy is versus tactics versus an approach and the very few countries in this world or when we first started looking at e-health and you looked at strategies around the world, there were many roadmaps that actually in Europe, there were many road maps that were creatable road maps. I'm sorry, they are not strategies. The road map comes after you've got your strategy together. So the strategy says this is where we're going to go and this is why we're going to go there. And then you need all sorts of other things to allow you to then achieve that strategy. Road maps being one of them. So you know exactly how the steps you can take along the way. So I think there's a lot of misunderstanding about what exactly strategy is. But anyway, the point I was making is at one point in time we had all sorts of documents flying around that people were saying, this is our strategy. This is our e-health strategy. They weren't at all. So we've got to understand what strategy is, and then we've got to have an mHealth strategy. I have no problems in having an e-health strategy within which there is a focus on mHealth. I think that's the way to do it. So the country understands overall. We have an ICT strategy and within that we have an e-health strategy and within that we have an mHealth strategy. Great. That's the way it's supposed to work. But what people are starting to do is, oh, we've got an e-health strategy, we've got an mHealth. Well, they haven't, but this is what I'd like to do. We've got a telemedicine strategy and they're putting things in, in, in parts, in pieces. Instead of understanding what is the overall need for technology, how can it best be applied within our situation? We've got health care to consider here, but you know, all of the infrastructure that we need doesn't have to be paid purely by the health care. It's also needed for education. It's also needed for social services so they understand the spread of things and yet still come in and focus in on a strategy for mHealth, because the strategy is what will encourage the leadership that is necessary, will encourage the financing that is necessary, will encourage the creation of the setting environment that we need to accomplish it. And if you don't have that strategy, you're waffling. And for me. I don't think I've actually. No, that's not true. There is an mHealth strategy in South Africa, if I'm correct.

I [00:52:52] I think so, too. I think it's like at least mentioned in the digital health strategy. There's a part about mHealth I think.

E4 [00:52:59] Yeah, yeah, yeah, I think there is. Yeah. But it's not a strategy. It's a mention, as you just said, the, um, who I stand to be correct. I may actually I need to look that up. I think there may be a draft strategy, but I'm not sure that anyway there needs to be that. And that for me is a very if you talk about construct planning, the planning process, that's a very fundamental and important need that is not really appreciated or understood at this point in time. But. Take it. As you wish.

I [00:53:37] Mm hmm. Okay. Thank you very much. Mm hmm. And the next question is, who are the key influential individuals to get on board with this implementation and how should they be dealt with? So I guess it's for you. It's like really the government, I guess.

E4 [00:53:59] Well, you know, the implementation obviously occurs at different levels. And so the key individuals are going to be those who make the initial decisions of the policy and decision makers actually even that there are policy and decision makers at different levels as well. So those. Those people have to be on board and aware and educated in terms of mHealth. But then when it comes to the implementation, you can take it all the way down to the field, if you will which health care, which clinic are we going to put this in? Which village are we going to put this in? So even there, there's the necessity to identify the key and the key influential individuals, those key individuals who are going to be important if they're onside. It will happen. So I can't be very specific, I suppose, except to say there will be key individuals at various levels who have to be identified, brought onside, and then things will happen.

I [00:55:08] Mm hmm. Okay. Thank you for that. And yeah, then we are already at the last question. And here it's more a round up conclusion. Kind of. So the question is, based on your insights, what are the key takeaways and recommendations you would provide to startups looking to implement mHealth in South Africa?

E4 [00:55:32] Have faith. The key takeaway is, okay, so I am going to be repeating myself, as you will obviously appreciate. You got to have a have a strategy in place that you know, where you're going and why you want to go there. You want to get the right people. In other words, the policy decision makers of the different levels informed and on side to allow it to occur. And in all of this, you've got to be trying to solve the appropriate need, health care, need for the end users who are the patients. And if you have the right solution and simple, the right reason and a simple solution for that health care need, then it will happen more naturally. I won't say it will just magically happen. I'd

like to think that's true. So, yes. Overall understanding. The strategy. People on board. For the right purpose. I think that probably.

I [00:56:49] Mhm. Yeah. That's really good. Thank you. Yeah. Then we covered already all of my questions. Do you have any questions or any comments or anything you want to add. Um, yeah. Before we finish up the interview.

E4 [00:57:07] No, I don't think so. I think I've probably given you more than enough to think about and probably, I hope, some slightly different responses from other people.

I [00:57:14] Yeah, you definitely did. It was really nice. And so it's thank you for that.

E4 [00:57:19] And I hope it's helpful to you in your in your endeavors. And I wish you well.

I [00:57:24] Thank you. And thank you very much for taking the time to have the interview with me and sharing your knowledge. Thank you for that.

Appendix 6.5: Interview Expert 5

I [00:41:41] Okay. Yeah. And yeah, before we start with the questions, can you tell me your position and your background with mHealth and also for how long you've already been involved in this topic?

E5 [00:41:57] Yeah. I am a graduate from university. It's a big institution here in Tanzania which is teaching students in medical careers. So background is digital technology why I was at a university and trying to solve some different challenges through the use of digital platforms like smart phones, application websites and others. So up to now we have developed some different application, which we are not so far in the market, but we are trying to match with what is utilized by the communities in our country.

I [00:42:51] Mm hmm. Oh, good. Okay. Yeah. So I see you are really dealing with the whole implementation of mHealth applications topics then?

E5 [00:43:04] Yeah, yeah, yeah.

I [00:43:05] Okay, good. Then. Yeah, we can start already with the first question about the about the adaptability. So in your opinion, what specific features of mHealth interventions do you believe contribute to their potential success or their challenge?

E5 [00:43:52] So in terms of adaptability in our country Tanzania, there is a big challenge of you know, our country is not much developed in terms of technology. So most of the people here in our country, they are trying to use traditional ways in getting different health services. So when it comes to mHealth technology it is new for them so it's very hard for them to adapt, but also due to lack of a good support. Government support. For

example, when I was at university doing this digital health technologies and really trying to develop something digitally as was going to help people, some of people even who graduate with head coaching about the importance of the application of mHealth because, they will see you like you are doing something which would not come to work because they believe that in your culture or in your tradition, those things are not there. Those things that are coming from the other country, maybe Sweden and the others, but not doing it to our country. So it is very easy for us to penetrate with the market, to get kind to get people across our application through with our digital technologies, but we can get that health service. So as we digital innovators, we are trying very hard to make sure come by the health services are available to everyone at anywhere. But the biggest challenges when it comes to adaptability that we develop it but most of the people, they know what they think, like they want the anomalies of getting the of getting health service. So it's quite a big challenge but we are trying to manage them, you know the importance of which.

I [00:46:01] Mm. And like what features for example for an application would make the people more willing to use it?

E5 [00:46:38] Okay. I think as developer we are trying to develop something which can be affordable to everyone. So for example, when you develop an digital health platform from which may be an application which does not use Internet, like it's something which you can enter to learn something you can start the application, you can learn from there without having internet. Most of the people they try to it because it is much cheaper. Systems which need bundles in which you need an internet connection you can get the information. So for us you when we develop, we are trying to see in terms of cost that the people will be able to afford this, but also our service when we try to make them. We are trying to make sure that everyone, even someone who has no money to pay the service, can use some of the service will be free so as everyone can be able to do access it. But some of the service will be payed. That will be premium service. It means people who are paying them, they'll be able to access them. So we are trying to make sure that everyone who has an access to a smartphone even though he or she cannot be able to pay. But at least he would be able to access some of the information, that's what we are doing.

I [00:48:15] Thank you, then. Yeah. Like the next question. It's about the next three questions about the costs. So what challenges related to costs arise for the implementation of mHealth and what strategies can be applied to succeed despite these challenges?

E5 [00:48:39] Full implementation of mHealth service does a good cost. You need to have different people in one place, you needed someone who can develop, someone who can code or someone who can do it, and someone who has knowledge about that. So when you when you combine them within one table all of those would need money if you want to implement. So in our country it is very positive. Even we the developers we don´t have money to do it. We have an idea but we don´t have money. So the only way we are going to trying to use supports. Support some young innovators within sub-Saharan Africa, Tanzania and then we apply our innovations and solutions. From there they can either support you or not. But still it is not enough support too because even if they end up support you, the innovation will still need someone you can contact someone at any time getting your information. So those people that have little they need to be paid by the end of the month. So it is very it's quite difficult for us to sustain the mHealth service in our country because of lack of support. So sometimes we think maybe the government can intervene and try to support us in terms of infrastructures and the development team of our application. That will be very easy if it was. But currently we are trying to struggling now until you make it. Because when you make it, people will see it and when they see. When you are in your underground levels, people will never see you what you are doing has potential or not. But until you succeed in one way or another, maybe he or someone that someone contacted you. Yeah, something like that.

I [00:50:46] Mm hmm. Okay. And also in Tanzania, who is responsible for covering the costs related to using mHealth and interventions? Is it like out of pocket payments most of the time, or are there some in insurances or anything supporting it?

E5 [00:51:10] Currently in our country, Tanzania there is no support. Support in terms of maybe some people will come to pay for you, no. That's why I say in the beginning sometimes we people who trying to focus on developing digital system application and digital health technology. People try to see you like you are doing something which has no impact because there's no support at all. So you're just doing you. Even there is a ministry, the health information and technology who specifically deal with this issue but there is no support which we are getting from them. Okay. Just trying to survive from now.

I [00:51:59] Mm hmm. Okay. Mm. Okay. And yeah, can you think of maybe some strategy that could be applied to ensure that patients can afford using mHealth? Like, of course you said it with that a basic basic version, which is for free, but like for the premium or if they have to pay something, can you think of some strategies?

E5 [00:52:28] Yeah. At the beginning we started using, which we are thinking because the implementation of digital mHealth technology with different partners. So I think some of the deliberate innovation you can link with the companies, for example so let's say you are building an application. You need people to pay directly for the application. So which means you must lead with other organization within your system so that we can support you in one of or another. So that's the biggest strategies which we can use. We are trying to use it, but still we are not getting much support to. For example, we are trying to communicate with these telecommunication people so that they can support us and be connected with us and with airlines through us maybe to where they can contact them and then they can deposit feedback. We are trying to make that kind of partnerships was to ensure that we are we are developing something which can help people get it directly or indirect but also we are trying to use because of lack of support. You know in your country we are trying to finally fund through grants writing proposal writing, lighting on different areas and organizations so that they can see, what we want to implement is very important to, to, to talk to us and to the people of Tanzania. So I think those are the very two best strategies which can be used to ensure that the development of digital mHealth technology in our country it would be very easy.

I [00:54:18] Mm. Okay. Yes. Thank you. And yeah, then we can move on to the next question. So in general, what opportunities and challenges arise from the broader health care landscape for implementing the mHealth Solutions in Tanzania?

E5 [00:54:41] I think the big the three biggest opportunity which we are getting in terms of integration of mHealth service. First, there would be an increase in access to health care services because through the use of mHealth technology as information will be available anywhere at any price. So we don't need any time to go traveling from one place to another. For example, our country is very huge in terms of size and population, and so we have limited the number of hospitals which can provide good services. So, for example, people are traveling more than 6000 kilometers each year in Dallas, which are one of the biggest national hospitals. So in terms of opportunities, we can see that this through the use of mHealth technology, the access of healthcare services will be available to everyone anywhere. But also, as I said before, through this, through the use of mHealth that would be cost reduction in terms of health service availability and affordability. For example, as I say, people, they are traveling a lot. They spend a lot of money traveling before getting the services. But what if those services will be available through their application or their smartphone. That will remove some of the cost which can be using other services. But also through the use of mHealth service will help us to get enough data in terms of because we want to know the trend of with the trend of health

services. If there´s an occurrence/elaption of disease. But if you use mHealth technology, that's not going to be very easy because all of the information will be available and the application of the system. So it really helps to provide good data which can predict the future, maybe the potential outcome of something which which can happen in the near future. So I think it is very important in terms of what opportunities we think mHealth is getting in. It will be a big impact on those three parties, but also in terms of challenge, challenge which we are facing currently in our country. It's one of the biggest challenges in regulatory compliance because of this the government systems which you need to pass before such implementing of mHealth. For example, maybe on mHealth community, a doctor, you must file your consent, which delivers medical doctors in Tanzania to get your license that which is very costly and it needs a lot of time. So there's a lot of regulatory compliance in terms of implementation of ambulance service in Tanzania. I think because of of what we are doing is the traditional forms, the people we are trying to tell them about mHealth services they are trying to say - I don't think this will work, so try to use another way. So there's a lot of regulatory compliance which we will try to restrict you in one way or another in where you are implementing your mHealth service, but also here in our country, everything which you are doing before you start doing it well, before that making available to the people, you must make it registered if you want to do it. People will catch you up because you are doing something which has been against the government. So there's a lot of regrettable price in terms of everyone's savings in Tanzania. But also there's interliability issues. As I said before, an mHealth technology there is a interconnection between different partners. Needed to interconnect together so as to solve the problem because all of the systems are needed in order to what are very important so as to reduce the availability of service. So when you want to apply for maybe for mHealth one organization will try to reject your application because they don´t want to cooperate with you. Maybe because you are that thing. You are a beginner in that area. So they just want that the thing that they will see that time and support from you. So most of us, we are trying all of our best about the interoperability issue will be a big challenge for us. Most of biggest challenge – In our country most of the people, the income is not much, not good, so most of most of the people in in Tanzania, they don't have smartphones.They are not able to support google service even app store services. So it can become very challenging for us to implement mHealth services for them because they are using the they don't have a smartphone actually. They don´t have a network. They don't have an internet connection. Some of the, in Tanzania there's no Internet, so I became very difficult for us to penetrate, to tell them about the technology. But also, there is a big change in data security and enterprises. As you know, you are collecting data from people. Privacy is a big challenge to us

because there is not really clear information or a clear way on how you're going to protect your information. Mm hmm. I think those are that dilemma to us.

I [01:01:25] Yeah. The question is, how can regulatory and policy considerations be navigated to ensure the compliance and smooth integration of mHealth?

E5 [01:01:39] Yeah, of course. As I said before, there is a lack of support here in the country in terms of regulatory compliance and others. So I think we are trying on a paper based of course we need to get it back for working to the government and leaders when they want us to digitize technology to our country. So currently they're trying to see the importance of meeting because some of the innovation now, I think they are trying to do it themselves. So we are, I think, after two to five years to come there be enough support in terms of mHealth services in Tanzania. So we believe that the kind of discussion which we are facing will be different because every day technology grows. So they will just understand try and understand the importance of routine and they would try to adapt it as soon as possible.

I [01:02:44] Okay. Thank you. And yeah, the next question. Yeah. Earlier, we already talked about the funding and you said that it's like really hard to get, you know, can you think of strategies to achieve sustainable funding for mHealth or is it just really not or almost not possible at the moment?

E5 [01:03:14] It is quite possible to get to and to get enough support. Well, funding for the mHealth implementation but much needed to dedicate to us and it demands that you must leave everything what you are doing and then catch on the end with skepticism. And then you must to finding the right partner to bond with because sometimes you are trying to connect with people. They just tell you they were happy with the movement innovation and then they're never helping or just using you. In one of the platform and then they just, you know. So it is very important to me. I think it is very important to connect with the right people because the some of the application and with the application, they they are now in the good stage trying to implement each. But with no support to leave our country, but with it support outside, with outside organization. And maybe from Sweden. Yeah, some of them they get funded from Sweden. Others get funded from this good organization, I think, which is good. There's a lot of the support from sub-Saharan African countries in terms of digital mHealth implementation. So that's where they get support. It´s just one time support funded is support in terms of of of implementation. So they just give you, just say that is the amount of money so you just implement it and then when it is over, you must make sure that your system which you

are developing already started making money. So if you cannot make money from it and then it will fail.

I [01:05:14] Mm hmm. So if you wanted to get more funding, like after the implementation, you can hardly get it.

E5 [01:05:24] Yeah, after the implementation, it is very easy to get the fund because you have something already which is functioning. So it is very easy to get the fund, but those funding are not all time fund that evidently will keep on funding you. You know that because they just support different local innovators in maybe Tanzania. So it does support you everydayl. And also because when you get support in one organization, they know that you are supporting with this organization and so we cannot support you again. It means that you have already been supported. You need your system to start already making money. What you are doing, whether it is an application that is making money, and then this money can be used on maintenance for this application and ensuring that each walk and or ability they can get disabled. But it wasn't going to become a big challenge. Of course we get support but in terms of adaptability, adaptability to the people, to be educated, if that to get grant to them, I guess we are doing a little bit to to tell them the importance of using mHealth but they are not really able to accept it because they know in the end we will need to pay will to pay you so they say you are just telling us to use your application so as we can get people together to use it. But we know that at the end you´ll want our our money. And so it became really difficult to implement it.

I [01:07:14] Okay. The next question is if you have information from participants like from health workforce or patients regarding their experiences with mHealth and whether it actually was able to meet their needs or if they didn't use it or yeah, what in general the experience was with it.

E5 [01:07:39] Yeah, I have a good experience on testing one when from the current digital field. We have one application currently it is called bonus (BONIS?????). It's an application to try to make sure to connect all the people even outside this city they can get information about the application. So it gets a lot of people through the app. They're trying to tell about them. And then we connect with medical doctors, nurses, pharmacists, and they try to help them learn how to get their treatment. They're trying to to to teach them how to use and how to get the good information on mHealth. So we get a lot of a lot of testimonies sending them mHealth services and their experience. I think it's quite good because they just tell you that. "Thank you. You´re application is very good for us to get information free phone service or something like that. So we say, Oh, well, thank you, thank you, thank you. So that's that's how it is. Yeah, Very good for that. Mm hmm.

I [01:09:00] Yeah. Yeah, that sounds good. Yeah. Okay. And then moving on to the next question. What are the organizational structures and cultures within the health care system that either support or hinder the implementation of the mHealth?

E5 [01:09:38] Currently as I said the support is still low. So there's an organizational structure which tried to support, but I think now they are trying to implement support. For example, and for example, last two weeks from the university together with the said they did, you know, virtually commission have. So it was just incubated under different ideas which they think about implementing it through mHealth services they can see they are more than 2 to 3 days per day in writing what they want to thinking and brainstorming to make sure that what they want to implement is possible that it is is going way. So I can say that organizational structure is still not available. But I think now they are attending, they will pass on the technology and the support is quite good now.

I [01:10:47] Okay. Yeah. We also talked about you also said already that partnerships are very important and I wanted to ask - how people can achieve like strategic long-term partnerships to ensure like the long term success.

E5 [01:11:16] To get a long-term partnership. You need to be ready to commit to others. And you need to commit to yourself because to get a long term partnership people must trust you. And but also you need to create an environment. And because most of the innovators here they are trying to innovate something but they don't have any license or they don't have an organization to grow. So when you get to what do you want in order to support you, they must see the infrastructure, the environment where you are. Either they support you, are you in a good environment so as they can support you? So it's sometimes difficult to get generally supported because the environment in which we are is not much good because we are and we are developing an application maybe from our home, we don't have an office, so we don't have anything. So when we get to a partner, it's quite very hard to build a long term partnership because the infrastructure which you are, the environment is not supportive to trust you. So it's quite a very difficult. So for us, we think we need a good infrastructure and a good environment. So when you get a good partnership, that would be very easy to trust in what you are doing because even if we pretty much all, you know, with mHealth services or mHealth technology. But if you do not have a good environment it will be very difficult for you to get support

I [01:13:05] Okay. And coming to the next question, how do you perceive the overall readiness of healthcare professionals and end users in their country to actually adopt and use those technologies in their practice?

E5 [01:13:23] The readiness is not much good because of knowledge. mHealth it needs all of the people to get good services. And you must know the importance of it. Sometime even with physical professionals. They don't understand the importance of mHealth. They'll just tell you you are trying to kill our job because they think maybe if you can use mHealth they're not getting paid through the application. So sometimes it's challenging even for most of the health care professionals. They just tried to say like this system is trying to take our job. So it can become a big challenge in terms of penetration of the people and adaptability, because there is a lot of say. Maybe some people, they say, no, I don't think this will work. This is from the outside. We should just use our normal ways of getting it.

I [01:14:37] Okay. So it's really quite a big challenge. Thank you. And yeah, can you think of strategies on how you can, like, get the health care provider providers more on board and the end user so that they feel more comfortable using the mHealth solutions.

E5 [01:15:08] In terms of strategies? I think it's the same discussion. You must educate them on the importance of using mHealth services and we are genuinely trying our best to educate them on the importance. I´m trained you know but we're trying to train. But also there are some people who are professionals like me who are trying to tell them, maybe we should not use this. Hmm. So there's a lot of challenges in terms of penetration and market penetration. Everyone believes what they want to believe so you cannot just change someone's mind or his mind accepting what you are saying. So we are trying our best but we are not reaching that far in terms of adaptability and the peoples acceptance of mHealth technology.

I [01:16:10] Okay. I see. Thank you for your answer. And regarding the planning and development of mHealth interventions in your country, can you think of success factors and barriers in those phases?

E5 [01:16:48] Okay, I got you. I think the biggest success factor is accessibility. Because mHealth technology can be accessible everywhere, even in those remote areas, you can be able to get it. So in terms of acceptability, it would be very easy to penetrate in the area. But also the mHealth technology is very convenient because convenience crosses the mHealth information through mobile applications and the websites. So people it will be very easy to get that information. But also the mHealth is very cost efficiency compared to the modern way, this modern ways in which people are trying to use. But with mHealth it is very easy to reduce cost, to get information as we can reduce some of the cost to some of the money which can be used in other areas. But in terms of challenges, you said. In terms of challenge it's like, as I said before, the biggest challenge

is the development, of course, because when you develop an application, there's a lot of, you must pay domain you must find someone to call someone to do this. So it is very it is a very, quite expensive to develop an application here in Tanzania, because there is no one who supports, even if you developed it, it won´t be that much good compared to what you had in mind. But also in terms of knowledge. So you have one idea of something maybe you want to implement this program and solve this problem, but how to implement it in terms of mHealth technology, it can become very difficult because you have the idea, but you don't know how to implement it and you don't know anyone because you're maybe the maybe we don't know. So we are trying to develop it, but we are not getting that what we want because of lack of knowledge on how to develop it. But also, as I said before, it is on the infrastructure and the environment is not good, it is not supporting the mHealth technology. So it's quite a very difficult you will develop with the application because of the infrastructure. But also that is even if you do develop it, you need to do a maintenance and update of the application. So sometimes it is very difficult to do it because of lack of money of doing it. Sometimes you just develop it.

I [01:20:09] Okay. Yeah, Well, yeah, I can imagine. I mean, if the people can't really do or don't really have access to smartphones and all, then of course it's hard to spread it in the country, you know? Makes sense. Yeah. Okay. Um, yeah. And the next question would be in Tanzania, who are the key influential individuals to get on board with with this implementation and how should these influential individuals be dealt with? I mean, like in like in Tanzania, like, yeah, like the important stakeholders that you would need to get on board with, like if you want to implement it.

E5 [01:21:06] Yeah, I get it. Now there is a lot of NGOs, which they are dealing with, supporting different healthcare matters. And the biggest one is trying to support young innovators from Tanzania or trying to develop a system in terms of families or in any other form, in any other ways which can help people in one way or another. But also there is another organization which is called **Paditinspa.** And so those are the two who are trying to support local innovators. And in terms of innovation and development of the mHealth technology in the country. There are different originies within the country Tanzania but some of the organizations are coming outside the country. For example the LM International. It is within the country. They are director here who support some of the innovators. There is Path finder. Those are some of the organizations which are in the country. They are trying to support local innovators by making sure that what they are doing, they get enough support.

I [01:22:37] Okay. Thank you. And then the last two questions. They do more. Yeah, like for startups and Yeah, and it's more like more general again. Like, you know what the

critical success factors in various are for startups when they are faced with implementing mHealth. I think the connection is gone. Hello.

Appendix 6.6: Interview Expert 6

I [00:12:35] Okay, So my first question would be, yeah, what exactly is your position and background with MHealth and for how long have you been involved with M have.

E6 [00:12:50] With the permission of mHealth, that means the use of ICT in the health sector of or through mobile technology. I think it's about ten or 15 years that we have been working more or less can be defined mobile apps. And with SMS, for example, in the calls in the health sector, telemedicine, they can all be defined as mHealth about 15, almost 16 years. I think that while in terms of data collection, as I said, but also communication with the clients for health promotion and the likes.

I [00:13:43] Mm hmm. And you are a professor, right?

E6 [00:13:47] Yes. Yeah. But I also have a company, private company, that also deals with the system development, ICT solutions in different sectors, including health.

I [00:14:36] That's true. Okay, good. Then. Yeah. We can start with, like, the more content questions. So my first question would be, um, what specific features of mHealth interventions do you believe contribute to their potential success or challenge?

E6 [00:15:10] I think the success of any digital health depends on a number of factors, but not only the technology aspects. I think with specific functional requirements. I can't tell which features because it all depends on the functions of the application. If it's health promotion, health education, surveillance of disease? So you need to get the requirements. So demand driven - what problem are we solving. Now we call them digital health interventions. Intervention as such that there's a problem that we are solving. There is a challenge that we are solving. For example, the mental health application. We want to increase health data that means the content has to be properly designed and well-presented. So one is the functional requirement in terms of the businesses or different technologies that has to be there. The other aspects will be nonfunctional requirements in terms of usability, user experience, the skills, the accessibility aspect in terms of okay if it's an online app that needs Internet connectivity, do you have Internet? That as users if they have internet – are they able to pay? The aspect of affordability. So these are not just a features of the technology features, but they are part of the factors that contributes to the system. So the system has to be the perceived easy and easiness, user friendliness. That's part of it. But perceived usefulness – is it useful to the users? Users can be patients or health clients. Pregnant women are not patients, but is it

perceived useful to these users? Does it contribute any data to the stakeholders that would need data? For example, terms of usage of this system if its for electronic medical records for decision support, like as it provides indicators that will inform decision making. So I think I think these these are the critical asoects. And then you also need the user experience. User designs are good, then the users will be satisfied and they will accept user needs. So these are more on the technology aspects. Then you also have this people aspect in terms, as I said, in terms of the skills and therefore the maybe the aspects, the organization of the culture. That's because that supports use of site application. So you may be promoting safe sex. What is sexual behavior? In some communities, they may not support this, depending either in religion, culture and the likes. So this intervention won't be successful even if it's a very good system in terms of technology. So the cultural aspects are going to vary, the organizational issues that I talked about in terms of capacity building, training, availability of technical support. So there is one guideline, W.H.O. guideline, World Health Organization, guidline on monitoring and evaluation of mHealth application. If you go through, it gives you different parameters on how to measure the success of the system. So the assets, of course, the technology that we talked about, the business processes, the organizational aspects, but also in the data aspects, there are areas where policy, regulations do not support or hinders adoption of technology. I would say this, that some of the issues that may hinder and as you can see. It can be the same solution developed in Germany, quietly adopted and used in Germany, but in Tanzania it may not because of these other nontechnical aspects.Yeah. I hope this makes sense.

I [00:20:01] No, no, it really does make sense. Thank you for your insights. And then the next questions are more about the cost. So one question is what challenges related to cost arise for the implementation of mHealth and what strategies can be applied to succeed these challenges?

E6 [00:20:24] So well as I said, cost is one of the limiting factors. One example that I give is in terms of accessibility, if it needs access to the Internet. Does the user have access to the Internet? Can they subscribe? They have data vendors. Can they pay the monthly fees that are required either to access the application or to pay for internet it in order to access the application so if the application is not free, then they have to subscribe. Will the users be able to do that? So this is more an operationalization, but there are costs for development of the solution. You'll need to pay for the experts, the programmers but also if their licenses during the development that you have to pay later on and these are some of the cost. And now what we are seeing is a lot of application being developed through funding - development partners or donors. But these are project based. So they

have timelines like three year projects and then after that you don't have funding to scale up, funding to improve, funding to sustain. You know, another aspect in terms of strategies now we have public digital goods, open source solutions that are vetted, promoted by big multinational organizations and what not, so that they can be used by especially in low and middle income countries, but also can be used everywhere. So some people have supported a net providing funding so that this was a kind of public goods. They can be used by everybody. But even though they are open and free sources and all this, there are still costs for customization for tailoring them into the context that we talked about in terms of German context, Tanzania context. We have different health systems. So this is a cost also that has to be taken in goods through the government budget or through user subscription. There could be different business models to support this. If the users see value out of the system and they find it useful, they may also subscribe some, but others may be through health insurance. If it's deemed necessary for the funders. But this is one of the challenging and then one of the discussion around the investment of medical devices and application, because they are currently not in the in the standard investment mechanism, but they are efforts to make sure this this is promoted.

I [00:23:18] Okay. Thank you very much. And, um. Yeah, like, we talked about this already now a little bit, because the next question is, who's responsible for covering the costs related to using mHealth interventions? I think you said right now that some insurances might already pay you maybe some parts of it. And yeah, but in general, is it more that the end users have to pay for it?

E6 [00:23:47] It´s hybrid modalities because one insurance can pay for development and deployment. But then in terms of daily use, users have to pay for data, bundles and all costs associated with accessing the system if it's not free and open source.

I [00:24:06] Mm hmm. And are there some strategies that could be applied that patients can also afford using mHealth? Because, I mean if it's if you have to pay for it, then of course a lot of people won't be able to. Um. Yeah. Might not be able to use it. Are there some strategies maybe to support this?

E6 [00:24:31] I think one aspect as I've said is promoting the public digital goods so that it custs down some costs in terms of initial development. So you do more customization. But there are also communities, often communities of practice or communities of developers, where you can reuse and improve the existing one. This cuts down the cost, but also these pooling of funds where tools can be shared within the country other than having multiple system for application. One example is in Tanzania. Now we have

different partners implementing a mobile app that's called unified community system, where different partners come in and provide funding to deploy develop and deploy the system. So in that way, you kind of cut down the cost of doing this work in parallel. So unification or pooling resources together is one strategy that is being used. And of course government funding to support that if there is seen value out of this. Because initially maybe you have cost of printing materials document and all these manuals that are collecting the likes. Now if you use technology, then you cut down this cost. So these are kind of strategies that can be used or that are used in countries.

E6 [00:26:06] Thank you.

I [00:26:08] And yeah, like in general, if you look at the broader health care landscape, what opportunities and challenges do you see for the implementation of mHealth?

E6 [00:26:24] There are a number of challenges like initially said around the technology. Frequent changes in the technologies. Some technologies may not be meeting some standards and whatnot around the technological factors. Compatibility are as aspect, interpretability between the mHealth application or mHealth application with the other system in the health sector. The siloed approach and fragmentation having the multiple systems that users have to subscribe to different technologies, but also the organizational aspect. The training of users, financial support, technical support from the organization, and also business process are not harmonized, they have parallel workstreams and then of course you test it out what are the steps or how workflows should look like but also aspects with data and data sharing or general data governance aspect in terms of management data, data definition and so forth. So this could be, of course, as I said infrastructure, the technology and part of the organization, the digital infrastructure, digital identities and all these. Some of the challenges is what if they are just because they are going to facilitate the adoption of technologies.

I [00:28:01] Okay. And some of it I think we just talked about challenges. Now, can you also think of some. Yeah, like some opportunities that are easing, um.

E6 [00:28:13] The use of public digital goods or global digital goods, applying principles that are well established like principles for digital development, which promotes designing with users so that you better understand their needs. And this system is adopted because they have been part and parcel of, of the development and they can share their experience and then also pooling resources together with them with the funding as they take the examples of unified community system where you have different donors putting funds into one basket to support, but also existence of infrastructure that can be reused for the systems. Mm hmm. Yeah, I think those are some of the areas, of

course, interest from the users as well. Penetration of mobile devices, mobile networks then facilitate their mobile application services like mHealth or any other related mobile application.

I [00:29:26] Mm hmm. Okay. Thank you very much. And yeah, like, of course, when it comes to integration of mHealth, there are a lot of regulations and policies. So the question is, how can regulatory and policy considerations be navigated to ensure compliance and the smooth integration of mHealth?

E6 [00:30:00] There are already efforts to establish a policy, legal and regulatory ecosystem in terms of personal data protection. Now context is one aspect, but also electronic government guidance standards that are put in place to ensure standardization of business processes and harmonization, business process engineering, while also applying this global standards into local settings or national settings like the SMART guidelines from the WHO, Virtual Fire Framework. These are some of the policy that sets standards that can support the adoption.

I [00:30:51] Thank you. Okay. And yeah, when we look more at the patients needs, do you have information from participants like, for example, health workforce or also patients regarding their experiences with health? Like is it actually helping them are there meets their needs met and yeah, does it actually have like a positive outlook on the people.

E6 [00:31:30] So I think this questions is depending on the application that you are assessing. So if you talk of a specific application, you can you can ask whether evaluation has been done in terms of a user. Frequently each application is being assessed. You can do a preview or post in terms of before the system or after some time you do the assessment user surveys to get their feedback and then later follow up and use that feedback to do kind of continuous improvement of the application. Mm hmm. We still have, as I said, challenges to do with the literacy to get, especially in the digital digital literacy, because most of the use has to be called digital immigrants. So digital immigrants means that they are born before computers before digital technology. And then you have digital natives. Generation Z are born with these devices. My my boy can play around with my smartphone even better than me. All the healthcare workers, the they have what we call techno phobia.

I [00:33:03] Yeah. So in general, like, the people are a bit reluctant in general.

E6 [00:33:09] So it's. Yeah, it's so it depends on, on the set of users that you are assessing. So sometimes with age, with the exposure, experience in using similar systems, there are differences, but they also depend on how your application will be

designed around user experience matters a lot. So the question should be application specific thing so for application A some users can say this is good, but not for another.

I [00:33:53] Yeah. Yeah. It was meant a bit like in general like how the overall attitude towards mHealth is. But yeah, of course it makes more sense if it's really specific on application. Yeah, it's.

E6 [00:34:08] Specific, yes. Because some users may be using, for example, Facebook, Instagram and through the Facebook and Instagram, they are not specific mHealth application, but they also have health content where they can view for health education and the like.

I [00:34:24] Makes sense Yeah. Okay. And then yeah. Moving onto the next question, which is what are the organizational structures and cultures within the healthcare systems that either support or hinder the implementation of mHealth.

E6 [00:34:48] I think yeah, in terms of the government, most of the governments of Tanzania and in other countries they have what we called digital health strategies. So in the digital mHealth is part of digital health application. So they are part of the strategy. So you have strategic priorities, for example, in the use of mobile technologies for providing needs. Beating them to screening, treatment, decision support, but also mHealth promotion and the likes. So these are part of this study, and the studies have governance to act out from the national level to the lower level. And the challenge would be around how strong is the structure, how frequently they meet, how when an evaluation mechanism of governance, including the funding aspects and the structures are there. But operationalization may be evident with challenge.

I [00:35:54] And yeah, like in literature, you read a lot that of course for the successful scaling up of mHealth, strategic partnerships are quite essential for that. And yeah, do you have ideas or like guidance how organizations can achieve this?

E6 [00:36:19] I think it is truly a strategy in which you must have what we call the investment roadmap, where you have strategic investment areas. So if these ones are followed, definitely the success would be there. But also nowadays we have also some guidelines set out, as I said, responsible digital development, which supports collaboration using the existing one, understanding the ecosystem, but also donor alignment to national priorities is also key now. And also regional block collaboration, for example, around disease surveillance, where they can have a mobile app in east African region which supports screening, disease surveillance and reporting, but also health education.

I [00:37:13] And yeah, the next question is about, you know, the readiness of health care professionals and the end users in their country to actually use mHealth Technologies?

E6 [00:37:35] In terms of the skills and you can have a measure around was digitally literacy depending on as I said the age groups the residency whether you're in rural urban settings experienced with the use of mobile phones for other usage like Facebook, as I've said, WhatsApp, Instagram. The penetration is increasing. So how does work as a part of these communities where they have? So if you come to a specific application, then they can easily use, depending on how friendly the application has been developed. Most of the age group would be able to use a well-designed solution because they own I would say most of them, if not all, they have mobile smartphones which have some application, mobile application even if they are not health. Application as well designed. And there's guidance around to use even with minimum or without training, they can use it.

I [00:38:42] Mm hmm. Okay. Yeah. And when you look at the planning and developing phase of mHealth, what would you say are like the critical success factors and the barriers?

E6 [00:38:57] I think around the same question. If you go through the thing you you have, as I said, the aspect to do technology. The selection of the technology, the principle, the approach that you use to develop and design with users, technologies that have been used everywhere, like not designing from scratch to reuse and improve these technologies that support security and privacy, but also the involvement of users and being collaborative. I think this is a I would say the critical success factors is and if you don't follow them, of course they are going to be critical failures or barriers to implementation. So the localization aspects, the technology, the business system and the involvement of stakeholders in thinking. If you go through what is called principles for digital development, they have nine principles around technology, organization and also the processes.

I [00:40:03] Mm hmm. Okay. I will check that out. Yeah. And yeah, like, for organizations who want to implement their mHealth, who are the key influential individuals or those stakeholders that they really need to get on board on and how should they be dealt with?

E6 [00:40:57] I would say is with understanding of the existing ecosystem, you do mapping of stakeholders. So they are all depends on where you are. And what is the structure of say the entity that is implemented or where the system is going to be used. So if you are in a district X you have your health governance structure. Those are the key stakeholders that you are going to involve, including the users. So you have user

representatives, you have the data user, the bodies that supervise the kind of service delivery from the national level to the community level, and then other partners who are supporting similar interventions. So mobile and mobile technologies are coming as an irregular tool that is used for service delivery. So you already have this structure that is used for service delivery. You need to align with it with the existing structures that are already established.

I [00:42:24] Yeah. And then we're already coming to the last question was, which is like a summary - So overall, based on the insights what are the key takeaways that you would provide to startups looking to implement improve solutions in their country?

E6 [00:42:48] I would say they should follow the principles for the digital development. In most cases, the start-ups do not have in-depth understanding of the existing ecosystem. They may be coming out with an App that is not relevant to the context because these already establish similar service standards in there. So with understanding of the existing ecosystem, you will do mapping of the technology, the business process, the governance of the organizational structure so that you also know the needs and the needs can be known through design to users. So users, you may not involve all the users, but at least get the representative, get the inputs from the who are going to be the potential users of the mHealth application. And then, of course, you follow all these other steps that you make sure the requirements gathering is what I want it to be. This business model of the mHealth intervention or mobile application for health service has to be properly defined. How are we going to pay, how are we going to scale up and sustain the service.

I [00:44:10] Mm hmm. Yeah. Okay. Yeah. Then. Yeah, we already have it. Thank you very much for taking the time to answer my questions. And, yeah, do you have any. Comments, which is questions?

Appendix 6.7: Interview Expert 7

I [00:57:38] Okay. Thank you very much. Yeah. What is your exact position and your background with mHealth? And for how long have you been already involved with MLS?

E7 [00:57:58] Okay, so I'm a graduate medical doctor. I graduated after this year, so. But I've been working on mHealth interventions since 2020, so it's 3 years now. And as more I'm working on artificial intelligence applications in medicine and we are currently working on a solution on this kind of AI. And that's how we are making cervical cancer screening faster, accurate and affordable. And what we are actually doing, we are creating an algorithm that can automatically analyze the cervical cancer images and give the

diagnosis at instance. Yeah, but also I've been consulting other solutions in mHealth. Typography for midwives and the labor process. Yeah.

I [00:58:55] Yes. Okay. Thank you very much. Really exciting.

I [00:27:28] Okay. So the next question is about the features of the mHealth services. So the question is, what specific features of mHealth integration interventions do you believe contribute to their potential success or challenge?

E7 [00:28:22] So concerning for the features of MHealth like in our country, to make it a success. First of all it is interoperability. Like there's a lot of initiative around mHealth, but certainly most of them are not interoperable or like these systems they don´t communicate with each other. So if there would be interoperability all the way how people are working on this mHealth intervention that will be very much more appreciated. But as to the other issues to involve different stakeholders. But you might find some of the people that they don't work actually in the part of health, but they have the technical expertise like engineers or something. So they just gather and having that one solution without involving the actual clinical, clinical environment where actually the problem is happening. So you find to have a solution but doesn't treat the clinical conditions. So the other issue is just having a collaboration or partnership between their technical expertise, but also the clinical ground. The other issue I see there is there might much like the awareness, like most of the people they breathe in their traditional way of doing things. Just going to a medical doctor now, having their lab results and then it's over. So but when it comes to that way of moving to mHealth, most of the people are reluctant, so they basically they don't believe in mHealth. They they don't believe in mHealth. Because when you combine just technology and it's more about personal health and so they feel like mistakes will happen and like, yes, I want to get treated so the awareness also is too low for which I can see. The interoperability, partnership and awareness, maybe the most important features.

I [00:30:53] Mm hmm. Okay. Thank you very much. And moving on to the next question. It's about the costs. So what challenges related to costs arise for the implementation of mHealth and also what strategies can be applied to succeed despite these challenges?

E7 [00:31:12] Okay. So I think I can say that most of the mHealth interventions they are cost effective, like most of them, but the only issue comes maybe with the infrastructure because the already existing infrastructure. There are not much more accommodative to new mHealth interventions in the country. And so most of the time or most of the cases, we spend a lot of time in terms of like convincing the decision makers to accept that, to accept this, this kind of solution. So we find a lot of meetings, like a lot of symposium,

just to make people understand of what you are doing. So this most of the cost they are there. But also what's more like, you know, we don't have like most of the people that aim to take when it comes to mHealth. They are, I can say that much more reliable because it gives them a solution to work for you. At the end of the day, they gave us something which is not what you wanted so you have to incur more costs to develop other kind of solutions. Yeah. And the way how to mitigate about this. You just have a regression framework for this mHealth so that they can have a pipeline from ideation to implementation to reduce all these obstacles in between and also to much more investing in the technology or the extract of things, because most of the clinicians, they have ideas but they can´t go and invent it. So having more investing also in terms of the human capital like human experts, which is something that I suggest.

I [00:33:05] Mm hmm. Okay. Thank you very much. And also in Tanzania, who is responsible for covering the costs related to using mHealth interventions? Is it like mostly out of pocket payments or are there like some insurances that can have the patients being able to cover the cost or how does it work?

E7 [00:33:28] So, okay, so most of the interventions that are widely used, there are more initiated by the governments. So they have budgets from the government. For the out of pockets is the behavior, the use of out-of-pocket for mHealth is not that much because first of all, the liability of them is for the people. So most of them that are implemented are governmental or non-governmental organization. So they just have this grand sponsorship. But they forget is that is not common when it comes to mHealth intervention.

I [00:34:11] Yeah. So for the end user, it's like mostly for free if it's supported by the government, I guess. And yeah, the next question would be what strategies can be applied to ensure that patients can afford using mHealth. But I guess, yeah, because you said that they are mostly government funded, so of course they don't need to be able to afford it because. Yeah, it's funded. Okay. Then we can go to the next questions. Um, what opportunities and challenges arise from the broader health care landscape for implementing mHealth interventions?

E7 [00:34:54] So the opportunities I see a huge potential because there is a lot of clinical problems to be solved. There are a lot of people that are able to use the solutions and are much involved in creating these digital health solutions and framework that's more suitable. So we have a lot of challenges that need to be addressed by using the mHealth, but also a large number of people with like of proper education. They can use it. But also we have people that's already working on the framework to address the problem. And

yeah, so for the case of challenges, mine is in case of the human capital. The expertise to develop this is not that much promising, but we are going and I think at some point we'll be there. And but also in terms of the framework I know people are working on it but it´s still a challenge. If you have in your mHealth intervention and you want it to be like in the health care system it is very different for now.

I [00:36:08] Mm hmm. Yeah. And what is the name of the framework that you're talking about?

E7 [00:36:14] It's a digital health framework. Maybe I can look for the whole title and show it to you.

I [00:36:24] Oh yeah, that would be great. Thank you.

E7 [00:36:26] Yeah.

I [00:36:31] Yeah, I guess you can also maybe just send it to me in an email so we can continue because of the time.

E7 [00:36:40] Yeah. Yeah. There's this digital health policy. I think it's done. Maybe I can show you the documents in Tanzania for that and a couple of other documents that might be useful for you.

I [00:36:53] Mm hmm.

E7 [00:36:54] Yeah.

I [00:36:55] Okay. Thank you. That would be really nice. And okay, then the next question - How can the regulatory and policy considerations be navigated to ensure the compliance and smooth integration of mHealth?

E7 [00:37:13] Okay, so the challenge that I see when it comes to regulators like a there is no way to approve this solution and tend to be successful to the society or to the communities, but there is always the punishment for a regulator who allows a solution and it was harmful to the community. So most of the people are reluctant. Like if you come with a new innovation mHealth intervention, it's very difficult for you to be endorsing in the system. That's because of that mentality. There's no reward, but there is punishment for you if you do things. So I think it's not a high time to have this flexible environment as long as you have a pipeline for testing a solution. You have the performance matrix, you have documentation of everything, but you have to be allowed to test a solution, given a period for testing so that it can be implemented. Yes, but also in the regressions process and everything, they have to be made available to everyone because most of the people are the groupings are solution in silos. They don't know even if there is a digital health policy that the country is working on, they don't know about

those. So they find they develop things and then they reach a point that they need to be approved. Then if you go to regulators, you find that you need this and this and this and this. Which you didn't know prior. So there must be awareness to know how the regulator framework, policies work out that's what I would suggest.

I [00:38:50] Mm hmm. And this some guidance like on what you need to provide, like, I don't know, like the testing and trials and all the documents. Is there like a. Yeah, like a document or guidance where you know what you have to do or?

E7 [00:39:08] Thank you. Yes. Yes, there is. There is a guidance for that. So from our Tanzania Medical Devices Authority, they have a guidance for this kind of intervention or application. But sadly, I don't think if the right number of people. They will come to them when they go to register the products. Yeah.

I [00:39:31] Mm hmm. Okay. Mm hmm. Okay. Um, thank you. And the next question would be what strategies can be applied by organizations to achieve sustainable funding for mHealth? So if it's not really from the government, but like, if some other organizations want to implement something like that.

E7 [00:39:54] Okay. So what I believe when it comes to funding is like if you have a viable solution that is promising, it's very easy to attract to trajectory funding for for the implementation. But what I would suggest is like to network more like they have this network of digital health innovators in Tanzania, maybe and abroad, and see how things work, because connections and networking is about people that can work or doesn't work. So if you work just in silos, it´s very hard to just have this funding, but also this kind of funding that just becomes like Netflix. Like if you're not doing that kind of network demands, even if you are having this promising innovation is very difficult for you to have this kind of funding. So also just the networking and having this strategic partnership, if you are coming from academia, which is the university or something, or if you are coming from the industry just to look for the people that are doing the same something and you have this networking so that you can have that funding for your innovation. Mm hmm.

I [00:41:06] Okay. Yeah. Thank you. And do you also have information from participants like on the one hand, the health workforce on the patients regarding their experience with mHealth? Like, for example, if it's actually helping them, if their needs are actually met, if you know.

E7 [00:41:28] Okay, So if it happens, like I'm working on an artificial intelligence system for cervical cancer screening. So I you know, when it comes to A.I. and most of the people do, they have attitude, like, what do you think if it makes a mistake and everything but with proper education it can work. So we have to show that, okay, it can work actually.

So they have this attitude to like to see how the solution is working. So like people, they, they have the need of using this mHealth interventions, but the proper education that's what is lacking. But people are willing to use it from the healthcare professionals up to the patients.

I [00:42:14] Mm hmm. Yeah. Okay. Thank you. Okay. And now to the next question. So what are the organizational structures and cultures within the health care system that either support or hinder mHealth implementation?

E7 [00:42:40] Okay. So first of all, something that it's very treasured when it comes to health care system, it's going to be patients doctor to patient kind of relationship. And you find some of these mHealth interventions like there is no direct link to doctor to patients. So this is the reason there's a patient and interface maybe connected to someone, some other healthcare professional. So like most of the people that would trust to talk to a doctor rather than give the information to a chatbot. Let´s say maybe they may be having symptoms, something that means that they're going to talk to a chatbot. That means it is very difficult to trust the systems. So for the terms of culture, I think what is lacking that trusts like how can I trust this system, having my information not seen by a doctor. And I just if you are having a doctor besides and say, okay, you can enter information here, this is just going to happen, that is great. No, no more trust on facts.

I [00:43:45] Okay. Okay. And then the next question would be a scene from the literature. Strategic partnerships are essential for the long-term success of mHealth because I also read that there are like a lot of health initiatives. They start, but then they don't get like past the scale up phase. So how can an organization achieve this that yeah, like it really has a long-term success.

E7 [00:44:18] Okay. Yeah. Yeah. So what I can say with my experience on that is like we are having many interventions in mHealth, but most of them, they don't make it to be actually implemented. Mm hmm. That would be a lot of factors, but I think most of them, they don't actually address the patient needs like a. We are. Me as IT specialist, medical doctors, we are in silos working on our solution. We don't really involve with patients on that matter. So when you bring a solution to the patients, the issue for adaptability, the patients becomes an issue. So no one is going to use a product that is not user friendly, or at least they don't believe that it's going to be like it's not in their setting. For instance, you are creating a mHealth to the rural people, but in your development you didn´t involve them or actually maybe you used a virtual test kits/case because they can use that solution and you have this one size fits all, which doesn't work. So I think we have to

adapt this human centered design. So even if I'm a medical doctor, a software engineer or something, when I'm creating mHealth interventions, the patient or the user is going to use that need to be at the center so that to make it to go to the to the market, you might have enough of funding for your solution, but it doesn't touch the people's life who are going to to use them. So I think that's the case for most of the solutions.

I [00:45:57] Mm hmm. Yeah. Thank you for that. And yeah, and overall, how do you perceive the readiness of the healthcare professionals and end users in your country to adopt and use M of technologies in their practice?

E7 [00:46:15] I will have to say these, like the awareness and readiness of people is increasing each and every day so little point that people have to be more adaptable to their solutions. Because I started working, for instance, in artifical technology since 2020, and there was much more resistance at that time, that particular time. But for now that this awareness, we've even having support to collect local data to train our A.I. algorithms. So I see there is a shift or though it is coming slowly, but there is a significant amount of shift in attitude since the way we started up to now. So I see there is much more adaptability actually to the future in using this mHealth intervention.

I [00:47:10] So you would say that yeah, like the skills are there to use the most um, intervention and they just have to get more open with it over time to actually implement it.

E7 [00:47:24] Yeah. Yes. And I can measure by the indicator that the number of people that are having now smartphones is increasing. And of course most of the mHelath interventions they are on individual smartphones. So I think there is a shift. Yeah.

I [00:47:40] Mm hmm. Okay and can you think of strategies that can be employed to ensure that health care providers and end users are receptive to and comfortable with using both using and health solutions? So as you said, that they are already aware, but like how can you even like accelerate that process?

E7 [00:48:06] So I think people would be much more to be much more adaptable to any kind of solution if they feel they are part of it. Like if you have an intervention having feedback to them, like going with a solution, get feedback to them, they give you feedback, you wait on them. So I like me to use that kind of solution. I'll be more happier because I feel like I'm part of doing it. It was developed before it was developed for me, you see. So involving them, that comes to the concept of humans centered design that are designed to involve them. When we were creating this kind of mHealth intervention we should have feedback from them, so let´s involve them from the start. That is very

difficult. But if you have a good feedback on them, you're improving something. But be happy being me.

I [00:49:07] MM Okay, Thank you. And okay. Looking at the planning and developing side of mHealth, what would you say are the success factors and barriers in those phases when you're planning?

E7 [00:49:33] Okay, so this success factors, I can categorize them into firstly human resources and then we come to financial resources, the infrastructure. So for the human resources, we need people who can develop this kind of solutions. Not just medical doctors or just nurses we need, but software and engineers, data science to actually understand clinical problems and have a common solution for them. So that is a first factor. But also, we need financial resources. Yes, in terms of developing the solution, testing them and everything, but the infrastructures also, they need to be very conducive in developing this kind of solution. But lastly, the policy or the framework for this kind of solution. They need to be energy friendly, they need to be inclusive, like they should not be more obstacles that at the end of the day, we discourage innovators and implementing new solutions.

I [00:50:48] Mm hmm. Okay. So the next question would be, who are the key influential individuals to get on board with this implementation? How should these and influential individuals be dealt with? So like the most important stakeholders that we really need to like align with.

E7 [00:51:13] Okay, So first of all, if I was catching this, I started there, say, a patient at the center. Because these are the people that we are creating solution for them. That's not just patient. We can say clients. Then we have clinicians because having this connection between patients, clinicians and the system, the solution developed is very important because people, they won't trust me as a software developer going to give them solution, but you rather trust them more a doctor with experience with them to use that kind of solution. So we need those of the clinicians, but also we need the decision makers, the ones who are making policy, the regulators and everything. They have to be part of this because things must be different at the clinical level or clinical solution. But the regulators have different concept of this kind of ideas. For instance, when we started this kind of AI solution, it was very difficult to explain to regulators, which we are really doing. But if we could have involved them, if they have this awareness of the change of the technology now, how things, that would be much easier for us four years ago, but for now, at least the understanding and they are waiting on it. So the regulators, but also when it comes to sponsors and funders or donors, they also have to to know like because

what I see most of the time, like this funding it comes with a different, it comes with an objective. So that objective might not be reflecting what is really happening in the clinical government. So I think there's also have to be flexibility in terms of this funding because you have a funding, but they need you to address the problem in HIV and so you need to tailor all the solution to go to patient groups HIV. That kind of solution will actually address a large population, not just just HIV. So I think also in terms of funding and support, also they have to be flexible based on the clinical environment, in the context of the where the solutions are being actually being developed. Mm hmm. Yeah.

I [00:53:38] Okay. Thank you very much for the insights. And yeah, no, it's like more as a sum up for startups as well who want to implement something like that. Yeah, like overall, what would you say other critical success factors and the barriers that startups are faced with for implementing mHealth in Tanzania?

E7 [00:54:05] There are internal factors for the startup itself and external factors. I would talk about the internal factors. First of all, most of the startups is like, they have a very good idea but the challenge comes to the team to actually take the idea forward. So you might have in mHealth interventions, they are working in silos. Maybe they're just software engineers or they're just medical doctors or the technical part of the things and actually move on. And also, they don't have these kind of people who can talk to supporters, donors, investors who come and invest in the solution to make it to move forward, and also the ability to position itself. But as also most of the startup, what is usually be done, like we will see a solution that is working in Europe or somewhere and try to implement in our own countries which are it might not work because of the different circumstance that we are having because we need a local solution for the local problem. So you are just taking something from somewhere else and then you are coming to implement it. That's is also a challenge. But when you come to external factors, yeah, at the same points, like the regulations, proper supports from the governments and organizations, but also networking. Yes, I find there are people that are working on the same solution, which ultimately could come from something us or find people. We can reach the same solution in German, but also working on the same solution in Tanzania. So if you team up, I think to get to the implementations. Yeah. Yeah.

I [00:56:15] Thank you. So as the last question, yeah. Do you have any like key takeaways or recommendations that you would provide to startups when looking for implementing mHealth Solutions in Tanzania?

E7 [00:56:32] Okay. So they have to develop solutions to the people and to the problem is not just the observation of the technology. Just as the AI we implemented, which does

actually suit our context that is best, of course. But another issue is also to make sure we create a very strong, strong teams that will make sure that in terms of ideation up to implementation. Networking also to pull out resources in the implementation of whatever that idea that they are working on, but also having mentorship and mentorship is very important. I like the way the people that are doing it and not just the mentorship in the country, but can be outside of the country that people that are already working ahead of you. So having a mentorship also makes that about the focus on what they're doing and making it to the market and implementation.

I [00:59:00] Thank you so much. Then we were really fast. Yeah, we already went through all of my questions, so. Right. Do you have any insights, anything you want to share?

E7 [00:59:18] Okay. No. Thank you so much. But, like, if you know someone who can work with AI if you can recommend. I really appreciate.

I [00:59:32] Oh, you mean some, like some programmers that are like. Yeah, good. In the medicine area as well. You mean.

E7 [00:59:39] Yeah. Programmers. The clinicians will be listed to work on cervical cancer. I appreciate.

I [00:59:45] That. Yeah, I'm not really in the field, but if I was lucky. But if I know, I think I will for sure.

E7 [00:59:53] Oh, okay. No problems. Okay. Yeah. Yeah.

I [00:59:56] But, um, thank you very much for taking the time. And, yeah, I wish you good luck with your mHealth initiatives, and I hope that. Yeah, it'll work out.

E7 [01:00:07] Okay. Thank you so much, Sandra.

Appendix 6.8: Interview Expert 8

I [00:16:22] Mm hmm. Yeah. So I'm writing my master thesis about the digitization of the healthcare sector in Africa. And, yeah, I focus on the mHealth for that. And I'm doing a country comparison between South Africa and Tanzania by looking at the success factors and the barriers for each of the countries. And yeah, maybe potentially how to overcome some of the barriers for successful implementation. Okay. Um, maybe. Do you want to introduce yourself and, like, what's your background? And with mHealth and your position and how long you've already dealt with the topic.

E8 [00:17:31] Okay. I'm Elina. I don't have much in my background, but I like what you're doing. It´s interesting and it's a nice thing you're motivating me, too, because I was thinking about taking a master's. So I'm like, Oh, yeah, you.

I [00:17:59] Should do it. You can come to Germany to do it?

E8 [00:18:03] Oh, I will definitely come to Germany. Okay, so let's get started.

I [00:18:28] What's your connection with MHealth? How are you connected to the topic?

E8 [00:18:42] Okay, I. I think it's all about my dream, because my dream is to help people. I mean, to help people in the health sectors digitally. Mhm. So I have a degree of health information system connecting into mobile health interventions and everything.

I [00:19:09] So the first question, it's like about the mHealth intervention. And for that, what specific features would contribute to their potential success or challenge in Tanzania? Like, for example.

E8 [00:19:38] Okay. When you talk about accessibility, it is like the mHealth interventions in most of the places I mean the mHealth interventions can be easily accessed via smartphones and maybe wearable devices or. So in Africa, it's not all the places that they have smartphones or the internet is fine and everything. But when you talk about there is data integration, integration with electronic health records at the health system can improve care and ensure the health care provides or have access to patient information. Okay there are a lot of specific features. There is also education, convenience, that's analytic. We have to change techniques. Yeah, those can be success factors or features that contribute to mHealth interventions implementations.

I [00:21:10] Good. Yeah. Then thank you for your answer. And the next questions. There are more regarding the cost. So, yeah. What challenges do you see related to cost that arise for the implementation of health and also what might be strategies to succeed despite these challenges?

E8 [00:21:32] Okay for in my country. First I´ll talk about development costs. First of all these mHealth applications are a bit expensive, like including software development and designs and ongoing updates of now in onward, but the strategies that maybe can be used in development costs seeking funding from governments or the private sector that are interested in health sectors, maybe NGOs. Yes, there is a infrastructure cost. This is supporting a larger user base like infrastructures that the storage can be useful for my country most of places. So in the strategies that can be used. It's like, okay the cloud computing can be cost effective solutions as it as it allows scalability and reduce the need to fix physical features. There is monitoring and evaluation. The impact and effect

of mHealth program can require resource and strategy, like allocating of appropriate portions of budget for ongoing monitoring and evaluation to help use data analytics to access the program impacts and make data driven improvement. There is also user adaption and engagement like you can have, this a bit costful, because you can create an application that can use the mobile technology and user adaption can be one of the most costful factor in my country. So lower user adoption and engagement can hinder the success of mHealth programs. So the strategy that can be used is develop user centric solution by involving end users in the design process. Like you have to involve people, you have to customize the application you are creating maybe into the language of specific people or into the culture of specific people. So as this user adoption cannot be a cost to hinder the mHealth programs.

I [00:24:05] Mm hmm. Okay. Thank you. In general, who's responsible for covering the costs related to you actually using the mHealth interventions? Is it more like paid out of the pocket or other there, like an insurance that might cover a part of it? Or how does it work in Tanzania?

E8 [00:24:24] Okay for my country most of people who are responsible to covering this cost related to mHealth intervention related to using mHealth interventions, are mostly means health care providers and organizations and there is health care companies like we have a national healthcare. I mean MHIF, it is national health insurance company well they hold in for the country. So there are other insurance companies for health. There is NSSA that also covers health sectors of their members. But there is also government in public health agencies. There is patients themselves. They somehow cover these costs. There is research grants in nonprofit organization NGOs. There is private sectors in technology, technology companies that are interested in health, in health or digital health innovations. Mhm. So all of I guess all of these are the responsible people to cover the costs in related mHealth interventions.

I [00:26:53] What strategies can be applied so that, like, the population can afford using it? Because. Yeah, of course, like the creation, everything, the cost, they are paid by the organization or whatever. But then is it like mostly for free, like when the population wants to use it or how can they afford it.

E8 [00:27:17] Okay for some few MHealth, the application that I know are available right now. I mean end users only provide money when they need service, but you know, using the mHealth in using the like mHealth applications that have been created for them. They only use data to access the service from the applications they want to save when they go to see if maybe there is this application called now um DAUAMconomy and enduser

can access maybe from whereever he or she is through the mobile phone. Yeah. So the only thing that he's paying is the product that he's requesting to get or the service that he's requesting to get. Mm hmm. But it is possible like he can access it when he's at home. He does not need to move from home to go to the hospital to get the medicine. So he can just access or he can just make an appointment with the doctor through the phone, or he can even talk with a doctor at home. He does not have to come to the health facilities. Mm hmm. Well, there are some. Yeah, there are some cost that endusers has to pay. But it's a bit reducing because when a person, when they choose to move from one place to go to the health facilitates it is more costly. So it´s a bit less.

I [00:28:53] Yeah. No, that makes perfect sense. Yep. And now, looking at the broader health care landscape in Tanzania, what opportunity, opportunities and challenges do you see for implementing M Health Solutions?

E8 [00:29:15] There is research and innovation funds like government agencies and private organizations often provide funding and grants for mHealth interventions and innovations encouraging the development of new and improved solution. So for my country, that can be the opportunity. And there is a patient centered care like policies emphasizing patient and centered care align with mHealth solution that to empower patient to take more active role in managing their health, but also challenges. So I was not able to find the challenges because it´s a lot.

I [00:30:31] Yeah, totally fine. Okay. And then for the next questions, um, how can regulatory and policy considerations be navigated to ensure compliance and the smooth integration of mHealth?

E8 [00:30:49] Okay. How can regulatory and policy consideration be navigated to ensure compliance and operational simplicity? There is a patient consent and engagement like clear communication and like clearly communicating the benefits and the risk of using the mHealth apps to the patients. For example, you are creating you like a mHealth application to deliver health service to people. You have to communicate with them like what are the risks and what are the benefits of it? And there is regular updates like you have to update the regulations and polices to update the mHealth solutions accordingly to how the environment change or how the people are adapting to how they people use it or how the people encounter the problem of mHealth application or solutions. It needs a regular update. But there is a privacy and security measure. Implement a privacy and security measure to protect patients data. In this mobile health applications. Most of them, they but yes, they get to get the patients, the patients details and it needs to be private, like it needs to be secured. So like privacy and security measure has to be taken.

I [00:32:35] Okay. And. Yeah. So what I read is that often it's hard to achieve like sustainable funding for mHealth. They get funding for research, but then afterwards, like the project kind of ends because yeah, like the funding stops or whatever. So my questions would be if, yeah, if you can think of some strategies that organizations could use to achieve like a longer term and sustainable funding?

E8 [00:33:08] Okay for my country most of these digital innovations they depend on the fundings due to the economy of the country. But the strategies that I can say are user fees and premium models like you can offer mHealth solution in a freemium business like you reduce the cost for the end users to get the health services as it's needed and to make this while mHealth interventions develop and implement. There is health care reimbursement, health care providers reimbursement - work with health care providers to include mHealth solutions into their service and include the reimbursement options from issuer of the government program for MHealth services. Like you cooperate with these health providers because they're the ones who issue the mHealth solutions. So when you you work closely to them and it helps these mHealth solutions to take place. There is public private partnership like collaborate with private sector organizations. There are private sector organizations that they can, they can sponsor these health care providers for them to deliver the health services and to influence people to use these same health interventions for their health and everything. So public private partners, these can be one of the strategies to be applied in the organization to achieve sustainable funding of mHealth.

I [00:35:26] Okay. Thank you. And do you have information from participants, like on the one side, like the health workforce? Health workforce. And on the other side, the patients regarding their experiences with mHealth, like, for example. Yeah. If they actually use it, if their needs are actually met, if they have like a Yeah.

E8 [00:35:59] Yes it´s working. There is this application is called the MOMONAMTOTO. And it's like an uber. Like a pregnant woman can request when she has a problem or she wants to deliver the kid by the time she can request for an ambulance from wherever. Yes. So it's working. And as people get the health services they need by the time. Mm hmm. Yeah.

I [00:36:36] And how is that actually covered like the cost, for example, when she's picked up by the ambulance?

E8 [00:36:53] She only pays a small amount of money away, but after that she has been driven to the hospitals. So it's the service that is provided. These people have to get that service in a perfect time. It is not free, but the cost is reduced. Mm hmm. Okay. Is the

cost reduced compared to the normal cost of, like, a person when they request an ambulance. So the cost is covered by the patient in some percent and by the health facility by some percent.

I [00:38:03] And also, what barriers can you see that individuals but will be and also what various individuals serve by the organization be faced with to participate in the intervention? And how could they also overcome it?

E8 [00:38:25] Okay. Here I can say digital literacy like digital skills and understanding of how to use a mobile apps like most of people in my country. Yes you can say in some high percent a lot have smartphones but they don't have that literacy of how to use it. So maybe only for calling or just texting, but there is a lot in a smartphone that a person can do. So the literacy they have, it's not that much.

I [00:39:00] So maybe I'm sorry for interrupting, but like even like younger generations, like the digital literacy is also low?

E8 [00:39:13] Here I talk of the older generations. For the young generations a lot are trying. We get to know a lot of things. So they overcome that can be used for these barriers utilized peer support in community location like providing education for how it is to be used the applications and needs to be delivered to people, you have to provide the community education and providing training sessions before it's applied to people to help them on how to use it. Mm hmm. Then there is a language of culture barrier. This is the biggest one because most of places we have different language, though we speak Swahili. But in in the rural areas, there are different languages. People speak their native language. So the language, different culture factors that affect understanding and trust. So that can be a barrier. Then they overcome that can be used you involve community leaders and interpreters, like when you want to deliver a health service through a digital through digital health solution or through a mHealth solution, like in order for them to encounter this language and culture barrier, you involve the community leaders because them it's easy to it's easy to influence that people use it than then the person from outside of their village or outside of the cultures that they're used to. There is then there is access to technology that's going to be one of the barrier. And the overcoming is to prove to develop offline capable solutions. Most of places the access to technologies is not that much covered in a large area compared to the urban places. So, um, and maybe you can have your application and it needs internet to operate and people don't have that access to that technology or don't have access to the Internet and Internet services. So it's hard for them to use. Yeah. Yeah. So, yeah. So they overcome like develop of, like, capable solution. Or maybe if you creating a mobile app that helps deliver health services

like it, you have to create in a way that a person can use even if he or she is in offline. Mm hmm. Yes, there is cost and affordability. Okay. Even though the cost is reduced to the patient is. But it's not everyone. It's not every pregnant woman that can afford still the same cost or it is still a problem and they overcome is partner with mobile carriers for discount, they like to provide the discounts to provide the discount. So the cost and the cost of everything, it's not like all the pregnant women can afford the costs even the reduces cost.

I [00:43:57] Then moving on to the next question. What are the organizational structures and cultures within the healthcare system that either support or hinder the implementation of the mHealth?

E8 [00:44:14] Okay the organizational structure. There is a leadership and visions. Supportive structure and supportive culture. Leadership and visions in the side of supportive organizational structure with visionary leadership that recognized the potential of mHealth and sets clear for its implementation are more likely to succeed compared to the organization leadership that don't have the visionary of the importance of mHealth solutions and to the side of supportive culture. A culture that encourages innovation and embrace technology as a means of improve health care can foster the impulse adaption compared to the culture that they launch, motivate their people, or they don't push their people into innovation and technology. So leadership and vision factor can be both supportive structure in culture. There is resource allocation in a side of supportive structure. Allocating adequate financial and Human Resource for mHealth Project demonstrates commitment for their success that is to the side of supportive structure and to the side of supportive culture, a culture that values investment in technology and healthcare innovation is more likely to allocate resources for mHealth. So compared to the culture that they don't, they don't value these things. So for my country, it's divided. There are cultures that they value the investment of technology and there are places in culture, that don't really value about that. They see it as culture destruction. It's hard for them to implement to allocate the resources in mHealth. Then there is data integration – Having IT system that's capable of integrating mHealth data with electronic health records and other healthcare data sources, streamlining information sharing. So that is to the side of supportive structure of data integration into the side of supportive structure, supportive culture, a culture that expertise data interoperability and sharing for the benefit of patients care supports mHealth integration. It's also divided like there's some culture that they prioritize the data interoperability, sharing data of their patients for the benefit of the patients. But there are some cultures that hinder that. Those are supporting factors. Hindering factors - They're resistant to

change. Most of places they're resistant to change. It depends it can be structural, it can be culture. Like hindering structure organizational structure that's resistant to change can impede the adoption of mHealth services. Let's say from paper based that they are used in the health facilities into electronic based or digital based. So they're just resistant to change. The same applies to the culture. So maybe they don't have enough understanding about the health services. It's just the lack of interest about health issues. There is a lack of IT expertise, there are some places that they left IT experts to mHealth implementations. And to the hindering culture. A culture that undervalues IT expertise maybe prioritize the equipment. There are just some places, they just don´t value IT people. So if they don't value IT people, they won´t bring them into their facilities because they just don't see the importance in their culture. Mm hmm. And yes there is inadequate training. To the side of hindering structure, an insufficient training program for health care staffs on mHealth tools can be lowered up to adoption rates of their places. They don't train their health care providers into more of the updates on mHealth delivery, the mHealth tools or health delivery, whatever they're doing, they just don't because these things everyday needs to be updated. And if it's updated means the health care providers need to be trained to go at that, to go with their application that are being made. So in some places they they don't give their healthcare providers adequate training. Yeah.

I [00:50:50] And how do you perceive the overall climate for implementing mHealth solutions in your countries Like yeah. Is it overall a pretty open and positive?

E8 [00:51:09] As for now, it's more positive. It's going to the positive side because compared to ten years back, it was different compared to as the time goes. So because most of healthcare, maybe the government, the NGOs, the private sectors, they provide the education to these people who are just resistant to change or who they just bring the barriers into mHealth implementations. So they are being provided with education, the health issues and everything, and they test all technology. So it's still going like if it's the chads, it's still increasing to the positive side. So it's still growing.

I [00:52:10] Yeah, but it's like still more in the beginning, I guess, like. Yeah. Like it? Of course. More open to it. But like, in the beginning of really implementing it and integrating it.

E8 [00:52:25] Yes, it's. It's more compared to then.

I [00:52:31] And then the next question. Um. Yeah. Like, yeah, I read that strategic partnerships are, of course, very important for the long term success. So I wanted to ask how organizations can achieve this.

E8 [00:52:51] One of the point can be identified the objective before seeking partnership in an organization. Organizations should define the strategic objective. What are their clear objectives and what they hope to achieve through collaboration with their partners that they are going to seek. This may include expanding services or entering new markets, enhancing innovations. There is also I mean identifying potential partners like Organization can achieve this mHealtth implementations by identifying potential partners that share similar goals. You can´t just go and seek a partnership to an organization that is not interested in the health issues. So they need to identify the potential partners for that matter, and their share risk and rewards like partners. Partners should share both the risk and rewards of the collaborations. And this can foster a sense of shared and protected interests of both parties so the organization can achieve this mHealth implementations by sharing both. If there is a risk that focus in the progress of implementing this mHealth, they also share with their partners. And if there are some rewards that they get or some rewards that they come across with, they also share. So this helps them to achieve the implementation of mHealth.

I [00:54:57] And yeah, how do you perceive the overall readiness of the health care professionals and users in their country to actually use the technologies? I Yeah, I mean, you answered it a bit already earlier when you said that they're not really training so I guess the readiness is low?

E8 [00:55:21] Not that much broadly. To some places, yet it's still a problem because of the cultural issues or the structure issues. So it's not that much broadly compared to the developed countries out there. So it's still a very still a problem now.

I [00:55:41] And can you think of strategies like how to make the end users and the health care providers more receptive and comfortable with using these services?

E8 [00:55:56] Okay. The strategies, training and education like provide comprehensive training and education program to health care providers. This might help the comfortability with using the mHealth solution to both the end users and healthcare providers. There is also user centered design like when you create mHealth applications or mHealth solution to people, you have to involve the health care providers because they're the ones who mostly communicate with the end users of the applications that you want to go, the health service that you want to deliver to people. They are the ones that provide. So you have to involve them health care providers and end users in a design and development process of mHealth solutions. Their inputs can help ensure that the technology meets the specific needs and preference for them, for them not to ignore it, because when it does not meet with their needs and their preference, they will not use it

because why would you.There is also data transparency like to be transparent about how patient data is collected, used and shared within the mHealth and address concerns, misconceptions. So when you are collecting data, you have to be you have to be honest with these agencies or with patients. This is how we collect the data and this is how data is going to be used or is going to be shared in the mHealth solutions but in a secured way like it's not like it's going to be public so you have to be transparent. Okay I´m taking your answers about these issues about this disease. And it's really going to be secure and it's going to be safe. So you have to be transparent to people for them to create this trust. There is a usability testing. Conducting usability testing to identify and address any usability issues or barriers. So before you, you have to test the usability. Okay. Just the application that may be of create for for, for you to identify if there is issues or barriers or benefits or this is appropriate, it meets their needs and everything. Always just there are a lot of barriers here in between for the health service to be delivered to the end users. Yeah.

I [00:58:58] Okay. Thank you and when you look at the planning and developing phase of mHealth interventions, what would you say are the most important success factors and the barriers?

E8 [00:59:14] Success factors - stakeholder involvement involving a diverse range of stakeholders including health care providers, patients, IT experts, regulatory authorities can ensure that the mHealth solution is well-rounded and meets the needs of parties involved. So this can be one of the success factors when you will involve all these people, because at the end of the day they're just going to be involved in the mHealth solution. Then there is a technical expertise. Access to technical expertise is essential for the developing and maintaining mHealth solution. Having a skilled, developed development team or partners can ensure that technology is secure and scalable. There is pilot testing, like conducting a pilot testing and trials for the mHealth intervention allows for refinement and optimizations based on real world feedback before the full scale rollout. So this can be this can be the success factor for planning and development for my country. But also there are some barriers. Limited resources, insufficient financial, technical and human resource can hinder the planning and development phase. In some places like deep rural areas, they don't have these resources, so the resources are limited. It can be one of the barrier that's going to hinder the planning and development phases of mHealth solutions. Then there is a lack of user input. Failing to involve end users, including healthcare providers and patients in the planning and designing phase can result in a solution. So when you fail to involve these healthcare providers and patients in the process of planning and designing and developing the mHealth solutions can bring the lack of user

input so it won't be of any need of any use if you don't involve this healthcare providers and patients. There is also cultural behavior factors. Culture, beliefs and behavior patterns may influence the acceptance and use of mHealth interventions like tailoring solution to a specific cultural context can be challenging. So they are cultures they just don't allow the use of smartphones or they don't have the access of smartphones. So they don't have this technology. So this this can be one of them. One of the challenge or barrier that can hinder this whole process of planning and developing the mHealth solutions.

I [01:02:41] So as like the summarizing question, like, what are the key takeaways or the recommendations you would provide, like to a startup that's looking to implement and have solutions?

E8 [01:03:29] Okay, the key takeaways and accommodation. First, it's needs to understand the local healthcare needs and regulations. In some places you just have to understand what the needs for this society are. What do they need in terms of providing healthcare services? What do they need? So if you understand the local healthcare needs and regulations, it's more easy. It's not used to implement mHealth solutions in most of places in my country because it´s still developing and. So then engage with health care stakeholders like you need to engage with these stakeholders and they can be they can be health care providers, clinics, hospitals and other stakeholders to understand their requirements and challenges because they're the ones that interact with the end users so they understand more what are the challenges and what are the requirement for implementing the mHealth solutions in a certain society. Then there is customized solution like this solution that you're trying to create to a certain area you need to customize. It needs to be customized into their needs and culture preference of the local populations. So you can't create a solution that is not of that culture or it is not of their preference. Then there is network with local expertise. Establish connection with local health care professionals, researchers and expertise who can provide valuable insights and guidance. Involve local expertise in the development evaluation of mHealth solutions. So when you're trying to create, you're trying to create the mHealth solution of a certain place, you need to involve the local expertise of that areas because they can be one of the people that can help you to know what are the requirements and the challenges because they have been there in the industry.

I [01:06:05] And thank you very much for your time and for all the insights.

Declaration

I declare that I have prepared this thesis independently, have not submitted it for examination purposes, have not used any sources and aids other than those specified, have marked verbatim and analogous quotations as such and tolerate verification using anti-plagiarism software

Neu-Ulm, 10/12/2023

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Place, Date

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Signature