Digital Rehabilitation Interventions at Home- and Life Space in Sub-Saharan Africa

Scoping review

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Abstract

Access to rehabilitation in sub-Saharan Africa (SSA) remains insufficient to meet growing needs. Due to lack of resources and issues with infrastructure, especially in low-income countries and Africa, rehabilitation is vastly inaccessible. In African nations, rehabilitation services face major shortages, leaving at least 63% of those in need without adequate care. Digital rehabilitation technologies offer cost-effective solutions, helping to reduce hospital stays and prevent re-admissions. SSA region's growing mobile and internet access offers opportunities for digital rehabilitation, though challenges such as infrastructure gaps remain.

A scoping review was conducted following the framework of Arksey and O'Malley, with improvements made by Levac et al. (2010) in collaboration within the RADIC project, focusing on digital rehabilitation in SSA countries. The project aimed to promote digital transformation in East Africa through capacity building in higher education. Led by Bochum University of Applied Health Sciences, the review explored digital rehabilitation methods in home and life space settings.

Nineteen studies were selected to gather knowledge and explain the facilitators and barriers of successful implementation of home and life space based digital rehabilitation in the SSA region. The results of the scoping review were identified and presented in three categories: environmental, access, and intervention related determinants. The findings strengthen the current body of evidence on the factors influencing the successful implementation of digital rehabilitation interventions. Further investigation is urgently needed to develop sustainable digital rehabilitation strategies contextualized for the SSA region.

Digital rehabilitation is gradually growing in SSA countries. However, significant challenges must be addressed before digital solutions can meet the region's growing demand for rehabilitation services. Policies and regulations based on evidence-based research and structural guidance are needed by governments to ensure the development of digital rehabilitation. The insights of the scoping review can be applied to support development projects and design processes of future digital rehabilitation interventions in sub-Saharan Africa.

Keywords

Digital rehabilitation, sub-Saharan Africa, home-based rehabilitation, life space -based rehabilitation, digitalization of rehabilitation services, rehabilitation science

Other information

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1 Background

The need for new solutions in the rehabilitation field has never been greater. Currently, an estimated 2.4 billion people worldwide have health conditions that could benefit from rehabilitation. The number is predicted to increase due to changes in the characteristics and health of the population. For instance, even though our life expectancy is higher than ever before, we also live with more chronic illness and disability than ever known in human history. (WHO, 2023.)

Access to rehabilitation is becoming increasingly limited. The global shortage of rehabilitation resources has been widely recognized, with more than 50% of people in low- and middle-income countries (LMICs) unable to access the services they need. In African nations, rehabilitation shortages are particularly severe, leaving at least 63% of those in need without adequate care (WHO, 2024). Sub-Saharan Africa (SSA) faces a shortage of healthcare professionals, accounting for only 3.5% of the world's health workforce despite bearing a high disease burden, including various disabilities (Mapulanga, & Dlungwane, 2022). Limited access to rehabilitation services is often linked to insufficient governmental prioritization, resulting in inadequate funding, persistent cultural and social stigmas, a shortage of rehabilitation centers, poorly equipped facilities, systemic health system failures, insufficient training for rehabilitation practitioners, and logistical as well as financial constraints (Cyuzuzo et al. 2025).

Disruptive events such as conflicts, natural disasters, and disease outbreaks further increase the demand for rehabilitation while simultaneously destabilizing existing services (WHO, 2023). One of the most recent disruptive events, the COVID-19 pandemic, has significantly impacted global health and strained rehabilitation systems. However, the pandemic has also prompted governments to take action, accelerating the development and implementation of digital rehabilitation technologies (Keesara, Jonas, & Schulman, 2020).

Even though the sub-Saharan Africa countries are boasting rich natural resources, and the economic growth is projected to accelerate to four percent in 2025-2026, many of the countries are fragile or conflict-affected and fall under the categories of low income, lower-middle income, and upper-middle income according to the World Bank country classifications by income level for 2024-2025 (World Bank Group, 2024). Financial factors significantly impact the availability of rehabilitation resources. When strategically planned, digital rehabilitation can serve as a cost-effective

investment—enhancing individuals' daily lives at the micro level and delivering broader societal benefits at the macro level. Rehabilitation services require substantial resources worldwide. In most EU countries, curative and rehabilitative care services account for more than half of total healthcare expenditures (Eurostat, 2023). The growing pressure to reduce costs while addressing unmet rehabilitation needs calls for innovative solutions.

Digital rehabilitation presents an opportunity to lower expenses and deliver essential healthcare services with fewer resources. Thorough planning and implementation of digital rehabilitation services can support key financial objectives in healthcare by:

- reducing the number of costly hospitalizations,
- shortening hospital stays, and
- lowering the risk of patient readmission. (WHO, 2023.)

Cost-effectiveness was listed as one of the main arguments for the appropriate use of digital health in the Digital Health Strategy 2020-2025 mapped out by the World Health Organization. Financial costs can be lowered with the help of strategic digital rehabilitation services because rehabilitation's purpose is to minimize the need for governmental financial aid or caregiver support, as it aims to support individuals' agency to engage in or return to work and employment, or to live independently at home. (WHO 2023.)

Launching digital health services requires a vast number of resources and competences. Even though some countries have been able to make noticeable advancements in the field of digital health strategy implementation, there are many countries that require institutional support to succeed in this area. Global strategy is needed to enhance and strengthen the existing and emerging digital health networks. To support the health system strengthening the WHO has issued Digital health guidelines comprising of evidence-based recommendations on digital interventions. According to the guideline digital health should be included as a vital part of health priorities and support people in a way that is ethical, safe, secure, reliable, equitable, and sustainable. Principles of transparency, accessibility, scalability, replicability, interoperability, security, privacy, and confidentiality should be followed when developing digital health services. (WHO 2021.)

There isn't yet a great number of published research available about digital rehabilitation in sub-Saharan Africa. Nevertheless, the field of digital rehabilitation is emerging in the region. There has been a rapid growth of digital health and technology in healthcare across the African continent, due to factors such as increased access to mobile phones and internet connectivity. According to the Mobile Economy report by GSMA (2023), in 2023 sub-Saharan Africa was one of the global regions that saw a great rise in smartphone adoption, and the numbers will keep rising. Smartphone adoption in the SSA region is predicted to reach up to 87% by 2030. Together with India, sub-Saharan Africa will account for almost half of the new mobile subscribers globally by the end of the decade (GSMA 2023).

Hundreds of millions of people have gained access to the internet to utilize various digital services during the last decade in sub-Saharan Africa. This demonstrates that the region has made notable developments toward digital transformation. Between 2019 and 2022 over 160 million Africans gained access to broadband internet, and between 2016 and 2022 there has been an increase of 115 % in internet users in the SSA region. Regardless of the great improvements, sub-Saharan Africa still has many challenges to tackle regarding the digitalization of rehabilitation services. The SSA region's digital infrastructure coverage, access, and quality still fail to keep up with other regional standards. For instance, in 2021 84 % of people living in the SSA region lived in rural areas where 3G service was available and 63 % had access to 4G mobile coverage. (The World Bank 2024.)

This master's thesis report utilizes a collaboratively carried out scoping review. The literature review was carried out in the context of digital rehabilitation in sub-Saharan Africa as part of the work and research completed within the RADIC project. The name of the project stands for "Rehabilitation for all through digital innovation and new competencies" and project is co-funded by the Erasmus+ Programme of the European Union. The aim of the project is to support and promote digital transformation in East Africa via capacity building in higher education. The project's timeline is from April 2023 until December 2025. (Jamk 2024.) The literature review was carried out as part of the project's work package 3 (Enhanced digital competencies) and the partner organization carrying out the lead responsibility of the literature review was Bochum University of Applied Health Sciences. The process of the literature review was carried out in collaboration with two researchers from the institution (A.A. and C.G.) and an article was published with the results of the

review. Reporting the process as a master's thesis report was carried out as individual work with parallel approach to research question formulation.

The purpose of this master's thesis report is to present data about the factors supporting or hindering the digital rehabilitation interventions applied in the home and life space settings in the sub-Saharan Africa region. Recent and applicable studies from the SSA region were selected to explain the current digital technologies used to promote rehabilitation for people with various rehabilitation needs. The aim of the report was to gather information about the factors which were meaningful to the succession of the digital interventions applied. The data produced from the literature review can be applied within future projects carried out in the SSA region supporting the digital transformation in healthcare studies. The synthesized information in this report is suitable to be utilized whilst planning effective digital rehabilitation interventions in the SSA region.

2 Digital rehabilitation key concepts

2.1 Defining digital rehabilitation

Digital rehabilitation is an innovative field where digital solutions and technology are supporting the health care professionals or rehabilitees themselves to carry out the rehabilitation process (Global Digital Rehabilitation 2023).

A way to understand the concept of digital rehabilitation better is to briefly examine its history. Before digital rehabilitation, terms such as tele-rehabilitation or telemedicine were used. Telemedicine began as early as the 1920s even though the actual term didn't come to use until the 1970s. Telemedicine was described as using telecommunications and information technologies to deliver healthcare services remotely, without the need for direct, in-person interactions between a health care specialist and a patient. It included the use of images, video, data, and voice communication to facilitate medical care across distances. Telemedicine began with the use of audio-based and cable television technologies and expanded in the 1970s to satellite-based technologies with the support of government-funded projects in the US and Canada. (Moore 1999.)

The concept of digital rehabilitation began to emerge in the early 2000s as the fields of telemedicine and tele-rehabilitation evolved. The twenty-first century saw the emergence of wearable health devices with real-time monitoring features, the use of data analytics and big data, as well as the integration of virtual reality (VR) and augmented reality (AR) technologies into healthcare, and especially into rehabilitation. The impact of these emerging technologies has been remarkable to the possibilities available in rehabilitation science. Use of artificial intelligence (AI) in diagnostics and patient care, wearable sensors for tracking patient data, for instance in cardiac rehabilitation, and VR and AR technologies for creating immersive therapy experiences, for instance in neurological rehabilitation, are just some examples of great innovations in (digital) rehabilitation. The rapid digitalization of health care services also transforms the skills set required as a rehabilitation specialist and highlights the importance for rehabilitation professionals to update their expertise with the latest knowledge and research of their selected field. (Afridi & Khan 2024).

Digitalization has a key role in planning efficient healthcare services. For the healthcare sector digital transformation is vital for ensuring the development, availability, and quality of rehabilitation services. Innovative technologies including the Internet of Things (IoT), artificial intelligence (AI), big data analytics, remote monitoring, blockchain, smart wearables, platforms, data exchange and storage enabling tools, and remote data capture and exchange tools have made it possible to share important information across the health care network, allowing multidisciplinary professionals to access the same data, and ensuring the continuum of care. This concludes that with the help of these technologies, improvement is seen in processes such as medical diagnosis, data-based treatment decisions, clinical trials, digital therapies, self-management of care, person-centered care, and creating more evidence-based knowledge, skills, and competencies for health care professionals supporting the whole industry. (WHO 2021.)

EHealth and mHealth are commonly used terms in digital rehabilitation. EHealth can be defined as the use of information and communication technologies (ITC) to support health care services. Use of eHealth supports cost-effectiveness and security. EHealth encompasses a range of interventions including telehealth, telemedicine, mHealth, electronic medical or health records, big data, smart wearables, and artificial intelligence. EHealth services are recognized as a vital method to attain general health priorities such as universal health coverage (UHC) and the Sustainable Development Goals (SDGs). (WHO, 2024a.) MHealth or mobile health utilizes mobile technology such as mobile phones, applications, patient monitoring devices, Personal Digital Assistants (PDAs), and other wireless devices to offer health care services directly, economically, and in an engaging way to the health care service users and providers (WHO, 2024b). The most common eHealth technologies applied in home-based digital rehabilitation are sensors, robotics, gamification, virtual reality, augmented reality, mobile apps, and digital platforms (Arnzt et al. 2023).

To be able to either receive or facilitate digital rehabilitation one needs to have a certain set of competencies and abilities. Related to digital rehabilitation are the abilities needed to participate and act as a digital citizen. According to the Council of Europe (2022), digital citizenship can be defined as a person who, through the development of a wide variety of competences, is able to engage actively, positively, and responsibly in both online and offline communities which function on

a local, national, or global level. Another related framework is the European Digital Competence Framework for Citizens (DigComp) reference framework which portrays an agreed vision of what is needed in terms of knowledge, skills, or competencies to overcome the challenges that arise from digitalization. The key competencies listed in the DigComp framework include information and data literacy, communication and collaboration, digital content creation, safety, and problem solving. (Vuorikari, Pluzer, & Puner, 2022.)

2.2 Digital rehabilitation frameworks

This chapter explains selected few of the most widely accepted theoretical frameworks and principles of digital rehabilitation which are useful in the design and implementation processes of digital rehabilitation in health care services. The frameworks explain the key concepts that need to be emphasized whilst planning digital rehabilitation interventions which are safe, effective, equal, and client centered.

2.2.1 Ethics in digital rehabilitation

Five research-based ethical principles related to telehealth practice have been identified: autonomy, fidelity, non-maleficence, beneficence, and justice. These principles support the practice of applying ethical considerations in digital rehabilitation methods and provide guidelines to digital rehabilitation design, implementation, and practice. (Keenan et al., 2021.)

Healthcare systems worldwide are being transformed by digital health. Digital health shows great potential to benefit population health but if services are not planned well, it might also lead to health inequities. This is why digital health needs to be looked at from an ethical perspective and it needs to be noted that it's much needed to adopt an approach which serves everyone equally and is fair towards all parties involved. (Brall, Schröder-Back & Maeckelberghe, 2019.)

The dimensions in which digital health related ethical issues proliferate are complex. Firstly, they are linked to several phases of digital health services usage such as before accessing the service, during the service, and after receiving the service. Second, there is a diverse set of stakeholders involved in digital technologies with medical and non-medical backgrounds and coming from both

public and private sectors. This creates new challenges regarding governance structures, highlighting the need for rethinking the segregation of responsibilities. Third, on one side the challenges are related to technical matters, such as figuring out a safe way to protect patient data with solutions such as firewalls etc., but on the other hand the challenges are linked to general governance factors such as accountability and transparency. (Brall, Schröder-Back & Maeckelberghe, 2019.)

2.2.2 Technology acceptance

To ensure the successful development of any emerging technology in the field of rehabilitation, research about user acceptance and attitude should be prioritized. Planning to implement new digital rehabilitation services should begin with recognizing the needs, preferences, and acceptance of the target group. Technology acceptance has been widely researched, and a vast number of frameworks and models have been created to analyze the user adoption of new technologies and to describe the factors affecting user acceptance. To anticipate and understand service users' behavior, technology acceptance models and theories have been applied within various settings from family planning to occupational orientations. (Taherdoost, 2018.)

The Technology Acceptance Model (TAM) is one example of the well-accepted and widely used models and frameworks used to identify and explain the determinants influencing user acceptance of innovative technologies. The TAM model has its origins in behavioral theory. It's created upon the Theory of Reasoned Action (TRA) by Fishbein and Azjen (1975). Additionally, focusing on behavioral intention, TAM describes the user motivation by three factors: perceived usefulness, perceived ease of use, and attitude toward use. TAM acknowledges the real-life constraints that users come across when adopting new technology such as user training or user participation during the design process. TAM explains how users perceive technology and assess its potential usefulness, influencing whether they embrace it or not. (Taherdoost, 2018.)

2.2.3 Person-centered approach in digital rehabilitation

The health care system needs to transform itself by focusing on giving emphasis on the service users and providing a service path that allows the users to have an active role in their rehabilitation process (Global Digital Rehabilitation 2023). Like all rehabilitation, digital rehabilitation should always be carried out in a way that aligns with the values of the patient, and this is why the person-

centered approach is needed. Person-centeredness is a theoretical approach deriving from the field of psychotherapy in the 1940s. (See & Kamnetz 2015.)

The core of a person-centered approach is based on the concept of self-actualization. Self-actualization comprises of an idea that each person carries their unique abilities to autonomously develop and gravitate towards finding the best solutions for themselves. This leads to reaching the state of enhanced agency and ultimately to experiencing the maximum potential in their lives. As time has passed, the approach has transcended into other fields of social and health care services and has been applied in guidance and rehabilitation practices. (See & Kamnetz 2015.)

Another way to define person-centeredness can be to describe it as a theory for planning and delivering rehabilitation based on patients' unique needs, personal preferences, and experiences allowing the patient to become as an equal participant in the rehabilitation process by encouraging them to being able to bring forward their own opinions and volition (Jesus et al. 2016). In the health care sector, a person-centered approach has become synonymous with quality of care (Waters & Buchanan 2017).

2.2.4 Legislation in digital rehabilitation

To be able to implement secure and safe digital rehabilitation services it's pivotal to have knowledge and understanding about the regional laws and regulations related to patients' security and safety of personal data. 33 out of the 55 African countries, which adds up to 60 percent of all the African countries, have enacted the data privacy laws by 2021. Due to lack of appointment of a data protection authority (DPA), only roughly half of these laws are in force and fully effective. These statistics reveal that there's a lot of challenges still to be faced to reach effective enforcement of data privacy laws in the region. (Greenleaf & Cottier, 2022.)

African instruments have derived influences from the European Union's General Data Protection Regulation (GDPR) and Data Protection Directive (DPD) which are perceived as standards to be emulated. Multilateral agreements exist, but further development is needed. For instance, the African Union's data protection and cybercrime Convention is yet of limited influence by not being in force yet. (Greenleaf & Cottier, 2022.)

3 Purpose and objectives of the literature review

The purpose of this literature review is to extract knowledge and provide a comprehensive overview of the present digital rehabilitation interventions used in the sub-Saharan Africa region. The literature review demonstrates important determinants which contribute to the efficiency of the interventions. The research question highlights the factors related to digital rehabilitation which are beneficial to be taken into consideration whilst planning effective interventions in the SSA region in the future.

The research question formulated as following:

Which factors act as the barriers and facilitators to the implementation of home and life-space based Digital Rehabilitation in the sub-Saharan region?

3.1 Methodology

The literature review was conducted by following the adapted version of the Scoping review framework of Arksey and O'Malley (2005) with the improvements proposed by Levac and colleagues (2010). Due to the need to limit and define the scope of this master's thesis report, the framework's optional step to include the stakeholder consultation was excluded. Quality assessment was conducted as part of the process even though it is not typically conducted whilst applying the scoping review framework by Arksey and O'Malley (2005). The literature review process was carried out as a collaboration with researchers (A.A. and C.G.) from Bochum University of Applied Health Sciences working within RADIC project ("Rehabilitation for all through digital innovation and new competencies". Project is explained further in the Background section). The research question, which was set for this master's thesis report, added an extra step to the study selection process.

The number of scoping reviews conducted has been steadily increasing since 2012. The scoping review method is valuable for identifying knowledge gaps, establishing research priorities, and informing decision-making. Scoping reviews are utilized to shape research agendas and highlight implications for policy or practice. However, there is inconsistency in terminology and methods reported. Additional research on scoping review methodology is needed in the future, especially to develop guidelines that standardize reporting. (Tricco et al., 2015.)

Munn et al. (2018) note that scoping reviews are suitable for examining ambiguous evidence that could lead to more focused research questions, which may be addressed more effectively through systematic reviews. Scoping reviews may often serve as precursors to systematic reviews. They are conducted to explore the range of available evidence in a given area and clarify key concepts or terms within the study. Additionally, scoping reviews provide guidance for conducting research in a specific field or topic, helping to identify the main characteristics associated with a particular concept. Overall, scoping reviews are a valuable addition to the growing range of evidence synthesis methods. (Munn et al., 2018.)

The scoping methodology was selected as a review process, because it functions as a useful tool to address broader topics where various study designs might be applicable. Rehabilitation science and other disciplines with emerging evidence may especially be suitable to benefit from the use of scoping review because the methodology can be especially appropriate to disciplines in which the scarcity of randomized controlled trial studies makes it challenging for researchers to carry out systematic reviews. In these situations, scoping methodology is ideal because researchers can incorporate a range of study designs in both published and grey literature, address questions beyond those related to intervention effectiveness, and generate findings that can complement the findings of clinical trials. (Arksey, H., & O'Malley, L., 2005; Levac et al., 2010.)

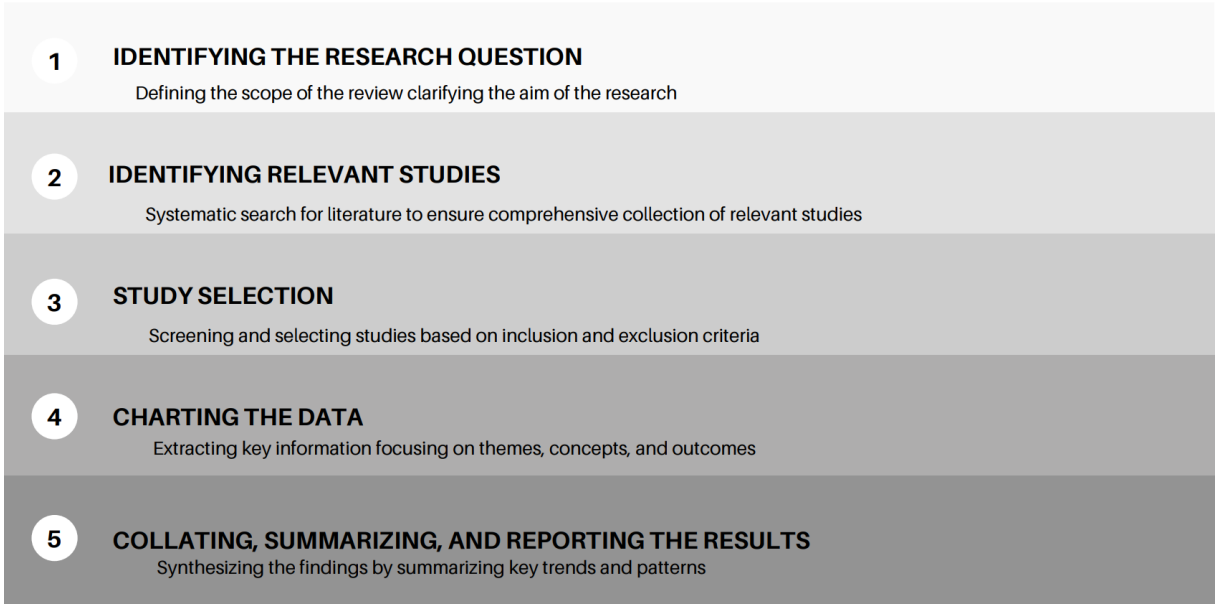

Figure 1. The scoping review process visualized by following the scoping review framework of Arksey and O'Malley (2005) with the improvements proposed by Levac and colleagues (2010).

3.1.1 Stage 1: Identifying the research question

Formulating the research question is the initial stage in a scoping review. The research question of this report is derived from the research questions developed within the RADIC project and formulated via processing the areas of interest within the topic. The research question in this report is more specified and simplified due to the need to limit the scope of the report. The aim of this report is to highlight the factors which can act as barriers and facilitators to the successful implementation of digital rehabilitation intervention in the sub-Saharan region. Outlining the research question aims clarifies the purpose of the study and it should align with the goals of the review. The research question will also assist in determining the inclusion and exclusion criteria. (Arksey, H., & O'Malley, L., 2005; Levac et al., 2010.)

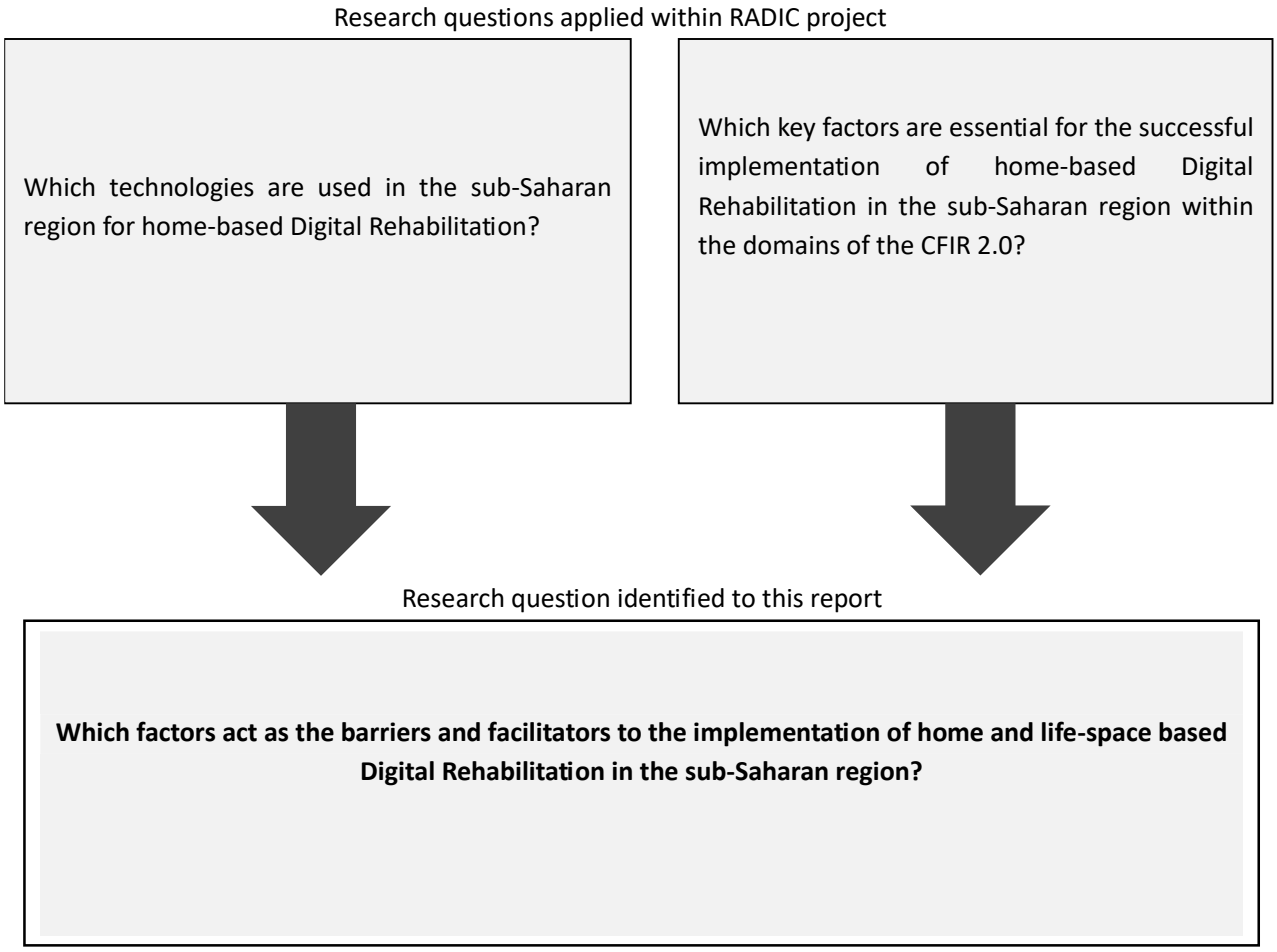

Figure 2. Identifying and formulating the research question

3.1.2 Stage 2: Identifying the relevant studies

The next step after formulating the research question was to identify the relevant studies. This phase entails selecting pertinent studies and formulating a strategy for conducting the search. It includes determining where to look, which keywords to use, which sources to include, as well as defining the time frame, and language criteria. Ensuring a thorough and wide-ranging search is essential. (Arksey, H., & O'Malley, L., 2005; Levac et al., 2010.) The objective of this step was to locate articles discussing digital technologies utilized in home- and life space based digital rehabilitation and factors influencing its implementation in sub-Saharan Africa. Within this process, literature was searched in PubMed, Embase, CINAHL, Cochrane, Web of Science, IEEE Xplore, Sci-

ence Direct, and SpringerLink for published studies. The search strategy was developed by researchers from Bochum University of Applied Health Sciences (A.A. and C.G.). First an initial, limited search was conducted to identify relevant keywords for the comprehensive search strategy. The search strategy was developed for PubMed and expanded for Embase, CINAHL, Cochrane, Web of Science, IEEE, Science Direct and SpringerLink. The selected keywords, along with their synonyms and related terms, encompassed “digital technology,” “rehabilitation,” and “sub-Saharan Africa.” To enhance the findings relevant to the research questions, a grey literature search was also undertaken. Altogether, 1,655 articles were identified from the databases mentioned above.

3.1.3 Stage 3: Study selection

The subsequent phase involves selecting studies that are relevant and closely related to the research. Since various factors can impact this selection process, it is essential to establish clear inclusion and exclusion criteria. (Arksey & O’Malley, 2005.) Studies accepted to the review had to present an implemented intervention in the SSA region from 2018 onwards. Below is presented the final inclusion and exclusion criteria list. The list was modified according to the discussions and findings of the research team (C.G., A.A. and M.V.) before the final study selection process was undertaken.

	Inclusion Criteria	Exclusion Criteria
Type of Publication	(R)CT's, case studies, cohort studies, qualitative studies, mixed-methods	All kind of reviews, conference proceedings, study protocols/registrations, commentaries, editorials, abstracts only
Timeframe	2018 –	Before 2018
Region	Study is conducted in the SSA region	Study conducted in other countries than the SSA region
Digital technologies	All references are included focusing on all kind of digital technologies (e.g., text messaging, videoconferencing like zoom/skype, applications, robots, gaming via a digital source, virtual/augmented reality, serious gaming, exergaming…)	Technology refers to laboratory or clinics only
Setting	The intervention is conducted at home or in the lifespace such as school or retirement home	The intervention is conducted in the hospital, clinic or rehabilitation center
Intervention	Study describes an intervention intended for a client; intervention refers to rehabilitation based on the definition of the WHO	Invasive procedure (e.g., surgery) performed before using the digital technology, such as in implantable device/sensors; the digital component of the described intervention includes telephone calls or E-Mail only
Implementation	At least one implementation determinant of the CFIR 2.0 [26] should be reported/measured/assessed; intervention described in the study is already implemented	Intervention described in the study is not implemented yet
Language	English, French, Swahili, Arabic	

Table 1. Inclusion and exclusion criteria of the scoping review

The inclusion criteria regarding implementation included the use of the updated version of the CFIR Implementation framework. The CIFR is the Consolidated Framework for Implementation Research based on user feedback. At least one implementation determinant of the CFIR must have been reported for the study to be selected as part of the review. The framework's purpose is to prognosticate or describe determinants of the implementation, meaning the contextual independent variables which can act as barriers and facilitators to implementation outcome and its effectiveness. (Damschroder et al., 2022.)

To assist with the study selection process, a web-based software, Covidence was used (version 2021; Veritas Health Innovation). Covidence is an online tool which streamlines the reviewing process by providing an online teamwork platform where you can effectively perform the screening of

your references including the title and abstract screening and the full text screening phases. Covidence has been used by over 400,000 researchers around the world. (Covidence 2024.) Three independent researchers (A.A., C.G., and M.V.) carried out the process of study selection. Data screening is a critical step of data analysis. The screening of data in this scoping review was done in two stages: title and abstract screening, and full text screening for final selections. All results of the database search results were uploaded to Covidence. The software removed the duplicate results (213 articles) automatically.

Researchers (A.A. and M.V.) took responsibility for the title and abstract screening, and the final full-text screening. All the studies identified were individually screened to match the inclusion and exclusion criteria by both researchers. All studies not meeting the criteria were excluded. Any disagreements in the title and abstract screening and the full-text screening were first discussed amongst all participants (A.A., C.G., and M.V.) and then the third researcher from Bochum University of Applied Health Sciences (C.G.) had the responsibility of decision-making if any conflicts remained. The first step of the screening process was concluded by reading and screening the titles and the abstracts of 1,442 studies. For the second step, the full-text screening, 88 studies were selected from the databases and 15 from other sources. After the full-text screening with thorough investigation to determine eligibility, 25 studies were selected for the review within RADIC project. After the collaborative work phases, studies which were not aligned with the master's thesis report's research question, were excluded. In the final stage of the study selection, 19 studies were selected for the scoping review presented in this master's thesis report.

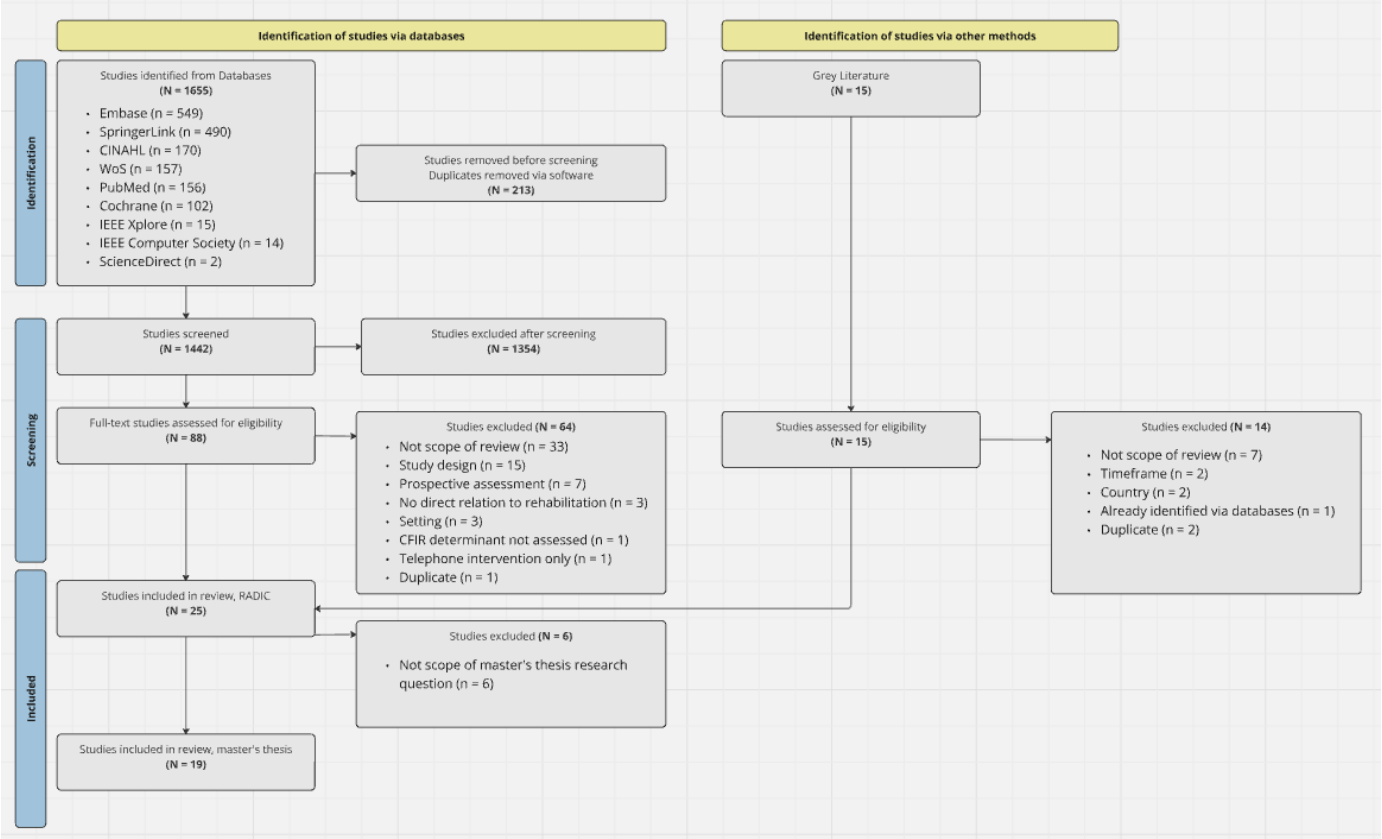

Figure 3. The Prisma flowchart of the study selection process

3.1.4 Stage 4: Data Extraction

Once studies that meet the established criteria have been selected, the next step in the scoping review is data extraction. Data extraction involves interpreting or synthesizing information in a way that aligns with the research question's purpose. It is typically carried out systematically using tables, charts, or graphs, which also aid in analyzing the collected data, interpreting it, and organizing it through codes and themes (Arksey & O'Malley, 2005). To assist this step, a data extraction table was created, which illustrates data important to the synthesis of the studies. The data extraction table included the most relevant data to the scope of the review such as author information, country of study, study title, aim of the study, description of the intervention, data about the technology used in the study, implementation determinant following the CFIR, results, and the facilitators and barriers regarding the implementation of digital rehabilitation. The data extraction was accomplished as collaborative work between A.A. and M.V. Researchers individually gathered

data to the data extraction sheet and then data was discussed and crosschecked as a team. The data extraction sheet also displays articles which were excluded from the master's thesis report due to not providing data about the research question set for this report. The data extraction table is displayed on Appendix 1.

3.1.5 Stage 5: Collating, summarizing, and reporting the results

The fifth step of scoping review involves organizing, summarizing, and presenting the data within an analytical framework that emphasizes the importance of the research question. (Arksey & O'Malley, 2005). In this scoping review, the findings of the studies related to the research question were compiled and summarized. The data extraction table (Appendix 1.) created in the earlier stage facilitated the identification of results relevant to the objective of this scoping review. The findings of the included studies were recognized by examining and disseminating the selected articles. Similarities and recurrences in the findings were identified and the process of data synthesis began to take place by combining data from different studies to generate a comprehensive understanding and identify patterns. The findings were providing data of factors which supported or hindered the implementation of digital rehabilitation intervention in the SSA countries.

3.2 Critical appraisal

As an additional step to the scoping review a quality assessment for carried out. The process was conducted amongst the research team with A.A. and M.V. taking first responsibility for the appraisals. Critical appraisal was conducted of the articles selected for the review included in the RADIC project. Researchers critically evaluated individually the selected studies by using quality assessment tools commonly used within the discipline and applicable to the selected studies' methodologies. Any discrepancies between the researchers were resolved through discussion or, if necessary, by consulting the wider research team. No studies were removed from the review due to their methodological quality. Randomized controlled trials were assessed applying the revised Cochrane Risk of Bias 2.0 (RoB 2.0) tool (Sterne et al. 2019). The qualitative studies were appraised by using the Critical Appraisal Checklist for Qualitative Research by the Joanna Briggs Institute (Treloar et al. 2000). Lastly, for the mixed methods studies the Mixed Methods Appraisal Tool (MMAT) Version 2018 was applied (Hong et al. 2018). The compiled results of the critical appraisal process are displayed in Appendix. 2.

4 Results

This scoping review explored the determinants that can act as facilitators or barriers towards implementing home- or life space based digital rehabilitation in the sub-Saharan region. Nineteen studies were identified as relevant to the aim of the research question. Identified factors supporting or hindering the implementation of digital intervention in SSA region were recognized and organized into three categories: environmental, access and intervention related contributors. Results are presented in the following table and described below.

The health conditions represented in the selected studies were Human Immunodeficiency Virus (HIV) (n= 5), psychological symptoms (n= 5), Cerebrovascular accident (CVA) (n= 3), auditory impairment (n =2), Diabetes Mellitus (DM) (n= 1), Pulmonary Tuberculosis (PTB) (n =1), and transtibial amputation (n= 1). One of the studies did not specify the condition of population and referred to the study participants as clients in occupational therapy.

The selected studies were conducted in Nigeria (n= 4), Kenya (n= 3), South Africa (n= 3), Uganda (n= 2), Rwanda (n= 1), Ghana (n= 1), Cameroon (n= 1), Ethiopia (n= 1), and Zambia (n= 1). Two of the studies were conducted in multiple countries including countries outside the SSA region. Study with chaplains working in hospices with intervention targeted to support mental health had participants from Kenya, South Africa, India (Mumbai) and Thailand (Bangkok) and the study related to participants with TT amputation took place in Uganda, Tanzania, and Cambodia.

A variety of technologies were utilized in the selected studies and many studies mentioned the use of multiple technologies, such as combined use of electronic devices and software. Most common technologies used were applications and web-based software. The selected studies included mentions of the following technologies: application software (n= 8), web-based platforms (n= 7), short message service (SMS) (n= 3), computer software (n= 2), social-media platforms (n= 1), digital devices (n= 1), use of video media (n= 1), and 3D printing (n= 1).

Implementation facilitators	Implementation barriers
Environmental • Access to devices at health care/educational facilities (1, 14) • Device and data provided (5, 10, 22) • Installation provided (16) • Economical and societal pressure to find alternative options to traditional methods (1, 5, 9, 10, 12) • Local language provided (1, 16, 21, 25) • Tailoring service design to local setting (5, 12, 17, 20) • Devices becoming more affordable (12) • Intervention is cost/time-efficient compared to traditional method (24) **Access** • Use of peer volunteers for tech support (3) • Device obtained boosted skills development (5) **Intervention** • Visual patient instructions (1, 16) • Simple language used (16) • Easy-to-use aspect (5, 10, 11, 21) • Anonymity/stigma free environment (5, 10, 14, 21, 22) • Use of peers for motivation and support (5) • Active facilitation (5, 17) • Social support (5, 10) • Educational training (5) • Interactive elements i.e. games (10) • Low costs (11) • Hybrid rehabilitation (11, 18) • Synchronous and asynchronous content (11, 15) • Privacy and security (12, 16, 21, 22) • Optimal frequency of messages (12) • High level of acceptance (12, 15, 18, 19, 25) • Use of lay health care workers (12) • Integration of research-based knowledge (17) • Information about benefit (17) • Supportive working culture (17) • Small group size (5) • Motivated participants (17)	**Environmental** • Shortage of resources (3, 14) • Schools banned use of smartphones (3) • Tension to participate from life partner (5) • Fear of stigma (11) • No device/data was provided (18, 20) • Noncompliance by clients and family members (17) • Unspecified barriers at boarding school to attend (22) **Access** • Low digital literacy of participants (3, 5, 15, 17) • Technological issues (5, 17, 19) • Low connectivity in rural areas (12, 15, 19) • Low multimedia capability of participants' own devices (12) • Limited letters per SMS (17) • No access to internet (15) • No access to suitable device (15, 16) • Intervention device more prone to malfunction (24) **Intervention** • Shortened time period (3, 10) • Client recruitment lagged (3, 10, 17) • Inactive facilitation (5) • Low participation (5) • High costs of equipment (11) • SMS format was not agreed on (17) • Lack of interest (23) • Too long intervention time (23) • Moderate confidence in using the intervention (25)

NOTE. Study numbers indicated in the parentheses match the numbers indicated in the summaries of studies (data extraction sheet, appendix 1).

Table 2. The barriers or facilitators towards implementing home- or life space based digital rehabilitation in the sub-Saharan region.

4.1 Implementation facilitators

Environmental facilitators

An environmental implementation facilitator that was found in multiple studies was economical and societal pressures which made participating in traditional rehabilitation methods challenging and created a need for other solutions. A study by Manyazewal et al. (2022) explains that patients with TB in Ethiopia face circumstances that encourage the use of digital solutions. There is an existing pressure to avoid structural barriers to therapy adherence, including catastrophic costs and income losses resulting from transportation, food, and accommodation for in-person directly observed therapy (DOT). Similarly, a study by Simpson et al. (2021) highlighted the need for accessible digital services due to significant barriers preventing individuals from attending face-to-face counseling or support groups. Economic and societal obstacles included time constraints related to employment or caregiving responsibilities, limited space in health facilities, lack of transportation funds, coercive control by male partners, stigma restricting mobility, and social distancing regulations. Mobile phone-based interventions can offer viable solutions to overcome these barriers, providing individuals with essential social and psychosocial support.

A study by Ofoegbu et al. (2020) described a similar situation with pressure arising from economic and societal aspects. The study reported that university students experiencing depression were hesitant to seek help due to challenges such as scheduling conflicts with school hours, financial limitations, low motivation, and anticipated delays in accessing interventions. Related to the topic, the ability to access rehabilitation without the need to travel from rural areas was highlighted in studies by Dulli et al. (2020) and Adewuya et al. (2019), emphasizing the economic benefits of digital rehabilitation.

The use of local languages and the adaptation of service design to local settings were also highlighted in multiple studies. Local language was used in instruction guides (Manyazewal et al., 2022), as an alternative to English in an application (Venter et al., 2019), provided by research assistants on the spot for translation (Boivin et al., 2019), and used as the language of instructions in a video-based intervention (Odetunde et al., 2020). Other ways to tailor service design to meet the

needs of the local setting included organizing participatory design workshops (Simpson et al., 2021), using individualized (rather than generic) informational messages (Adewuya et al., 2019), modifying the intervention to align with client preferences and needs (e.g., adapting person-centeredness to family-based approaches when communication was observed to be family-centric) (Terio et al., 2019), and selecting the intervention technology based on the interests of the target population (Sap et al., 2019).

The remaining environmental implementation facilitators concern factors related to the devices used in digital interventions. The use of existing technical resources was mentioned in a study by Manyazewal et al. (2022), which described how the clinics in the study already had computers in use prior to the research. Software was set up on these computers, which had already been used in TB clinics or similar facilities. A similar situation was reported in the study by Osborn et al. (2020), which explained that most of alike schools to the participants' institution, the secondary school in Kiambu County, Kenya, were equipped with computers and internet access. The intervention was carried out using the stakeholders' facilities, with computers and internet provided by the school.

Providing devices and mobile data to participants enhanced recruitment and supported implementation. In a study by Simpson et al. (2021), participants were given ITEL 1503 smartphones (running Android 4.4 KitKat®), which were kiosked (restricted to pre-installed apps) and preloaded with mobile data. Similarly, in a study by Dulli et al. (2020), funding covered both device and data. All participants received a smartphone (valued at US $65) and a monthly data bundle (US $3.50 for 1 GB) for the duration of the intervention. A comparable approach was used in a study by Chory et al. (2021), where participants were provided with a smartphone preloaded with WhatsApp®, a SIM card, and phone credit (US $7 per month), eliminating concerns about device or data access. Other device-related factors that supported implementation included providing free installation of the intervention app for participants (Venter et al., 2019), the widespread ownership of texting-capable smartphones among patients living in poverty due to lowered costs of smartphones (Adewuya et al., 2019), and the cost- and time-effectiveness of the intervention device compared to traditional methods (Ratto et al., 2021).

Access facilitators

Low digital literacy and technical skills were common challenges identified in the selected studies. To address these challenges and support the implementation of digital interventions, various solutions were introduced. In a study by Ivanova et al. (2019), peer volunteers played a key role supporting the issue of limited digital skills. During a 1.5-month usability assessment, over 50 % of participants reported needing assistance with the intervention platform. To address this issue, peer volunteers (aged 15–24) helped participants navigate the platform, sensitized youth to engage with it, and facilitated access to information and adherence counselling from health professionals. These volunteers also contributed to managing the platform by writing posts and initiating discussions. Monthly meetings were held to review progress in the development and implementation of web-based activities.

Digital literacy was also self improved during the interventions via participants familiarizing themselves with the provided devices. In a study by Simpson et al. (2021), the provision of equipment contributed to improving participants' technological literacy. During a focus group discussion, one participant noted that they had no prior experience with touchscreen devices but had learned to use one through the intervention. Another participant highlighted improvements in writing English messages and spelling words correctly, aided by the spell-check and speech-to-text features of the provided device.

Intervention facilitators

Critical intervention facilitators identified across multiple studies for successful implementation included ensuring participant anonymity, protecting privacy, and fostering a stigma-free environment. These strategies helped to address participation barriers, particularly in sensitive contexts, by reducing fears of judgment or privacy breaches. A study by Owolabi et al. (2020) discovered that participant anonymity facilitated open communication, allowing individuals to freely discuss personal issues and overcome the stigma associated with HIV. Similarly, in a study by Dulli et al. (2020), most participants reported a lack of social support outside the intervention due to fear of stigma. They expressed positive feelings towards the selected platform, as it allowed them to participate in “secret” groups that ensured their privacy.

In a study by Boivin et al. (2019) it was ensured that procedures were convenient, easy, and private for participants to take part in the training. To minimize unnecessary attention and potential stigmatization, training was conducted in a quiet setting near the participants' home after school. Other methods to protect privacy and reduce stigma included the use of pseudonyms in WhatsApp® discussions (Chory et al., 2021), safeguarding the confidentiality of SMS content to preserve recipient privacy (Adewuya et al., 2019), and explicitly incorporating stigma-free content as a design goal for the intervention (Osborn et al., 2020). Additionally, a study by Venter et al. (2019) prioritized confidentiality and data security by designing the app icon to avoid any reference to diagnosis and modeling its security features after local banking applications.

Motivation and participant acceptance were identified as key facilitators of intervention success in multiple studies (Adewuya et al., 2019; Terio et al., 2019; Khatib & Hlayisi, 2022; Sarfo et al., 2018; Odetunde et al., 2020). Studies by Abiodun et al. (2023) and Ratanjee-Vanmali et al. (2020) highlighted that positive experiences and high patient acceptance were enhanced by offering both synchronous and asynchronous communication modes. This combined approach of synchronous and asynchronous methods also helped overcome barriers related to unstable internet connections.

Participants also appreciated the hybrid rehabilitation model, which combined face-to-face and remote rehabilitation methods. Ratanjee-Vanmali et al. (2020) highlighted that implementation was supported by offering hybrid rehabilitation. The therapeutic relationship began before the in-person appointment and continued throughout the patient's rehabilitation with the same clinic audiologist, either online or in person. Similar findings were reported by Khatib & Hlayisi (2022), who attributed the high compliance rate to the hybrid tele-audiology model, which included regular clinician support. The study emphasized that remote rehabilitation should not fully replace clinician contact; rather, maintaining clinician involvement through a hybrid approach is essential for positive patient compliance.

The easy-to-use aspect of the intervention was identified as a key facilitator in several studies. Participants reported finding the selected platform "not hard to use" (Simpson et al., 2021). In a study by Dulli et al. (2020), 80% of participants stated that they could connect via the selected platform with ease. Similarly, Ratanjee-Vanmali et al. (2020) found that most patients agreed or strongly agreed that the online phases of the intervention were simple to complete, quick, informative,

and easy to operate. To enhance user-friendliness, visual and color-coded patient instructions were incorporated (Manyazewal et al., 2022; Venter et al., 2019), and information was communicated in simple language (Venter et al., 2019).

The contributions of facilitators, rehabilitation staff, lay health care workers, and volunteers were critical to the successful implementation of interventions. Simpson et al. (2021) noted that implementation of intervention was supported by motivated and active rehabilitation staff and small size of virtual groups of 6-8 people supported participation. Active facilitation of the groups led to more intimate displays of social support. Participants stated that they enjoyed the groups because they felt free to ask questions about a wide variety of topics. Participants preferred the small group setting and reported having feelings of getting to know each other on a personal level and making friendships within the groups. Social support experienced during intervention supported active participation. The peer-led structure of the social support groups played a key role in participant acceptability, as it fostered an inclusive and non-intimidating environment.

Similarly, in a study by Dulli et al. (2020) experienced social support was given emphasis. In the study, social support from facilitators and other group members supported active participation. Participants described receiving encouragement and advice, having people to “share my feelings with” or “someone to talk to,” and receiving answers to factual and personal questions. Participants stated they felt a sense of connectedness with the group which was strengthened by having group members of the same age range and diagnosis. Also, social and interactive elements of the intervention, such as riddles posed by the facilitator, received positive feedback from participants. A study by Terio et al. (2019) mentioned the positive effect of supportive working culture amongst the rehabilitation specialists which allowed them to discuss challenges freely amongst each other without any hierarchical setting.

Educational training was another factor supporting the implementation of intervention (Simpson et al. 2021). In the study, the support groups served as a valuable source of reliable information on pregnancy, child health, and HIV. Participants were satisfied with the discussions provided that were guided by peer mentors and guest speakers, who provided insights into HIV-related topics.

Other factors supporting the implementation included integrating relevant research-based knowledge into practice and providing information about the benefit of the innovation (Terio et al. 2019), low costs of participating in the remote parts of rehabilitation (Ratanjee-Vanmali et al. 2020), and the optimal frequency of intervention messages sent (not too often) (Adewuya et al. 2019).

4.2 Implementation barriers

Environmental barriers

The most highlighted environmental barriers affecting the implementation of digital rehabilitation interventions were related to the availability of resources and funding. No financing for internet connection (Ivanova et al. 2019) and devices for participants (Khatib & Hlayisi. 2022, Sap et al. 2019), and limited availability of preexisting devices available affecting the number of participants per session (Osborn et al. 2020) were mentioned. In a study by Terio et al. (2019) factors influencing the implementation process included lack of transparency and non-compliance by clients and family members as well as doubts about how beneficial the research would be. The study reported that at times the phone airtime, which was provided for the intervention, was used for other purposes by family members or clients. Challenges occurred when conducting follow-ups, at times phones were switched off, and family members who handled the phone had travelled or there was a network failure.

Other environmental barriers included no permission to use smartphones in schools (Ivanova et al. 2019), tensions with their partners about taking part in the project (Simpson et al. 2021), concerns of the stigma related to wearing rehabilitative aids (Ratanjee-Vanmali et al. 2020), and in a study by Chory. (2021) one participant did not complete the study due to barriers experienced at boarding school (not specified), which made it difficult to fully participate in the intervention.

Access barriers

Low digital literacy among study participants was the most common access related barrier to implementing digital rehabilitation. A study by Ivanova et al. (2019) described low internet literacy as a key challenge. Similarly, Simpson et al. (2021) reported that 29% of recruited participants could

not take part due to relational, technological, and literacy barriers. Abiodun et al. (2023) also noted that digital rehabilitation faced multiple constraints, including poor technical skills that affected clients' readiness to participate in e-therapy sessions. Digital competency challenges extended beyond clients to rehabilitation specialists as well. Terio et al. (2019) found that rehabilitation professionals would have required additional support to manage SMS monitoring, while clients' limited technical skills also posed barriers. Additionally, intervention staff struggled to assist clients effectively due to language barriers.

Unexpected technical issues were also reported as barriers to implementation. Device malfunctions and repairs causing delays, frustrated participants who had to wait for their devices to be fixed (Simpson et al. 2021). In a study by Terio et al. (2019), an unexpected server breakdown and possible blocking of international SMS by local telecom operators in Uganda (as the server was based in Sweden) hindered operations. Sarfo et al. (2018) highlighted challenges with internet connectivity and unstable audiovisual streaming, forcing some participants to complete exercises without access to streaming. Low internet connectivity in rural areas was reported as a barrier in multiple studies (Adewuya et al. 2019; Abiodun et al. 2023), limiting the effectiveness of digital interventions.

The barrier of having no access to internet or to suitable devices was explained in multiple studies. For example, in the study by Abiodun et al. (2023) to be able to participate in the study, own device was needed, and participating client or caregiver needed to have a functional electronic device. In the study by Venter et al. (2019) device to participate with was also not provided. Ineligible participants were excluded from the study if they had no active subscriber identity module card in their phone, no Android smartphone, or no data on their phone. It was discovered that the rehabilitation application could not be installed if the participants had insufficient RAM on their phone or if their Android version was too old (pre-version 4.2), so these parameters were also added to the exclusion criteria. In the study, the designed rehabilitation app worked as anticipated; however, the smartphone specifications required for installation excluded over 90 % of candidates who volunteered to participate in the study.

Device-related limitations imposed restrictions on interventions. In the study by Adewuya et al. (2019), the intervention was limited to SMS and voice messages due to low connectivity in rural

areas and the low multimedia capabilities of most phones in low-resource settings. Similarly, Terio et al. (2019) reported about challenges faced with the character limits of SMS messages. Since stroke survivors were expected to have difficulties adapting to new technology, they used their own devices. However, technical limitations arose when non-smartphone users could only receive SMS messages within a restricted character count.

Another device-related challenge was highlighted in the study by Ratto et al. (2021), which explored the use of 3D-printed transtibial (TT) prosthetics. The study found that 3D prosthetics were more prone to malfunction compared to traditional ICRC (The International Committee of the Red Cross) manufactured devices. Results showed that 3D-printed TT prosthetics (3DPA) were returned due to a "loose fit" more frequently than the ICRC manufactured devices (11.48% vs. 6.56%). They also had higher rates of minor damage (3.29% vs. 0.00%) and breakage (6.56% vs. 0.00%). The researchers suggested that these failures were likely due to printer limitations, such as small layer heights, as well as user unfamiliarity with optimal geometries for 3D printing.

Intervention barriers

Barriers related to the intervention included delays in the recruitment process, which led to shortened intervention time. Ivanova et al. (2019) reported that participants were exposed to the intervention for only three months instead of the planned six months due to logistical and financial constraints, prolonged platform development, and slow recruitment. Similarly, Dulli et al. (2020) found that recruitment took more than twice as long as expected because youth living with HIV (YLHIV) enrolled in antiretroviral therapy (ART) at a much lower rate than initially estimated. As a result, intervention participants joined at different times, and some waited months before their support groups could begin. Terio et al. (2019) also highlighted recruitment challenges due to high mortality rates and limited access to healthcare facilities. These issues were exacerbated by a lack of engagement, support, and knowledge among local colleagues and medical personnel.

Inactive facilitation and low participation were identified as barriers to implementation in the study by Simpson et al. (2021). Some groups had less engaged facilitators, and participants were either inactive or did not contribute to discussions, resulting in superficial conversations. Additional barriers included lack of engagement and the intervention duration being too long. Pandya

(2021) reported that some participants from the intervention group failed to attend follow-ups due to a lack of motivation. Moreover, prolonged intervention periods could have introduced unforeseen challenges.

Further obstacles identified across studies included the high cost of hearing aid equipment as a prohibitive factor (Ratanjee-Vanmali et al., 2020) and unclear procedures due to the SMS format not being defined before the beginning of intervention (Terio et al., 2019). Lastly, Odetunde et al. (2020) highlighted that some participants lacked confidence in performing all aspects of the intervention. Over half of the study participants reported only moderate confidence in using the intervention, which may explain why the stroke survivors found mat-based exercises more engaging, whereas standing exercises were the least appealing. Participants seemed more inclined toward exercises they perceived as safer and easier to perform. This underscores the importance of incorporating clear, cautionary instructions for certain exercises to enhance participant confidence and engagement.

5 Discussion

The analysis of the results of this scoping review demonstrates that various technologies are currently being utilized in home- and life space based digital rehabilitation settings in the sub-Saharan Africa region. The technologies mentioned in the selected studies included low- and mid-tech solutions such as application software, web-based platforms, short message service (SMS), computer software, social-media platforms, video media, and 3D printing. However, at the time of this review, no published studies were found that incorporated more advanced and innovative technologies such as the Internet of Things (IoT), artificial intelligence (AI), smart wearables, or the integration of virtual reality (VR) and augmented reality (AR) technologies into rehabilitation in the SSA region.

This scoping review presents a thorough examination of determinants which can act as facilitators and barriers to the implementation of home- and life space based digital rehabilitation in the SSA region. The key findings include facilitators and barriers which are linked to environmental, access, and intervention related aspects. The contributors identified as facilitators align with the principles of digital rehabilitation frameworks of person-centeredness and technology acceptance. For instance, the needs, preferences, and acceptance of the target group were acknowledged by measures such as offering services in local language (Manyazewal et al., 2022; Venter et al., 2019; Odetunde et al., 2020) and tailoring the service design to meet the needs of the target group (Simpson et al., 2021; Terio et al., 2019; Sap et al., 2019).

One of the most influential factors to the implementation succession was the availability of resources and funding. Infrastructural issues and financial constraints were mentioned in multiple studies (Terio et al. 2019; Adewuya et al., 2019). Interventions which had sufficient funding to provide the participants with the device and data needed to take part in rehabilitation, might have avoided issues with slow recruitment and reported positive impacts on participation (Simpson et al., 2021; Chory et al., 2021). There is need for future research, since yet there remains limited evidence on the long-term sustainability of digital rehabilitation models in resource-limited settings.

Moreover, global strategy is needed to support the structural and economic challenges. Government and international funding decision-makers' attention needs to be captured with evidence-based digital rehabilitation benefits. Furthermore, it is important to convince the government and

global stakeholders of supporting digital rehabilitation development by demonstrating how adequately planned digital rehabilitation can serve as a cost-effective investment and a solution to address the increasing demand for rehabilitation services. Partnerships, NGOs, private and public sector support, and help from global organizations are needed to create strategies to support the growth of digital rehabilitation in the SSA region.

The barriers that would hinder individuals from participating in traditional face-to-face rehabilitation created economic and societal pressures which strengthened the need for other options such as digital rehabilitation solutions. Challenges in everyday life, such as daily responsibilities, schedules, financial and social aspects, and long distances for people living in rural areas, made digital rehabilitation services appealing to participants and strengthened the engagement, access, and retention to treatment (Manyazewal et al., 2022; Simpson et al., 2021; Ofoegbu et al., 2020; Dulli et al., 2020; Adewuya et al., 2019). This finding highlights the importance of renewing and modernizing the methods of delivering rehabilitation services by ensuring accessibility and equal possibilities for everyone to receive the health-related support needed. Unrestricted equal access to rehabilitation services for individuals with functional impairments at all levels of healthcare helps to minimize the adverse effects of health conditions on their overall functioning (Htwe, O. et al., 2024).

The results of the review indicate that digital rehabilitation services are effective, feasible, and acceptable. Participants were especially satisfied with the possibility of engaging in interventions anonymously as this provided a safe, stigma-free environment (Simpson et al., 2021; Dulli et al., 2020; Osborn et al., 2020; Boivin et al., 2019; Chory et al., 2021.) This is a significant finding, because reduced stigmatization methods can be used to prevent individuals from keeping away from the health services they require. As an example, HIV-related stigma is associated with delays in individuals learning their HIV status; reluctance or challenges in disclosing their status to family, friends, sexual partners, or healthcare providers; postponement of care-seeking or avoidance of care altogether; delays in initiating antiretroviral therapy (ART) and poor adherence to treatment; mental health challenges such as depression and anxiety; and an overall reduction in quality of life (Relf et al., 2022).

The safe environment created during the interventions, supported by active facilitation and educational content, played a key role in engaging the participants to receive the maximum benefits and social support from the offered interventions. Besides anonymity, this was encouraged by keeping the rehabilitation group size small, and by initiating conversations with introducing interesting educational topics selected according to the participants' situation and needs (Simpson et al. 2021). Besides, the implementation determinants synthesized from the reported outcomes of the selected studies, something highly important was visible in the citations of messages shared in the intervention platform between the participants and group facilitator presented in the study by Simpson et al. (2021). The messages demonstrated a strong awareness of local culture and communication practices. As a rehabilitation staff facilitating the intervention dialogue, having cultural knowledge is highly important to approach the rehabilitees with respect by understanding of their backgrounds, traditions, and cultural beliefs.

To summarize the previous point, incorporating cultural considerations into the design process is essential when planning future digital rehabilitation interventions. According to Betancourt et al. (2003), a culturally competent healthcare system can be described as one that recognizes and integrates cultural considerations at all levels. It involves assessing cross-cultural interactions, being aware of the impact of cultural differences, expanding cultural knowledge, and adapting services to meet diverse cultural needs. Additionally, it acknowledges how health beliefs, behaviors, disease prevalence, and treatment outcomes vary across different patient populations.

Another aspect of the intervention that participants valued, contributing to a positive user experience and higher acceptability, was the perceived ease of use of the implemented digital rehabilitation technology. (Simpson et al., 2021; Dulli et al., 2020; Ratanjee-Vanmali et al., 2020; Boivin et al, 2019). User acceptance was supported by offering combination of asynchronous and synchronous rehabilitation methods and hybrid rehabilitation.

Several studies highlighted that hybrid rehabilitation and combination of asynchronous and synchronous rehabilitation methods can offer solutions to the barriers coming from technical challenges. Hybrid rehabilitation, with on-site and remote rehabilitation, was seen as a factor which led to high compliance (Khatib & Hlayisi, 2022) and strengthening of the therapeutic relationship (Ratanjee-Vanmali et al., 2020). These findings align with the results of a study by Velez et al.

(2023), which was concluded to identify factors which affect the organization and delivery of in-person home-based rehabilitation and home-based telerehabilitation for people needing rehabilitation services. The study explains that patients, caregivers, and healthcare providers involved in telerehabilitation services found that some in-person home visits remained essential. They recognized that relying solely on remote rehabilitation reduced the sense of social interaction and limited opportunities to establish meaningful connections.

An interesting finding of the scoping review was the use of interactive elements including the use of games such as riddles and puzzles to support the implementation of digital intervention (Dulli et al., 2020). The strategic use of game mechanics in non-game contexts to drive user participation and retention has become increasingly prominent in interaction design and can be defined as gamification. Gamification can be extended to a variety of contexts. (Deterding, et al., 2011.) Based on the positive effect of interactive elements mentioned in the study by Dulli et al. (2020), the use of gamification in the setting of digital rehabilitation in the SSA region, would be beneficial to study further. According to the study by Adlakha et al. (2020), gamified interventions enhance traditional medical treatments by boosting patient engagement, socialization, and treatment adherence, thereby improving clinical outcomes. They also promote motivation, health education, and serve as a therapeutic distraction during painful procedures.

The results of this review about the implementation barriers align with related studies that highlight the fact that even though digital rehabilitation lowers costs and enhances access to services, particularly in rural geographical areas, it also encounters a variety of challenges such as connectivity issues, limited access to technology, insufficient technical knowledge, privacy concerns, and ethical considerations (Cyuzuzo et al., 2025). The sub-Saharan region region is in urgent need of setting and enforcing policies supported by evidence-based frameworks such as the European Digital Competence Framework for Citizens which lists digital literacy as one of its key competencies (Vuorikari, Pluzer, & Puner, 2022).

Digital illiteracy was highlighted in numerous studies as a major barrier to implementation of digital rehabilitation interventions (Ivanova et al., 2019; Simpson et al., 2021; Abiodun et al., 2023; Terio et al. 2019). On an individual's level, low digital literacy can lead to inequity and unequal access to services, and related studies have concluded that higher levels of digital health literacy was

linked to better health outcomes and improved health behaviors (Yuen et al., 2024). As challenges with digital competences are widely recognized in the SSA region, actions are required. Reinforcing access to digital literacy education is needed urgently. A positive and slightly surprising finding was that in a study by Simpson et al. (2021) it was discovered that participants adapted quickly just by having access to a smartphone. The assistive functions and familiarization with the device promoted self learning and improved the participants' technological skills. This shows that just by having exposure to technology can have positive effects on digital literacy.

The results suggest policymakers should prioritize enforcing digital rehabilitation supportive legislation. The challenges in expanding rehabilitation services highlight the necessity for greater awareness and advocacy, increased investment in the rehabilitation workforce and infrastructure, and enhanced leadership and governance. The scale and extent of these unmet rehabilitation needs underscore the urgent need for a unified and coordinated global response from all stakeholders. (WHO 2017.) The results of the scoping review highlighted especially the need to enforce privacy and security laws as they were mentioned as facilitators to successful intervention implementation in multiple studies (Adewuya et al., 2019; Venter et al., 2019; Boivin et al., 2019; Chory et al., 2021). As explained by Greenleaf and Cottier (2022), even though African nations have taken influences from the European Union's General Data Protection Regulation (GDPR) and Data Protection Directive (DPD), still further capacity building and developing policies and guidelines is required.

6 Reliability

The scoping review was conducted following the steps of the selected protocol thoroughly. The search terms were defined carefully, and the conducted search was wide including the use of multiple databases. The use of a systematic search strategy ensured the inclusion of articles providing recent scientific data of the research focus. The articles were selected using criteria that minimized the risk of bias. With a thorough search, it can be concluded that articles relevant to the search were identified and included in the scoping review, and no relevant articles were left out. The availability of existing studies focusing on advanced digital rehabilitation technologies set some limitations to the scoping review. The available studies only provided data about low- and mid-tech solutions as at the time of this review, no published studies were found that presented more advanced technologies.

As a responsible researcher, I ensured methodological transparency, adhered to ethical research practices, and maintained objectivity throughout the review process. I critically assessed the quality of sources, minimized bias in selection and interpretation, and remained committed to accurately representing the results of the review. My approach was guided by integrity, respect for the research team, and a focus on producing work that contributes meaningfully to the field. Lastly, thorough and thoughtful referencing of the utilized sources was ensured throughout the process.

Additionally, the master's thesis report was carried out by following the guidelines of The Finnish National Board on Research Integrity (TENK). The board's national guidelines' purpose is to guarantee the ethics and quality of research conducted in Finland. According to the code of conduct, the research should be conducted by following the principles that are accepted by the research community. These principles include integrity, conscientiousness, and accuracy in conducting and presenting the research, and in evaluation of the research results. Respect for other researchers must be shown by practicing the correct methods to cite their work appropriately. All existing conflicts of interest need to be declared, and the standards set for scientific knowledge in conducting research must be followed. (TENK, 2024.)

7 Conclusions

This scoping review contributes to the understanding of the facilitators and barriers related to implementation of home- and life space based digital rehabilitation solutions in sub-Saharan countries. Digital rehabilitation is gradually becoming more widely adopted in SSA countries with currently low- and mid-tech solutions being utilized to help with various health conditions. However, significant challenges must be addressed before digital solutions can meet the region's growing demand for rehabilitation services and more complex technology can be integrated into rehabilitation. Policies and regulations based on evidence-based research and structural guidance are needed to be reinforced by governments to develop safe, effective, client centered, and sustainable digital rehabilitation services.

Supporting digital literacy is imperative, necessitating the expansion of accessible digital competency education and training infrastructure. Disseminating evidence-based knowledge regarding the efficacy, advantages, and objectives of digital rehabilitation solutions is equally critical. This review's findings augment the existing evidence base on determinants influencing the successful implementation of digital rehabilitation interventions. Beyond the insights generated by this scoping review, cultural factors must be prioritized as critical considerations in the design of future digital rehabilitation initiatives. Further research is urgently required to explore sustainable digital rehabilitation strategies tailored to the sub-Saharan Africa context. Especially the sustainability aspect of interventions in resource-limited settings needs to be further researched and developed.

Digital rehabilitation can help to create new solutions which can help to overcome the existing barriers of participating in the traditional face-to-face rehabilitation services. If designed thoroughly, digital rehabilitation can offer cost effective solutions to meet the growing needs of rehabilitation in the SSA countries. Securing funding for health care in low- and middle-income countries (LMICs) requires strategic planning. The interest of funding sources needs to be turned towards digital rehabilitation with evidence-based proof of its efficiency and cost-effectiveness. The results of this scoping review can be applied to support future projects and planning of digital rehabilitation interventions in sub-Saharan Africa.

References

Abiodun, O., Murebwayire, E., Damien, T., Celestin, H., Jonathan, H., Alexandre, M., Peressi, N., Vedaste, M., Bigirimana, C., Kayode, K., & Nyirahabimana, M. (2022). Impact of specific e-therapy application in advancing occupational therapy intervention in a low-resourced country: A case study of Rwanda. *World Federation of Occupational Therapist Bulletin*. Volume 79, 2023 – Issue 1. https://doi.org/10.1080/14473828.2022.2088185.

Adewuya, A., Momodu, O., Olibamoyo, O., Adegbaju, A., Adesoji, O., & Adegbokun, A. (2019). The effectiveness and acceptability of mobile telephone adherence support for management of depression in the Mental Health in Primary Care (MeHPriC) project, Lagos, Nigeria: a pilot cluster randomised controlled trial. *Journal of Affective Disorders*. 2019;253:118-125. https://doi.org/10.1016/j.jad.2019.04.025.

Adlakha, A., Chhabra, S., & Shukla, S. (2020). Effectiveness of gamification for the rehabilitation of neurodegenerative disorders. *Chaos, Solitons & Fractals.* Volume 140, November 2020, 110192. https://doi.org/10.1016/j.chaos.2020.110192

Afridi, A., & Khan, S. (2024). Digital transformation in healthcare rehabilitation: A narrative review. *Journal of Process Management New Technologies*. 12. 16-30. 10.5937/jpmnt12-48336.

Arksey, H., & O'Malley, L. (2005) Scoping studies: towards a methodological framework, *International Journal of Social Research Methodology*, 8:1, 19-32, DOI: 10.1080/1364557032000119616.

Betancourt, J., Green, A., Carrillo, E., & Ananeh-Firepong, O. (2003). Defining Cultural Competence: A Practical Framework for Addressing Racial/Ethnic Disparities in Health and Health Care. *Public Health Reports*. Jul-Aug;118(4):293-302. https://doi.org/10.1093/phr/118.4.293.

Boivin, M., Nakasujja, N., Sikorskii, A., Ruiseñor-Escudero, H., Familiar-Lopez, I., Walhof, K., van der Lugt, E., Opoka, R., & Giordani, B. (2019). Neuropsychological benefits of computerized cognitive rehabilitation training in Ugandan children surviving severe malaria: A randomized controlled trial. *Brain Research Bulletin*. 2019 Feb;145:117–28. https://doi.org/10.1016/j.brainresbull.2018.03.002.

Brall, C., Schröder-Bäck, P., & Maeckelberghe, E. (2019). Ethical aspects of digital health from a justice point of view. *European Journal of Public Health*, 29, Issue Supplement_3, October 18–22. https://doi.org/10.1093/eurpub/ckz167.

Chory A., Nyandiko, W., Martin, R., Aluoch, J., Scanlon, M., Ashimosi, C., Njoroge, T., McAteer, C., Apondi, E., & Vreeman, R. (2021). HIV-Related Knowledge, Attitudes, Behaviors and Experiences of Kenyan Adolescents Living with HIV Revealed in WhatsApp Group Chats. *Journal of the International Association of Providers of AIDS Care*. Mar 4;1–11. https://doi.org/10.1177/2325958221999579.

Council of Europe (2022). DIGITAL CITIZENSHIP EDUCATION HANDBOOK. Accessed on 31st January 2025. Available at 1680a67cab (coe.int)

Covidence systematic review software. Accessed on 29th February 2025. Available at Covidence - Better systematic review management

Cyuzuzo, C., Dukuzimana, M., Muhire, C., Ames, M., Ngwakongnwi, E. (2025). Challenges to Rehabilitation Services in Sub-Saharan Africa From a User, Health System, and Service Provider Perspective: Scoping review. *JMIR Human Factors.* Feb 28;12:e58841. https://doi.org/10.2196/58841.

Damschroder, L., Reardon, C., Widerquist, M., & Lowery, J. (2022). The updated Consolidated Framework for Implementation Research based on user feedback, *Implementation Science*, 17, 75 (2022). https://doi.org/10.1186/s13012-022-01245-0

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments; MindTrek 11; 28-30 September 2011; Tampere, Finland. Envisioning Future Media Environments; 2011. https://doi.org/10.1145/2181037.2181040

DigComp 2.2: The Digital Competence Framework for Citizens - With new examples of knowledge, skills and attitudes. Accessed on 20th February 2025. Available at https://publications.jrc.ec.europa.eu/repository/handle/JRC128415

Dulli, L., Ridgeway, K., Packer, C., Murray, K., Mumuni, T., Plourde, K., Chen, M., Olumide, A., Ojengbede, O., & McCarraher, D. (2020). A Social Media-Based Support Group for Youth Living With HIV in Nigeria (SMART Connections): Randomized Controlled Trial. *Journal of Medical Internet Research*. 2020 Jun;22(6):e18343. Doi: 10.2196/18343.

Eurostat (2023). Healthcare expenditure statistics. Accessed on 11th of February 2025. Available at https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Healthcare_expenditure_statistics#Healthcare_expenditure_by_provider

Global Digital Rehabilitation (2023). Global Digital Rehabilitation Initiative. Accessed on 11th of December 2024. Available at https://digitalrehabilitation.org/

Greenleaf, G., & Cottier, B. (2022). International and regional commitments in African data privacy laws: A comparative analysis, *Computer Law & Security Review*, Volume 44, 2022, 105638, ISSN 0267-3649, https://doi.org/10.1016/j.clsr.2021.105638

GSMA (2023). The Mobile Economy 2023. Accessed on 29th February 2025. Available at The Mobile Economy 2023 (gsma.com)

Hong, Q., Pluye, P., Fàbregues, S., Bartlett, G., Boardman, F., Cargo, M., Dagenais, P., Gagon, M., Griffiths, F., Nicolau, B., O'Cathain, A., Rousseau, M., & Vedel, I. (2018). Mixed Methods Appraisal Tool (MMAT) Version 2018. Accessed on 10th January 2025. Available at http://mixedmethodsappraisaltoolpublic.pbworks.com/w/file/fetch/127916259/MMAT_2018_criteria-manual_2018-08-01_ENG.pdf

Htwe, O., Yuliawiratman, B., Tannor, A., Nor Asikin, M., Soh, E., De Groote, W., Naicker, M., & Naicker, A. (2024). Barriers and facilitators for increased accessibility to quality rehabilitation services in low- and middle-income countries: a systematic review. *European Journal of Physical and Rehabilitation Medicine*. Mar 29;60(3):514–522. https://doi.org/10.23736/S1973-9087.24.08154-1.

Ivanova O., Wambua, S., Mwaisaka, J., Bossier, T., Thiongo, M., Michielsen, K., & Gichangi, P. (2019). Evaluation of the ELIMIKA Pilot Project: Improving ART Adherence among HIV Positive Youth Using an eHealth Intervention in Mombasa, Kenya. *African Journal of Reproductive Health*. Mar;23(1):100–10. https://doi.org/10.29063/ajrh2019/v23i1.10.

Jamk (2024). RADIC Project. Accessed on 31st January 2025. Available at https://www.jamk.fi/en/project/radic/radic-project

Keenan, A., Tsourtos, G. & Tieman, J. (2021). The Value of Applying Ethical Principles in Telehealth Practices: Systematic Review. *Journal of Medical Internet Research.* 23(3):e25698. https://doi.org/10.2196/25698.

Keesara, S., Jonas, A., & Schulman, K. (2020). Covid19 and Health Care's Digital Revolution. *The New England Journal of Medicine, 382*(23): e82. https://doi.org/10.1056/NEJMp2005835

Khatib, N., & Hlayisi, V. (2022). Is a hybrid of online and face-to-face services feasible for audiological rehabilitation post COVID-19? Findings from three public health patients. *South African Journal of Communication Disorders*. Aug 17;69(2):e1–11. http://dx.doi.org/10.4102/sajcd.v69i2.937.

Manyazewal, T., Woldeamanuel, Y., Fekadu, A., Holland, D., Marconi, V. (2022). Effect of Digital Medication Event Reminder and Monitor-Observed Therapy vs Standard Directly Observed Therapy on Health-Related Quality of Life and Catastrophic Costs in Patients With Tuberculosis: A Secondary Analysis of a Randomized Clinical Trial. *JAMA Network Open*. Sep 15;5(9):e2230509. https://doi.org/10.1001/jamanetworkopen.2022.30509.

Mapulanga, M., & Dlungwane, T. (2022). Mapping evidence of community health workers delivering physical rehabilitation services in sub-Saharan Africa: a scoping review protocol. *BMJ Open* 12:e053736. https://doi.org/10.1136/bmjopen-2021-053736.

Moore, M. (1999). The evolution of telemedicine. *Future Generation Computer Systems*, Volume 15, Issue 2, pages 245-254. https://doi.org/10.1016/S0167-739X(98)00067-3.

Munn, Z., Peters, M. D. J., Stern, C., Tufanaru, C., McArthur, A., & Aromataris, E. (2018). Systematic review or scoping review? Guidance for writers when choosing between a systematic or scoping review approach. *BMC Medical Research Methodology*, 18(1), 143. https://doi.org/10.1186/s12874-018-0611-x

Odetunde, M., Binuyo, O., Maruf, F., Ayenowowon, S., Okonji, A., Odetunde, N., & Mbada, C. (2020). Development and Feasibility Testing of Video Home Based Telerehabilitation for Stroke Survivors in Resource Limited Settings. *International Journal of Telerehabilitation*. Dec 8;12(2):125–36. https://doi.org/10.5195/ijt.2020.6321.

Ofoegbu, T., Asogwa, U., Otu, M., Ibenegbu, C., Muhammed, A., & Eze, B. (2020) Efficacy of guided internet-assisted intervention on depression reduction among educational technology students of Nigerian universities. *Medicine (Baltimore)*. Feb;99(6):e18774. http://dx.doi.org/10.1097/MD.0000000000018774.

Osborn, T., Rodriguez, M., Wasil, A., Venturo-Conerly, K., Gan, J., Alemu, E., Arango, S., Otieno, B., Wasanga, C., Shingleton, R., & Weisz, J. (2020). Single-session digital intervention for adolescent depression, anxiety, and well-being: Outcomes of a randomized controlled trial with Kenyan adolescents. *Journal of Consulting and Clinical Psychology*. Jul;88(7):657–68. https://doi.org/10.1037/ccp0000505.

Owolabi, E., Goon, D., Ajayi, A. (2020). Impact of mobile phone text messaging intervention on adherence among patients with diabetes in a rural setting: A randomized controlled trial. *Medicine*. Mar;99(12):e18953. http://dx.doi.org/10.1097/MD.0000000000018953.

Pandya, S. (2021). Meditation app alleviates burnout and builds resilience for chaplains in hospices for older adults in Asian and African cities. *Journal of Health Care Chaplaincy*. Jul;27(3):129–45. https://doi.org/10.1080/08854726.2019.1670539.

Ratanjee-Vanmali, H., Swanepoel, D., Laplante-Lévesque, A. (2020). Patient Uptake, Experience, and Satisfaction Using Web-Based and Face-to-Face Hearing Health Services: Process Evaluation Study. *Journal of Medical Internet Research*. Mar;22(3):e15875. http://dx.doi.org/10.2196/15875.

Ratto, M., Qua Hiansen, J., Marshall, J., Kaweesa, M., Taremwa, J., Heang, T., Kheng, S., Teap, O., Mchihiyo, D., Onesmo, R., Moshi, B., Mwaijande, V., & Evans, J. (2021). An International, Multicenter Field Trial Comparison Between 3D-Printed and ICRC-Manufactured Transtibial Prosthetic Devices in Low-Income Countries. *Journal of Prosthetics & Orthotics (JPO)*. Jan;33(1):54–69. Doi: 10.1097/JPO.0000000000000349.

Relf, M., Holzemer, W., Holt, L., Nblade, L., & Caiola, C. (2022). A Review of the State of the Science of HIV and Stigma: Context, Conceptualization, Measurement, Interventions, Gaps, and Future Priorities. *Journal of Association Nurses in AIDS Care*. May-Jun;32(3):392–407.https://doi.org/10.1097/JNC.0000000000000237.

Sap, S., Kondo, E., Sobngwi, E., Mbono, R., Tatah, S., Dehayem, M., Koki, P., & Mbanya, J. (2019). Effect of patient education through a social network in young patients with type 1 diabetes in a Sub-Saharan context. *Pediatric Diabetes*. May;20(3):361–5. https://doi.org/10.1111/pedi.12835.

Sarfo, F., Adusei, N., Ampofo, M., Kpeme, F., Ovbiagele, B. (2018) Pilot trial of a tele-rehab intervention to improve outcomes after stroke in Ghana: A feasibility and user satisfaction study. *Journal of Neurological Science*. Apr 15;387:94–7. https://doi.org/10.1016/j.jns.2018.01.029.

Simpson, N., Kydd, A., Phiri, M., Mbewe, M., Sigande, L., Gachie, T., Ngobeni, M., Monese, T., Figerova, Z., Schlesinger, H., Bond, V., Belemu, S., Simwinga, M., Schaap, A., Biriotti, M., Fidler, S., & Ayles, H. (2021). Insaka: mobile phone support groups for adolescent pregnant women living with HIV. *BMC Pregnancy and Childbirth*. Sep 30;21(1):1–11. https://doi.org/10.1186/s12884-021-04140-6.

Sterne, J., Savović, J., Page, M., Elbers, R., Blencowe, N., Boutron, I., Cates, C., Cheng, H., Corbett, M., Eldridge, S., Emberson, J., Hernán, M., Hopewell, S., Hróbjartsson, A., Junqueira, D., Jüni, P., Kirkham, J., Lasserson, T., Li, T., McAleenan, A., Reeves, B., Shepperd, S., Shrier, I., Stewart, L., Tilling, K., White, I., Whiting, P., & Higgins, J. (2019). RoB 2: a revised tool for assessing risk of bias in randomised trials. *The BMJ*. 2019;366:14898. https://doi.org/10.1136/bmj.l4898

Taherdoost, H. (2018). A Review of technology acceptance models and theories, *Procedia Manufacturing Procedia Manufacturing,* Volume 22, 2018, Pages 960-967, ISSN 2351-9789. https://doi.org/10.1016/j.promfg.2018.03.137

Teriö, M., Eriksson, G., Kamwesiga, J., & Guidetti, S. (2019) What's in it me? A process evaluation of the implementation of a mobile phone-supported intervention after stroke in Uganda. *BMC Public Health*. Dec;19(1):562. https://doi.org/10.1186/s12889-019-6849-3.

The World Bank. (2024, January 18). Digital Transformation Drives Development in Africa. Accessed on 20th February 2024. Available at Digital Transformation Drives Development in Africa (worldbank.org)

Treloar, C., Champness, S., Simpson, P., Higginbotham, N. (2000) Critical appraisal checklist for qualitative research studies. *Indian Journal of Pediatrics*. 2000 May;67(5):347–51. https://doi.org/10.1007/bf02820685

Tricco, A. C., Lillie, E., Zarin, W., O'Brien, K., Colquhoun, H., Kastner, M., Levac, D., Ng, C., Sharpe, J. P., Wilson, K., Kenny, M., Warren, R., Wilson, C., Stelfox, H. T., & Straus, S. E. (2016). A scoping review on the conduct and reporting of scoping reviews. *BMC Medical Research Methodology*, 16(1), 15. https://doi.org/10.1186/s12874-016-0116-4

Velez, M., Lugo-Agudelo, L., Lugo, D., Glenton, C., Posada, A., Franco, L., Negrini, S., Kiekens, C., Brunal, M., Roberg, A., & Sarmiento, K. (2023). Factors that influence the provision of home-based rehabilitation services for people needing rehabilitation: a qualitative evidence synthesis. *Cochrane Database of Systematic reviews*. Feb 10;2023(2):CD014823. https://doi.org/10.1002/14651858.CD014823.

Venter, W., Fischer, A., Lalla-Edward, S., Coleman, J., Lau Chan V., Shubber, Z., Phatsoane, M., Gorgens, M., Stewart-Isherwood, L., Carmona, S., & Fraser-Hurt, N. (2019). Improving Linkage to and Retention in Care in Newly Diagnosed HIV-Positive Patients Using Smartphones in South Africa: randomized Controlled Trial. *JMIR mHealth and uHealth*. 7(4):e12652. https://doi.org/10.2196/12652.

Vuorikari, R., Kluzer, S., & Punie, Y. (2022). DigComp 2.2: The Digital Competence Framework for Citizens - With new examples of knowledge, skills and attitudes. Accessed on 3rd of March 2024. Available at https://publications.jrc.ec.europa.eu/repository/handle/JRC128415

WHO (2017). Rehabilitation 2030 a call for action. Accessed on 10th of March 2025. Available at https://iris.who.int/bitstream/handle/10665/339910/9789240007208-eng.pdf?sequence=1&isAllowed=y.

WHO (2021). Global strategy on digital health 2025. Accessed on 27th February 2024. Available at https://www.who.int/docs/default-source/documents/gs4dhdaa2a9f352b0445bafbc79ca799dce4d.pdf

WHO (2023). Rehabilitation. Accessed on 20th February 2025. Available at https://www.who.int/news-room/fact-sheets/detail/rehabilitation

WHO (2024). Increasing access to quality rehabilitation services in Africa. Accessed on 5th February 2025. Available at https://www.who.int/publications/i/item/WHO-AFRO-UHP-2024-03

WHO (2024a). Guiding optimal development and use of digital health towards improved health outcomes. Accessed on 24th February 2025. Available at Guiding optimal development and use of digital health towards improved health outcomes (who.int)

WHO (2024b). mHealth programmes are sponsored by government. Accessed on 24th February 2025. Available at mHealth programmes are sponsored by government (who.int).

World Bank Group (2024). The World Bank in Africa. Accessed on 11th March 2025. Available at Africa Overview: Development news, research, data | World Bank.

Yuen, E., Winter, N., Savira, F., Huggings, C., Nguyen, L., Cooper, P., Peeters, A., Anderson, K., Bhoyroo, R., Crowe, S., & Ugalde, A. (2024). Digital Health Lietracy and Its Association With Sociodemographic Characteristics, Health Resource Use, and Health Outcomes: Rapid Review. *Interactive Journal of Medical Research*. Jul 26;13:e46888. https://doi.org/10.2196/46888.

Appendix 1. Summaries of studies (Data extraction sheet)

(Studies excluded from this master's thesis report are coded with red indication.)

SECTION A: Title, author, Year of publication, Journal, Type of article, aim of the study, population, and country

STUDY #	Article, Author(s), Year of Publication	Journal	Type of article /study	Purpose/aim of the article/study	Population's condition	Country
1	Effect of Digital Medication Event Reminder and Monitor-Observed Therapy vs Standard Directly Observed Therapy on Health-Related Quality of Life and in Patients With Tuberculosis: A Catastrophic Costs Secondary Analysis of a Randomized Clinical Trial. Manyazewal et al. 2022	JAMA Network Open	RCT	To test the hypothesis that a digital medication event reminder monitor (MERM)-observed therapy provides higher health-related quality of life (HRQoL) and lower catastrophic costs compared with standard directly observed therapy	People with Pulmonary TB	Ethiopia
2	A Pilot Study of a Mobile Intervention to Support Mental Health and Adherence Among Adolescents Living with HIV in Western Kenya. Chory et al. 2021	AIDS Behav	Mixed-Methods	To evaluate the acceptability and feasibility of the WhatsApp ® platform to deliver individual counselling services and facilitate peer support for ALWH in western Kenya.	Adolescents with HIV	Kenya
3	Evaluation of the ELIMIKA Pilot Project: Improving ART Adherence among HIV Positive Youth Using an eHealth Intervention in Mombasa, Kenya. Ivanova et al. 2019	Afr J Reprod Health	Pilot study	To report on the usability and the effectiveness of a pilot digital peer support system in improving HIV/ART knowledge, perceived importance of adherence, perceived self-efficacy in adhering and future intentions towards adherence.	Adolescents with HIV	Kenya

4	A qualitative study of university students' experience of Internet-based CBT for depression. Gericke et al. 2021	Couns and Psychother Res	Qualitative study	Experiences of using a brief semi-guided Internet-based cognitive behavioral therapy (iCBT) for depression and document the acceptability of this mode of psychotherapy.	Students with symptoms of depression	South Africa
5	Insaka: mobile phone support groups for adolescent pregnant women living with HIV. Simpson et al. 2021	BMC Pregnancy Childbirth	Mixed-Methods	To assess the acceptability and feasibility of a phone-based, peer-to-peer support group intervention for adolescent pregnant women aged 15–24 years living with HIV in Zambia	Adolescent pregnant woman with HIV	Zambia
6	Impact of mobile phone text messaging intervention on adherence among patients with diabetes in a rural setting: A randomized controlled trial. Owolabi et al. 2020	Medicine (Baltimore)	RCT	This study assessed the effect of unidirectional text messaging on adherence to dietary and activity regimens among adults living with diabetes in a rural setting of Eastern Cape, South Africa	Adults with Diabetes	South Africa
7	An Evaluation of a Low-Intensity Cognitive Behavioral Therapy mHealth-Supported Intervention to Reduce Loneliness in Older People. Jarvis et al. 2019	IJERPH	RCT	This study implemented and evaluated a low-intensity Cognitive Behavior Therapy (LI-CBT) mHealth-supported intervention which targeted maladaptive cognitions in older people (≥60 years) experiencing loneliness.	Elderly with maladaptive cognition	South Africa
8	The Clinical and Cost-Effectiveness of Telerehabilitation for People With Nonspecific Chronic Low Back Pain: Randomized Controlled Trial. Fatoye et al. 2020	JMIR Mhealth Uhealth	RCT	This study aimed to evaluate the clinical and cost-effectiveness of telerehabilitation compared with a clinic-based intervention for people with NCLBP in Nigeria.	People with nonspecific chronic low back pain (NCLBP)	Nigeria
9	Efficacy of guided internet-assisted intervention on depression reduction among educational technology students of Nigerian universities. Ofoegbu et al. 2020	Medicine (Baltimore)	Group-randomized trial	The study's objective was to determine the efficacy of guided internet-assisted intervention (GIAI) on depression reduction among educational technology students of Nigerian universities.	Students with depression	Nigeria
10	A Social Media-Based Support Group for Youth Living With HIV in Nigeria (SMART Connections): Randomized Controlled Trial. Dulli et al. 2020	J Med Internet Res	RCT	This study aimed to test the effectiveness of a structured support group intervention, social media to promote Adherence and Retention in Treatment (SMART) Connections, delivered through a social media platform, on HIV treatment retention among YLHIV aged 15 to 24 years and on secondary outcomes of antiretroviral therapy (ART) adherence, HIV knowledge, and social support.	Adolescents with HIV	Nigeria

11	Patient Uptake, Experience, and Satisfaction Using Web-Based and Face-to-Face Hearing Health Services: Process Evaluation Study. Ratanjee-Vanmali et al. 2020	J Med Internet Res	Process Evaluation Study	This study aimed to investigate a hybrid (Web-based and face-to-face) hearing health service in terms of uptake, experience, and satisfaction in adult patients with hearing loss.	People with hearing loss	South Africa
12	The effectiveness and acceptability of mobile telephone adherence support for management of depression in the Mental Health in Primary Care (MeHPriC) project, Lagos, Nigeria: a pilot cluster randomized controlled trial. Adewuya et al. 2019	Journal of Affective Disorders	Pilot RCT	To evaluate the effectiveness and acceptability of adding a mobile telephone adherence support to a Collaborative Stepped Care (CSC) intervention for primary care management of depression.	People with depression	Nigeria
13	Economic evaluation of an online single-session intervention for depression in Kenyan adolescents. Wasil et al. 2021	Journal of Consulting and Clinical Psychology	data from a RCT	To evaluate the costs and cost-effectiveness of Shamiri-Digital, an online single-session intervention (SSI) for depression among Kenyan adolescents.	Students with depression	Kenya
14	Single-Session Digital Intervention for Adolescent Depression, Anxiety, and Well-Being: Outcomes of a Randomized Controlled Trial With Kenyan Adolescents. Osborn et al. 2020	Journal of Consulting and Clinical Psychology	data from a RCT	Evaluation of computerized single-session interventions (SSIs) for Kenyan adolescents.	Students with depression	Kenya
15	Impact on specific e-therapy application in advancing occupational therapy intervention in a low-resourced country: A case study of Rwanda. Abiodun et al. 2023	World Federation of O.T. Bulletin	Case study	Impacts on specific e-therapy application in advancing occupational therapy intervention as a rehabilitative profession: To assess the therapist' and institution's levels of readiness towards e-therapy application, to assess clients' levels of acceptance towards e-therapy application, to explore the effect of specific e-therapy-based intervention and to explore the barriers faced by occupational therapists in implementing e-therapy services in Rwanda.	Not specified, people in occupational therapy	Rwanda
16	Improving Linkage to and Retention in Care in Newly Diagnosed HIV-Positive Patients Using Smartphones in South Africa: Randomized Controlled Trial. Venter et al. 2019	JMIR Mhealth Uhealth	Multisite RCT	This study's purpose was to evaluate the ability of SmartLink to improve linkage to care for HIV-positive smartphone owners.	People with HIV	South Africa
17	What's in it for me? A process evaluation of the implementation of a mobile phone-supported intervention after stroke in Uganda. Terio et al. 2019	BMC Public Health	Mixed-methods	The aim of the study was to evaluate the implementation process of a mobile phone-supported family-centred rehabilitation intervention and to gain knowledge on the mechanisms of impact as well as the contextual factors that might have affected the implementation process and its outcome.	People with stroke	Uganda

18	Is a hybrid of online and face-to-face services feasible for audiological rehabilitation post COVID-19? Findings from three public health patients. Khatib & Hlayisi. 2022	SAJCD	Mixed-Methods	This study aimed to investigate the feasibility of implementing a hybrid tele-rehabilitation programme in a South African public health context. An online auditory training (AT) programme was used to determine (1) compliance, (2) clinical benefit, (3) participant experience and (4) costs.	People with hearing disorders	South Africa
19	Pilot Trial of a Tele-Rehab Intervention to Improve Outcomes after Stroke in Ghana: A Feasibility and User Satisfaction Study. Sarfo et al. 2018.	Journal of the Neurological Sciences	Quasi experimental research	Study's purpose was to examine the feasibility and effectiveness of mobile technology assisted physical therapy exercises for stroke victims in Ghana.	People with stroke	Ghana
20	Effect of patient education through a social network in young patients with type 1 diabetes in a Sub-Saharan context. Sap et al. 2019	Pediatr Diabetes	Non-randomized clinical trial	To evaluate the short-term impact of patient education through WhatsApp on the knowledge of the disease and glycemic control of adolescents and young adults living with T1D in a resource-limited setting.	People with diabetes	Cameroon
21	Neuropsychological Benefits of Computerized Cognitive Rehabilitation Training in Ugandan Children Surviving Severe Malaria: A Randomized Controlled Trial. Boivin et al. 2019	BMC Proc	RCT	To assess the effects of Computerized Cognitive rehabilitation training in children with malaria	Children with malaria	Uganda
22	HIV-Related Knowledge, Attitudes, Behaviors and Experiences of Kenyan Adolescents Living with HIV Revealed in WhatsApp Group Chats. Chory. 2021	J Int Assoc Provid AIDS Care	Prospective, qualitative inquiry	Qualitative analysis of the WhatsApp® chat transcripts as described here provide an organic assessment of adolescent knowledge, attitudes and beliefs about HIV, as well as self-reports of their HIV-related behaviors and experiences, in a group context led by the ALWH themselves.	Adolescents living with HIV (ALWH)	Kenya
23	Meditation app alleviates burnout and builds resilience for chaplains in hospices for older adults in Asian and African cities. Pandya. 2021	Journal of Health Care Chaplaincy	Cohort study	To assess whether a smartphone-based meditation app for chaplains working in hospices for older adults would alleviate burnout symptoms and enhance feeling of personal achievement and build resilience as compared to a leisure-based app. To assess whether a fairly long duration sustained app-based intervention would be effective. The paper reports on a one-year active control design study.	Chaplains working in hospices of older adults	Kenya & South Africa, also the study had participants from Mumbai and Bangkok
24	An International, Multicenter Field Trial Comparison Between 3D-Printed and ICRC-Manufactured Transtibial Prosthetic Devices in Low-Income Countries. Ratto et al. 2021	J Prosthet Orthot	Cohort study	To compare the efficacy of TT sockets fabricated with the 3DPA digital toolchain with devices fabricated using the traditional ICRC methodology. Participants had previously worn and used at least one other TT socket previously,	Participants with TT amputation	Uganda, Tanzania,

				ages of 5 and 25 with unilateral TT amputation and well-healed residual limbs for casting during ICRC device assessment.		(and Cambodia)
25	Development and Feasibility Testing of Video Home Based Telerehabilitation for Stroke Survivors in Resource Limited Settings. Odetunde et al. 2020.	Int J Telerehabil	Pilot study	To assess the feasibility of a home-based intervention for stroke survivors who speak indigenous African languages.	Stroke survivors	Nigeria

SECTION B: Environment/setting, intervention data, outcome measure, conclusion, information about technology

STUDY #	Environment/ setting	Intervention	Outcome measure	Conclusion	Technology, name, type
1	Life space, not clearly specified	Two months. 52 participants in the intervention group, 57 in control group. Intensive treatment phase with a digital medication event reminder monitor (MERM)-observed self-administered therapy. Participants were randomly assigned (1:1) to receive a 15-day TB medication supply dispensed with a MERM device to self-administer and return every 15 days. At return a clinician counted any remaining tablets and connected the MERM module with the computer software. The clinician downloaded pill-taking data from the device to the computer and reviewed the event reports over with the participant. The continuation phase (4 months) followed the standard DOT practice for both arms.	HRQoL, catastrophic cost, post diagnostic cost, indirect cost, factors contributing to lower HRQoL, higher catastrophic costs	In patients with TB, MERM-observed therapy was associated with higher HRQoL and lower catastrophic costs compared with standard DOT. Patient-centered digital health technologies could have the potential overcoming structural barriers to anti-TB therapy	Computer software and digital devices. evriMED500® MERM. Digital medication event reminder device and computer software
2	Life space	Six months. 15 participants in intervention and 15 in control group. Participants were provided with a smartphone with the WhatsApp® application preinstalled, a SIM card, and phone credit (~ 7 USD per month). ALWH enrolled in the study were placed in one of two WhatsApp ® groups based on their age, either a group for 9–14-year-olds or a second group for 15–19-year-olds. A trained pediatric HIV adherence and disclosure counsellor facilitated the WhatsApp ® groups according to a structured curriculum to encourage positive support between members, to introduce weekly group discussion topics, and to answer participants' questions. Weekly group discussion topics were informed by formative qualitative work with this cohort as well as a	Adherence to HIV treatment, experiences with stigma, mental and behavioral health, and clinical status	Interventions should allow for both group and one-on-one messaging with a counsellor to facilitate a sense of community with the option for private interactions to discuss more sensitive topics. Further data on the effectiveness and impact of mobile-based	Apps. WhatsApp. Text messaging.

		multimedia curriculum developed previously by this research team that has modules on stress management, drug and alcohol abuse prevention, intimate relationships, and issues related to HIV adherence, disclosure, and stigma.		counselling and peer support interventions on mental health outcomes and adherence among ALWH in this setting are needed.	
3	Life space	Three months. 81 participants. Digital peer support platform aiming at improving adherence to ART treatment among HIV positive youth in Mombasa, Kenya. The intervention consisted of interactive web-based peer support platform which included a blog with posts written by project coordinators, health care providers and young people on different topics related to sexual and reproductive health, HIV, medication, nutrition, relationships etc.; discussion section; Q&A section with health care providers; stories contest and private messaging. The platform resembled social media platforms with secure users' profiles for posting and communication.	Usability, knowledge, perceived self-efficacy and adherence intentions	Overall, the participants were satisfied with the main features of the web platform and stated that they would use it again (95%). However, there was not a significant change in knowledge and behavior, but adherence intentions after 3 months intervention period have improved	Web-based platforms. ELIMIKA platform. Web platform.
4	Life space	Web based cognitive behavioral intervention. 9 participants. The iCBT intervention consists of seven weekly online sessions and an additional booster session, covering topics such as behavioral activation; reducing incongruence; overcoming difficulties and scheduling pleasant activities; psychoeducation; cognitive restructuring; problem-solving, exposure; and planning. The online sessions make use of student testimonials, audio-video material, practical exercises and homework assignments. Students were responsible for working through the online material on their own and at their own pace, but anonymous eCoaches provided guidance and support using individualized feedback via email.	n/a	Findings suggest that some students may find iCBT acceptable and effective as a mode of delivering psychological treatment for symptoms of depression. Moves to incorporate iCBT into student counselling should take account of and manage students' expectations about the ability of e-interventions to mimic traditional therapy and/or incorporate more opportunities for human interaction.	Web-based platforms. ICare platform. Web platform.
5	Life space	4 months. 61 participants. Mobile phone-based intervention that allowed to anonymously communicate in a small group led by a facilitator. During the intervention, the participants could freely communicate amongst themselves anonymously. Groups were facilitated by a trained Peer Mentor (PM) who delivered a curriculum of topics developed in consultation with the project team and key stakeholders. There were a number of sessions where health professionals – a	Berger stigma scale, Multidimensional Measure of Perceived Social Support (MMPSS), Rosenberg Self Esteem Scale, HIV Knowledge and Self-Reported Adherence.	Findings from this study suggest that mobile phone support groups are an acceptable and feasible means of delivering psychosocial support to adolescent pregnant women living with HIV in Zambia. The peer-led, small group structure of the intervention proved important for the provision of support, while guest	Apps. Rocket.Chat®. Mobile platform.

		gynecologist, a nutritionist and a general practitioner - were invited into the groups to run a session on a particular topic, where participants could ask specific medical questions, as informed by information gathered in the participatory workshops at the beginning of the study.		speaker sessions proved effective at delivering accurate information.	
6	Life space	Sending a SMS reminder to people with diabetes with the aim to support the adherence to diabetes therapy. Intervention group 108 participants; Usual care + short message services (SMS) at an agreed time of the day, tailored according to their needs, care plan, and goals. Participants also received reminders, motivational and support messages, and advice on lifestyle behaviors like diets, physical activity, smoking cessation, medication, and appointment reminders. Text messages were sent through an online bulk messages platform, which allow messages to be scheduled for a specific time and show the message delivery status. Control group: 108 participants; Care as usual.	Diet adherence, physical activity adherence	There is a moderate level of adherence to medication and a low level of adherence to dietary and physical activity recommendation in this setting. The text messaging intervention did not bring about any significant improvement in medication, dietary and physical activity adherence levels. There is a need to design effective strategies for improving adherence to recommended lifestyle changes in this setting	SMS. not applicable. Text messaging.
7	Elderly home	Three months: A LI-CBT intervention, Living In Network Connected Communities (mLINCC) to be delivered on WhatsApp. All participants in the intervention group (15 participants) were added to the mLINCC WhatsApp group, which was a closed group and at cross-over a separate WhatsApp group (mLINCC 2) for the control group (17 participants). In the second phase (2 weeks), psychoeducation was delivered through four 90-min F2F sessions on factors underlying loneliness. Key messages from these sessions were confirmed through messages on WhatsApp. In phase three (1 month) individualized messages with positively framed content aimed at countering maladaptive cognitions were sent to participants via WhatsApp. The messages were constructed by the CBT specialist and each message had two components: acknowledgment of the maladaptive cognition linked to loneliness, and a positively framed counter message to allow the participants an opportunity to reflect on the cognitive distortion and its influence on their feelings and behaviors. The final phase was a maintenance stage (1 month) during which just the weekly Help Desk was continued, with the moderator still presiding over the WhatsApp group though not participating.	Usage (frequency and function of mobile phone), social cognition (SQ-SF), loneliness (DJGLS), mental wellbeing (WHO-5)	LI-CBT delivered via instant messaging may be effective in reducing loneliness experienced by older people.	Apps. WhatsApp. Text messaging.

8	Home	3 times / 8 Weeks: Telerehabilitation-based McKenzie therapy (TBMT). Intervention group: 21 participants, control group (clinic-based therapy): 26 participants. TBMT is a comparable version of CBMT performed at home with the assistance of a mobile phone app. The mobile app is a combination of the McKenzie extension protocol and back care education developed and enabled to run on a smartphone or an Android phone with an operating system of version 3.5. TBMT is a mobile phone video app designed for patients with chronic LBP. The app incorporated personalized and guided self-therapy using the same protocol as the McKenzie protocol (ie, extension lying prone, extension in prone, and extension in standing). Performance feedback and progress tracking were telemonitored through enhanced caregiver support to improve patient engagement and therapy compliance	Oswestry Disability Index, health-related quality of life, the ODI was mapped to the short-form six dimensions instrument to generate quality-adjusted life years (QALYs).	The findings suggested that telerehabilitation for people with NCLBP was cost saving. Given the small number of participants in this study, further examination of effects and costs of the interventions is needed within a larger sample size. In addition, future studies are required to assess the cost-effectiveness of this intervention in the long term from the patient and societal perspective.	Apps. Not specified. Instructions via app and feedback via videoconference.
9	Life space	10 weeks. Intervention group: 96 participants, control group: 96 participants. Guided internet-assisted intervention; psychoeducation, interactive peer support, cognitive disputation, behavioral homework assignments, roleplay, and depression management. The GIAI therapists also followed the principles of ICBT in line with previous studies. GIAI includes the provision of helpful materials through the internet, an initial support session through telephone and regular guidance from the therapists through telephone and the internet. The therapists were a clinical staff of the federal universities in Southeast Nigeria with proven evidence of expertise in depression intervention. GIAI helped the participants to maintain self-reflection and identity construction which are the qualities needed for the depression reduction process.	Depression (Beck's Depression Inventory-II (BDI-II))	The study's findings indicated that GIAI was efficacious in reducing depression among participants in the treatment group when compared to those in the usual care control group.	Combination of apps and web-based platforms. Not specified. Guided internet-assisted intervention.
10	Life space	22 weeks, 2 sessions/week. Intervention group: 177 participants, control group with standard care: 172 participants. The intervention was designed to promote retention in HIV care by leveraging social support and improving HIV-related knowledge and treatment literacy. The content of the structured support groups was adapted from an existing support group guide, Positive Connections, and delivered through secret Facebook groups.	Retention in HIV treatment, HIV treatment literacy, social isolation, Depression, stigma	Improved HIV knowledge and high acceptability. A lack of measurable effect on retention. Data indicates contribution to retention and social support in ways that were not captured quantitatively. Intervention can permit access to information privately, when convenient without travel. Such interventions may help fill critical gaps in services available for LHIV.	Social Media Platform. Facebook. Web-based platform.

11	Life space	Not applicable. 31 participants completed an online survey. Satisfaction (Short Assessment of Patient Satisfaction), a process evaluation of all the 5 steps completed, and personal preferences of communication methods used vs methods preferred was conducted, which was sent to 46 patients who used clinic services.	Surveys: Short Assessment of Patient Satisfaction, process evaluation	The positive patient experience and satisfaction demonstrates the potential of hybrid online and face-to-face service to meet patient needs. Sustainable and scalable service delivery models that incorporate eHealth are required to meet the challenges of untreated hearing loss globally.	Web-based platforms. Not specified. Web-based platform.
12	Life space	6 months. 439 participants in the intervention group were designed to receive tailored (rather than generic) informational messages which served as reminders for clinic, psychological sessions and medication and overall adherence to treatment protocols. Care was taken to ensure that the messages were non-obstructive, not too frequent and the contents were motivational and privacy preserving. 456 participants in the control group received manualised treatment.	Self-rated: adherence, depression, reduction in disability, health, cost, perceived content, perceived usefulness	The addition of mobile telephone support significantly improves adherence and clinical outcomes and was cost effective and acceptable to clients. Mobile telephone technology can substantially aid the scale up of mental health services in developing countries.	SMS. Not specified. Text messaging.
13	Life space	Shamiri-Digital intervention consisted of three modules: growth-mindset, gratitude, and value affirmation. 101 participants in total, not indicated how many in intervention or control group. In the growth mindset module, students learned about how the brain changes in response to challenges, read a testimonial written by a peer, and wrote a story about a time they grew because of a challenge. In the gratitude module, students completed the “three good things” exercise, in which they reflected on things in which they were grateful. In the value affirmation module, students reflected on personal values and wrote about a time in which they used their values to guide their life decisions.	Depressive symptoms, anxiety symptoms, and subjective well-being, cost assessment	A low-cost intervention for reducing depression symptomatology, especially relative to traditional psychotherapies. The public health benefit of empirically supported single-session interventions could be especially important in low-income countries, where funding is limited.	Web-based platforms. Shamiri-Digital. Web-based platform.
14	Life space	Shamiri-Digital intervention consisted of three modules: growth-mindset, gratitude, and value affirmation. 103 participants, fifty adolescents, were randomly assigned to the Shamiri-Digital intervention group, and 53 to the study-skills control group. In the growth mindset module, students learned about how the brain changes in response to challenges, read a testimonial written by a peer, and wrote a story about a time they grew because of a challenge. In the gratitude module, students completed the “three good things” exercise, in which they reflected on things	Depressive symptoms, anxiety symptoms, and subjective well-being and happiness	The intervention group experienced larger declines in depressive symptoms from baseline to 2-week follow-up than control group. This decline was though non-significant. No difference emerged on self-reported wellbeing and happiness between adolescents in the intervention and control groups. In both	Web-based platforms. Shamiri-Digital. Web-based platform.

		in which they were grateful. In the value affirmation module, students reflected on a personal value and wrote about a time in which they used their values to guide their life decisions.		groups, those with elevated anxiety at baseline showed declines in anxiety symptoms.	
15	Not specified, presumably home	Not same for each participant. Different modalities of e-therapy were used during the intervention with clients. Clients were engaged in synchronized (combination of real-time face-to-face and phone conversations), asynchronized (SMS messages, WhatsApp text. Clients in this category had been previously trained in activities by the therapists using face-to-face and online), or combined methods and remote monitoring methods of e-therapy intervention service delivery. The study was based on 74 participants: 65 clients and 9 therapists. Client/caregiver must have a functionally electronic device (smartphone, laptop, tablets, etc.)	Telehealth Readiness Assessment Questionnaire for therapists. Health Optimum Telemedicine Acceptance Qtn for clients. Post intervention Telehealth Satisfaction survey for both	The therapists' readiness assessment indicates many are ready to carry out e-therapy. A small proportion reported challenges due to limited knowledge and institutions' readiness. Most clients had a maximum acceptance level. Lower levels might be attributed to unfamiliarity with e-therapy services. Client's acceptance was supported with the use of the combined method, which might have reduced constraints of equipment or technology and eased access to care.	Videocalls within the synchronized method. SMS, WhatsApp text within the asynchronized method. N/a. Video calls, Text messaging
16	Life space	The app, available in English or Zulu, was designed to engage participants in their own care by directly providing them with 2 laboratory results; appointment reminders; and information about the laboratory tests, ART adherence, and HIV in general. The 2 laboratory results were CD4 count and viral load, and they were communicated in simple language. These values were also expressed visually on a color-coded scale that showed normal values and were accompanied by a short explanation of the results and guidance. All participants (181 in intervention group, 164 in control group), regardless of the study arm, were instructed to attend their local clinic for a follow-up within a few weeks of trial commencement and not to wait for the results on their phone.	HIV-related laboratory test results between 2 weeks and 8 months of participant recruitment were sought; Linkage to care (visits in clinic); viral load	Youth aged less than 30 years have been historically difficult to reach with traditional interventions, and the SmartLink app provides proof of concept that this population reacts to mobile health interventions that engage patients in HIV care.	Apps. SmartLink. Mobile platform.

17	Home	8 weeks; The F@ce™ intervention. F stands for Face-to-face between the OT and the client, for Assessment, C for Collaboration and E for Evaluation. During the intervention, the three set activity targets were delivered to the client every morning and evening by short message service (SMS). The morning SMS was a reminder to perform the activities during the day. In the evening the client was supposed to respond in three separate SMSs by scoring the performance of the activity between 0 (has not performed the activity) and 5 (did the activity well). If the clients had scored 0 or had not responded to the SMS, a red flag (a message that gave information of a non-performed activity) was sent to the OT who the following morning should call the client to solve the problem. Additionally, the clients were to receive calls from OT twice a week as follow-up. 15 participants in both intervention and control groups.	Presented in another study	The intervention was partially delivered in accordance with the logic model for the project, where the implementation process was influenced by several barriers in the context such as technical setbacks. However, there were also several mediators in the process driving the project forward, including strong facilitation and motivated participants.	SMS. N/a. Text messaging.
18	Home and clinic	4 weeks, auditory training via a web-based platform. Three participants, with access to Internet-capable device. All included participants were women between the ages of 35 and 55 years, diagnosed with a bilateral hearing loss and fitted monaurally. The participants' aided period (duration since fitting) ranged from 6 to 24 months.	Abbreviated Profile of Hearing Aid Benefit (APHAB); Quick Speech In Noise (QuickSIN); System Usability Scale (SUS)	The results showed positive indicators that the use of hybrid tele-rehabilitative strategies may provide a viable alternative to the traditional face-to-face modality. The hybrid approach showed clinical benefits, cost-effectiveness, minimal contact time as well as COVID-19 compliance. Further large-scale research is still needed.	Web-based platforms. Online training platform. Online auditory training (AT) program.
19	Home	Twenty participants were selected from consecutive stroke survivors attending a neurology service. They received a smartphone or had theirs installed with 9zest Stroke Rehab App®. The participants received individualized directions and exercise programs from a tele-therapist for five days a week. The system allowed for the recording of the sessions. The participant received progressively updated rehabilitation programs addressing all the 4 categories of physiotherapy components namely (I) mobility, upper and lower limb strengthening, (II) dexterity to improve fine motor movements, (III) seated and standing balance exercise and (IV) Walking endurance.	Stroke Levity Scale (SLS)9, Modified Rankin score, Barthel's Index of Activities of Daily living, National Institute of Health Stroke Scale, MoCA, Fatigue severity scale10 visual analogue scale for pain	The intervention was effective and yielded satisfaction among the participants. It is a feasible path of delivering rehabilitation services.	Apps. Video. Mobile phone delivered domiciliary rehabilitation intervention

			and feasibility outcomes such as fidelity checklist including internet connectivity issues and App functionality.		
20	Life space	4 sessions of patient education on people with diabetes through WhatsApp as follow- up. Participants had to have their own smartphone. The Intervention group consisted of 25 participants, a control group 29 participants, the median age was 19 years in both groups.	knowledge of diabetes, acute events, and glycemic control, before and after intervention	Patient education through social networks helped to improve knowledge on Type 1 diabetes and to reduce acute complications without an improvement of glycemic control after 2 months.	Apps. WhatsApp. Text messaging.
21	Life space	2 months, Captain's Log® by BrainTrain is a comprehensive set of computerized cognitive rehabilitation training program (CCRT) with five modules - Developmental, Visual Motor Skills, Conceptual Skills, Numeric Concepts with Memory Skills, and Attention Skills. Intervention group: CCRT N=51 Limited CCRT N=54. Control N=45.	Kaufman Assessment Battery for Children, 2nd edition (KABC-II), computerized CogState cognitive tests, the Behavior Rating Inventory for Executive Function (BRIEF), and the Achenbach Child Behavior Checklist (CBCL).	For severe malaria survivors, limited CCRT improved attention and memory outcomes more than full CCRT, perhaps because of the greater repetition and practice on relevant training tasks in the absence of the performance titration for full CCRT. There were fewer significant cognitive and behavior benefits for the non-malaria children, except for the planning/reasoning subtest of Conceptual Thinking, with stronger full- compared to limited-CCRT improvements persisting to one-year follow-up.	Computer software. Captain's Log® by BrainTrain. Captain's Log® is a comprehensive set of computerized cognitive training program.

22	Home	6 months. A mobile-based mental health, peer support intervention in which Kenyan ALWH were provided with smartphones and encouraged to participate in group chats using the WhatsApp® platform. Participants (N = 30) were provided with a smartphone with the WhatsApp® application preinstalled, a SIM card, and phone credit (* 7 USD per month). ALWH enrolled in the study were placed in 1 of 2 WhatsApp® groups based on their age, either a group for 9 to 14-year-olds or for 15- to 19-year-olds. Each group had 15 study participants at baseline. A trained pediatric HIV adherence and disclosure counsellor facilitated the WhatsApp® groups according to a structured curriculum to encourage positive support between members, to introduce weekly group discussion topics, and to answer participants' questions. Weekly group discussion topics were informed by formative qualitative work with this cohort, as well as a multimedia curriculum developed previously by this research team that has modules on stress management, drug and alcohol abuse prevention, intimate relationships, and issues related to HIV adherence, disclosure, and stigma. Additionally, the WhatsApp chat platform remained open outside of the structured modules to allow for natural communication among participants, and these conversations were monitored by the study counsellor. In addition, the counsellor contacted individual participants via direct WhatsApp® messaging every other week throughout the duration of the study period. Participants could contact the study counsellor individually on an unscheduled, as needed basis in the same manner. Study participants were assigned a pseudonym to use during the WhatsApp® discussions to protect their privacy.	Not applicable.	Qualitative analysis of WhatsApp® chat discussions identified a gap in HIV knowledge, high medication-taking literacy, need for mental health support and significant barriers to adherence.	Apps. WhatsApp. WhatsApp group messaging.
23	Not specified, home and life space	One-year study. 48 Participants were provided with the meditation app (M-App) which was developed in consultation with two meditation training experts, two app developers and two geriatric social workers based in Mumbai and Pretoria respectively. The M-App had short videos, voice-guided instructor learning sessions, and self-practice component. Short videos were lecture demonstrations and instrumental music to facilitate stillness and centering as integral to the meditation repertoire. 48 participants were in a waitlist control group and given access to leisure app (L-app) with informative learning games, documentaries and music videos.	Maslach Burnout Inventory (MBI) and Connor–Davidson Resilience Scale (CD-RISC).	Results indicated that chaplains who used the M-App exhibited less emotional exhaustion and depersonalization as burnout markers and higher personal achievement and resilience as compared to leisure app (L-App) users.	Apps. M-App. Smartphone meditation app.

24	Clinic	The study had an 8-week timeframe. The study had two stages for each participant (N = 61). Participants were fitted with a new TT socket fabricated using the 3DPA toolchain and then remained at the clinic for up to 2 weeks for rehabilitation and oversight. Participants then went home with their 3D-printed device and after 4 weeks, returned to the clinic and completed the PEQ for assessment purposes. In stage 2, participants were given a new TT socket manufactured using the ICRC methodology. After 4 weeks at home with their ICRC device, participants returned to the clinic and completed the modified PEQ for a final time.	Post intervention Likert ratings on a modified Prosthetist Evaluation Questionnaire (PEQ) to measure efficacy	Data from the Tanzania Training Centre for Orthopedic Technologists (n = 10) indicated that their users rated ICRC devices significantly higher in categories measuring stability, including ability to walk, walking up steep slopes and stairs, walking on slippery surfaces, overall fit, comfort while standing, and texture of the device. In contrast, participant data from Comprehensive Rehabilitation Services in Uganda (n = 25), Cambodian School of Prosthetics and Orthotics (n = 10), and Comprehensive Community Based Rehabilitation in Tanzania (n = 16) showed no significant differences across all measured outcomes.	3-D printing. 3DPA device. 3D printer.
25	Home	This study developed a video-based home exercise program (VHEP) for stroke survivors. The exercise instructions were presented in the Yoruba language. Each exercise was demonstrated for five minutes on video for a total of 30 minutes. Each imitated the VHEP twice per week for two weeks and thereafter completed a feasibility questionnaire.	The feasibility testing involved ten consenting chronic stroke survivors.	Most participants liked the novel use of Yoruba as the language of instruction on VHEP. The VHEP was found feasible and acceptable. Video based home telerehabilitation for stroke survivors therefore has the potential to meet the growing need for telephysiotherapy in resource limited settings.	Video-based home exercise program (VHEP). Video.

SECTION C: Implementation determinant (according to CFIR), Results regarding the implementation determinant, Facilitators of implementation of digital rehabilitation, and Barriers of implementation of digital rehabilitation

STUDY #	Implementation determinant (CFIR)	Results regarding the implementation determinant	Facilitators of implementation of digital rehabilitation	Barriers of implementation of digital rehabilitation
1	Effectiveness and cost-effectiveness	In patients with TB, MERM-observed therapy was associated with higher HRQoL and lower catastrophic costs compared with standard directly observed therapy (DOT). Patient-centered digital health technologies could have the potential to overcome structural barriers to anti-TB therapy.	TB clinics in the study already had computers in use prior the study. The MERM software was set up on computers that had already been in use in TB clinics or similar facilities to understand the sustainability of the intervention in a broad sense. Circumstances that encourage use of digital solutions such as pressure to avoid structural barriers to therapy adherence, including catastrophic costs and income losses resulting from transportation, food, and accommodation for in-person directly observed therapy (DOT). Instructions for the participant were given in a leaflet with patient-friendly explanatory graphics prepared in the national language that outlined the procedures.	Not assessed.

2	Acceptability and Feasability	Participants reported overall positive experiences and indicated that the platform encouraged peer network development. They endorsed potential benefits for treatment adherence, stigma reduction, and mental and behavioral health. All participants supported intervention expansion. In western Kenya, WhatsApp ® was an acceptable and feasible platform for mobile counselling and peer support for ALWH.	Not assessed.	Not assessed.
3	Acceptability and Usability	Difficult to implement based on listed barriers; however overall, the participants were satisfied with the main features of the web platform and stated that they would use it again (95%). However, there was not a significant change in knowledge and behavior, but adherence intentions after 3 months intervention period have improved	Use of volunteers. More than 50% of study participants during a 1.5-month usability assessment reported a need for help using the ELIMIKA platform. To address this issue, ELIMIKA peer volunteers aided the participants with platform use. The peer volunteers (aged 15-24) who were on ART treatment were used to sensitize youth to visit the platform and access information and adherence counselling services from health professionals. The volunteers actively participated in the implementation of the intervention activities as well as helping to manage the digital platform, e.g. writing posts and starting the discussions. The team of volunteers had monthly meetings to review the progress in development and implementation of the web activities.	Lack of money for the internet, no permission to use smartphones in schools and low internet literacy. Short implementation time. The exposure of young people to the intervention was only 3 months (planned – 6 months) due to logistical and financial limitations, longer development time of the web-based platform and slow recruitment.
4	Acceptability	Participants found the anonymity, privacy and accessibility of iCBT appealing, believing this facilitated use of the intervention and overcame stigma associated with accessing traditional campus counselling services. The intervention was helpful and facilitated self-disclosure, emotional expression, self-awareness and skill acquisition. However, students also reported disappointment with the lack of human contact and immediate responsiveness, articulating an expectation that the e-intervention would mimic face-to-face psychotherapy	not assessed	not assessed

5	Acceptability, feasibility	Evidence in this process evaluation of the Insaka intervention suggests that the intervention is both feasible and acceptable: Findings from this study suggest that mobile phone support groups are an acceptable and feasible means of delivering psychosocial support to adolescent pregnant women living with HIV in Zambia. The feasibility of the intervention was facilitated by a number of factors: First, it was feasible to recruit from the antenatal clinics due to the intervention's alignment with the existing standard of care that participants were receiving and their regular attendance. Second, the intervention was technically feasible because participants were able to use the platform, even if their literacy levels or English language skills were poor. The speech-to-text and spell check functions facilitated such interaction. The intervention was sufficiently flexible, so women were able to access support despite their complex lives. The acceptability: First, the anonymity of participants made it easy for them to communicate openly and reduce the burden of stigma. Second, the peer-led structure of the social support groups was an important factor in acceptability as it encouraged a democratic and unintimidating space for women.	Digital device supplied: Participants were given a mobile smart phone device (ITEL 1503 mobile devices, running the Android 4.4 KitKat® operating system) which was kiosked (the interface did not have other apps on them) and had pre-loaded mobile data. The device provided added possible improvement to participants' technological literacy: During the focus group discussion, a participant expressed that they had no prior experience with touchscreen devices but learned to use one through Insaka. Another participant noted that they improved their ability to write messages in English and spell words correctly, aided by the spell-check and speech-to-text features. Participants reported finding the platform "not hard to use". Anonymity: The participants' anonymity facilitated open communication, allowing them to freely discuss the issues affecting their lives and was critical to overcome the burden of stigma on people living with HIV. The peer-led structure of the social support groups played a key role in their acceptability, as it fostered an inclusive and non-intimidating environment for women. Peer motivation: Over the course of the groups, rules of engagement were implicitly established and explicitly enforced by participants, when participants were not engaged, they would address their peers directly, asking where they were, why they were not participating. Motivated and active rehabilitation staff in most groups and small size of virtual groups of 6-8 people supported participation: active facilitation of the groups led to more intimate displays of social support. Participants stated that they enjoyed the groups because they felt free to ask questions about a wide variety of topics. Participants enjoyed the small group setting and had feelings of getting to know each other on a personal level and making friendships within the groups. Social support experienced during intervention supported active par-	Reasons for participants not returning to the groups after recruitment included tensions with their partners about taking part in the project, poor literacy levels and technological issues: Twenty-nine percent of those recruited in the study could not participate due to relational, technological and literacy barriers. Technical issues/ repairs on the phone: Participants were frustrated when "the phones would delay coming back when they go for repair". Attitude of staff, inactive group members, not all groups had very active facilitators and other group members were not active or not commenting on the initial topic which led to that topic remaining superficial.

			ticipation. The support groups served as a valuable source of reliable information on pregnancy, child health, and HIV. Discussions were guided by peer mentors and guest speakers, who provided insights into HIV-related topics. Need for a digital easy-to-access service due to significant barriers to attending face-to-face counselling or support groups including time limitations - due to employment or caring responsibilities in the household, a lack of space in health facilities, a lack of funds for transport, the coercive control of male partners, stigma preventing mobility or social distancing regulations. Mobile phone-based interventions can help individuals overcome obstacles to accessing essential social and psychosocial support. The everyday challenges that may hinder women from attending an in-person support group can be addressed through a mobile phone-based platform. The intervention was flexible enough to allow women to receive timely and personalized psychosocial support from both peers and professionals, even amid their complicated lives. Tailoring the service design: participatory design workshop was held, and participants shared their social support requirements, challenges in accessing services, and technology usage behaviors. The insights gathered were then utilized to tailor the mobile phone support group model to better suit the needs of this population: Using a digital messaging platform instead of SMS, the implementation of a smartphone, the integration of a core curriculum covering maternal and child health, intimate partner violence, and pregnancy, the involvement of trained peer support workers (who were also young women) as facilitators, and the emphasis on recruitment within antenatal clinics.	

6	Effectiveness	On a scale of 8, the mean medication adherence level for the intervention group was 6.90 (SD ± 1.34) while that of the control group was 6.87 (SD ± 1.32) with no statistical difference (P = .88). The adjusted mean change in the medication adherence level was 0.02 (0.33 to 0.43) with no significant difference (P = .79). There was however a low level of adherence to dietary recommendations (1.52 ± 1.62), and physical activity (1.48 ± 1.58) at baseline, and both groups demonstrated a nonsignificant increase in dietary (P = .98) and physical activity adherence (P = .99) from baseline to the follow-up period.	Not assessed.	Not assessed.
7	Effectiveness	There were significant changes in social cognition (YSQ-SF T0–T1–T2, X2 = 9.69, p = 0.008) and loneliness levels (total loneliness T0–T1–T2, X2 = 14.62, p = 0.001), and an increase in WhatsApp usage (T0 = 26% vs. T1 = 60%, X2=15.22, p = 0.019). At 1-month follow-up, even with a significant reduction in WhatsApp usage, a significant reduction in loneliness was maintained. It is recommended that residential care facilities implement measures to facilitate residents' positive cognitive appraisals of relationships and contexts such as regular psycho-education sessions. It is further recommended that the study is repeated with a larger sample, over for a longer period, possibly six months, and involves community dwelling older people. This should be conducted in Africa, where there is a paucity of comparable loneliness studies. In addition, further studies on the development of trust among older people could result in a measure to increase enrolment in intervention programs targeting loneliness	Not assessed.	Not assessed.
8	Effectiveness and cost-effectiveness	The mean cost estimates of TBMT and CBMT interventions per person were 22,200 naira (US $61.7) and 38,200 naira (US $106), respectively. QALY gained was 0.085 for TBMT and 0.084 for CBMT. The TBMT arm was associated with an additional 0.001 QALY (95% CI 0.001 to 0.002) per participant compared with the CBMT arm. Thus, the ICER showed	Not assessed.	Not assessed.

		that the TBMT arm was less costly and more effective than the CBMT arm. This suggests that the implementation of TBMT could help to overcome barriers to access to physiotherapy services, particularly in low-income countries such as Nigeria, thereby improving the health outcomes of patients in these countries.		
9	Effectiveness	The study concluded that GIAI was significantly effective in reducing depression among university students in the treatment group compared to those in the usual-care control group. Therefore, educational technologists, counsellors, psychologists, health workers, and other social workers should adopt educational intervention using GIAI in helping university students undergo depression reduction.	Digital intervention can support the challenges: University students experiencing depression are hesitant to seek help due to challenges such as scheduling conflicts with regular school hours, financial limitations, low motivation, and anticipated delays in accessing intervention. Selected participant group might have acted as a facilitator: educational technology students may prefer/are more motivated towards internet intervention since the internet is part of their curriculum. Presumably this group has good technical and literacy skills and are well-acquainted with the use of internet.	Not assessed.
10	Effectiveness/Attitude	Retention was high at the end, with 75.7% (112/163) of intervention group participants and 83.4% (126/161) of control group participants active on treatment. HIV-related knowledge was significantly better in the intervention group at endline, but no statistically significant differences were found for ART adherence or social support. Intervention group participants overwhelmingly reported that the intervention was useful, that they enjoyed taking part, and that they would recommend it to other YLHIV.	Easy-to-use aspect was reported, 80 % reported connecting via Facebook very easily. Funding was enough to cover the smartphone and data: All study participants received a smartphone (valued at US $65) and a monthly data bundle (US $3.5 equivalent to 1 gigabyte of data) for the duration of the intervention. Most participants felt the Facebook platform was acceptable, reporting that the “secret” groups ensured their privacy, and the web-based format allowed them to interact with the group at their convenience and without the need to travel. Social support from facilitators and other group members. Participants described receiving encouragement and advice, having people to “share my feelings with” or “someone to talk to,” and	Recruitment lagged, taking more than twice as long as planned because YLHIV enrolment in ART was substantially lower than estimated using HIV service data before the study. Slow enrolment prolonged the time necessary to enroll enough intervention participants to form a support group in many cases. Thus, participants contributed different amounts of time to the study, and some intervention group participants waited months before their support group could begin.

			receiving answers to factual and personal questions. Participants stated they felt a sense of connectedness with the group which was strengthened by having group members of the same age range and HIV status. Most participants reported not having social support outside the intervention due to fear of stigma. Social and interactive elements of the intervention, such as riddles posed by the facilitator, received positive feedback from participants.	
11	Attitude/Motivation to use	Patient experiences with this online screening test were positive and, together with motivational engagement, were rated as time-efficient, valuable, and supporting continuation with HHC.	Low costs of online parts of the intervention; web-based hearing screening and motivational engagement were free. The therapeutic relationship had already commenced before the face-to-face appointment and was continued through the patient's HHC journey with the same clinic audiologist either online or in-person. Most patients agreed or strongly agreed that the online phases of the hybrid intervention were simple to complete, quick and informative and easy to use. Positive experience and high patient satisfaction with hybrid clinic with synchronous and asynchronous modes of communication. WhatsApp messaging was highly acceptable, and patients were satisfied with this mode of communication.	Reasons for patients not continuing with HHC (11/18, 61%) included high cost of the hearing aid equipment as a prohibitive factor (7/18, 39%), concerns regarding the stigma of wearing hearing aids (3/18, 17%).
12	Effectiveness, Cost Effectiveness, Need	The intervention group had significantly better adherence rate compared to control group at 6th month and at 12th month follow up. Compared to the control group, the intervention group had significantly higher recovery rate, better quality of life, retention in treatment, was more cost effective and had high level of acceptance amongst clients	Intervention provision from lay health care workers under supervision of mental health specialists. Most patients living in poverty have cell phones with texting capability, access to treatment even in rural areas, and smartphones becoming more affordable. Tailored (rather than generic) informational messages and messages were non-obstructive, not sent too frequent and	Intervention was limited to only SMS and voice messages due to low connectivity in rural areas and low multimedia capability of most phones in low-resource setting.

			the contents were motivational and privacy preserving. High level of acceptance amongst the clients towards intervention.	
13	Costs, Cost-effectiveness	In the base-case (the most realistic cost estimate), the cost was US $3.57 per student to deliver Shamiri-Digital. Depending on the definition of clinically meaningful improvement, 7.1 to 9.7 students needed to receive the intervention for one student to experience a clinically meaningful improvement, which translated to a cost of US $25.35 to US $34.62 per student. Under a worst-case scenario (i.e., assuming the highest treatment cost and the strictest effectiveness definition), the cost to achieve clinically meaningful improvement was US $92.05 per student.	Not applicable.	Not applicable.
14	Effectiveness	Compared to the control, Shamiri-Digital produced greater reduction in adolescent depression symptoms in both the full sample (p = 0.028, d = 0.50) and a sub-sample of youths with moderate-to-severe depression symptoms (p = 0.010, d = 0.83) from baseline to two-week follow-up. The effects exceed the mean effects reported in meta-analyses of full-length, face-to-face psychotherapy for youth depression. There were no significant effects on anxiety symptoms, well-being, or happiness.	Use of stakeholder's facilities, intervention was completed in school setting, computers and internet provided by school: most such schools in Kenya have computers with internet connection. Content on intervention was designed to be as stigma-free as possible.	Availability of resources affected the number of participants per session, as only 18 computers were connected to the internet, the intervention was conducted in groups of 18 or fewer students.
15	Acceptability, Readiness, Satisfactory level	The acceptance level of participating clients for e-therapy services was high, however a few participants showed fewer acceptance levels. The outcome of the e-therapy readiness assessment showed that most of the therapists were ready to carry out e-therapy practices. 4 therapists were satisfied, 2 moderately satisfied and 2 therapists were not at all satisfied with the implementation due to different reasons. Majority of clients were moderately satisfied with the sessions (66,7 %) and rest (33,3%) were highly satisfied with the sessions.	Use of the combined method: Therapists combined synchronous and asynchronous methods during the intervention to aid optimum client acceptance and participation in the treatment process, this was necessary because some clients did not have access to the internet, a smartphone/laptop, plus illiteracy among some. The use of combined methods increased the feasibility of e-therapy interventions with several clients from different areas.	Own device needed: Participating client/caregiver must have a functional electronic device. Each method was associated with many challenges that constrained the e-therapy sessions, such as inconsistent audio, video use, lack of real-time information, poor technical operation affecting client's readiness and inadequate equipment. Note that the combined method was used to resolve some of these barriers and was very crucial in the Rwandan context because during the provision of e-therapy services some occupational therapists lost internet connection and others chose to use messages and

				phone calls instead of video calls, especially for those living in the remote/rural areas.
16	Innovation Relative Advantage	Linkage to care between 2 weeks and 8 months was 48.6% (88/181) in the intervention arm versus 45.1% (74/164) in the control (P=.52) and increased to 64.1% (116/181) and 61.0% (100/164) (P=.55), respectively, after the initial 8-month period. Moreover, youth aged 18 to 30 years showed a statistically significant 20% increase in linkage to care for the intervention group.	Funding: Installation of the SmartLink app was done with an Android install file and Wi-Fi dongle to allow installation at no data cost to the participants. Besides English the app was available in Zulu. Laboratory results given via the app were communicated in simple language and color coding was used to visualize the results. App icon made no reference do diagnose ensuring confidentiality and app security was modeled after local banking apps to ensure privacy and security of participants health data.	Funding: Device was not provided. Ineligible participants were excluded from the study if they had no active subscriber identity module card in their phone, no Android smartphone, or no data on their phone. It was discovered that the app could not be installed if the participant had insufficient RAM on their phone or if their Android version was too old (pre-version 4.2), so these parameters were also added to the exclusion criteria. SmartLink app worked as anticipated; however, the smartphone specifications required for installation excluded over 90% of candidates who volunteered to participate in the study.
17	Implementation process	Eight categories emerged including: 1) perceptions on facilitation, 2) using scientific and experience-based knowledge, 3) tailoring the intervention to need of target group (family-based), 4) supportive working culture, 5) barriers to the service delivery, 6) implementers' interaction with the intervention, 7) perceptions on motivations and values, and 8) improving the model and enabling sustainability. Mechanisms contributing to the implementation of the intervention included engaged facilitators and motivated participants. Challenges in client recruitment and poor dissemination of information were some of the mechanisms impeding the implementation.	Engaged and strong facilitation by highly motivated participants, tailoring the intervention to local preferences (person centeredness was adapted to family-based), integrating relevant research-based knowledge into practice, therapists value innovation; supportive working culture, motivation of clients and therapists; information about the benefit of the innovation	Client recruitment faced issues due to high mortality and not getting access to health care facilities due to lack of engagement, support and knowledge among local colleagues or other medical personnel. Factors influencing the implementation process included dishonesty and non-compliance by clients and family members as well as doubts about how beneficial the research would be, at times the phone airtime was used for other purposes than the intervention by family members or clients. Challenges occurred when conducting follow-ups, at times phones were switched off, family members who handled the phone had travelled or there was a network failure. Challenges with technical skills, more support would have been needed to handle monitoring of SMS sending. Unexpected server breakdown and the fact that international SMS might have been blocked by local teleoperators in

				Uganda (a server in Sweden was used). SMS format was not defined before commencing the intervention created challenges, participants found it unclear how the SMS message should look like. Technical skills of the clients, participants found it difficult to explain in the local language how to send SMS. Limited number of letters per SMS; the clients were using their own devices since stroke could be expected to cause issues in adapting to using new technology, and technical restrictions appeared when not using smartphones since the targets formulated were required to fit in the SMS function with a limited number of letters.
18	Advantage of innovation, costs, feasibility	The findings from this feasibility study may be seen as initial positive indicators that audiological rehabilitation of disabling hearing loss could be administered using a hybrid model in a low-resourced context. Key findings of this study included (1) a high compliance rate (84.82%) with minimal clinician contact time at 3 h 25 min over 5–6-weeks; (2) improvement in perceived hearing aid (HA) benefit, and improvement in listening skills; (3) reported positive experiences; and (4) minimal programme costs at an average of R1350.00 per participant	The high compliance rate in this study may be attributed to the hybrid tele-audiology model used where there was regular clinician support. This is an important finding to consider as it implies that tele-rehabilitation should not fully replace clinician contact; in fact, clinician contact (through a hybrid model of delivery) is pertinent to positive patient compliance.	Study required participants to have access to an Internet-capable device, no devices or data were provided.
19	Feasibility. User satisfaction was examined in the research.	A significant majority of the participants expressed satisfaction with this medium of rehabilitation service delivery.	Positive attitude towards intervention, all the subjects stated that they would use tele-intervention in the future.	Internet connectivity and inadequate stability of streaming of the audiovisuals was the biggest obstacle. Some of the subjects had to do some exercises without the streaming.

20	Effectiveness	The study indicates that patient education through a social network has a positive impact on knowledge on diabetes and reduction of acute complications in young patients living with T1D in sub-Saharan Africa. In the short-term, there is no positive effect on glycemic control but further studies on long-term effect need to be done, especially in the context of low physical access to health care facility.	Selecting intervention technology according to the interest of the focus group: Teenagers and young adults are the biggest consumers of social networks.	Android phones were not provided to patients, study only recruited participants with own phones: this might have caused selection bias. This also explains the small size of the sample.
21	Effectiveness	Severe malaria survivors receiving limited CCRT intervention were significantly better than the passive control arm on KABC-II Mental Processing Index (MPI; composite of all cognitive domains), sequential processing (working memory), and the Conceptual Thinking subtest from the planning global domain, which is a measure of executive function and reasoning.	Language considered: Research assistants supervised the computerized CCRT training program, translating any screen instructions in English by speaking to them to the children in the local language (Luganda). Convenient, easy and private for participants to take part in the training: Training was done in a quiet setting near the child's home after school so as to avoid bringing unnecessary attention to the child and possible stigmatization by classmates, or disruption of training by distractions and interruptions in the home environment.	Not assessed.
22	Need	Kenya has high rates of mobile phone usage. No need to worry about device or data: Participants were provided with a smartphone with the WhatsApp® application preinstalled, a SIM card, and phone credit (* 7 USD per month). Privacy: Study participants were assigned a pseudonym to use during the WhatsApp® discussions to protect their privacy.	Kenya has high rates of mobile phone usage. No need to worry about device or data: Participants were provided with a smartphone with the WhatsApp® application preinstalled, a SIM card, and phone credit (* 7 USD per month). Privacy: Study participants were assigned a pseudonym to use during the WhatsApp® discussions to protect their privacy.	One participant did not complete the study due to barriers (not specified) experienced at boarding school that made it difficult to fully participate in the intervention.
23	Effectiveness	Results support the initial hypotheses. Chaplains working in hospices for older adults who used the M-App exhibited less emotional exhaustion and depersonalization as burnout markers and higher personal achievement and resilience as compared to LApp users	Not assessed.	The participants from the intervention group were not showing up to follow-up due to lack of interest. Also, long intervention duration: several intervening and unknown factors emerge in a fairly long-term intervention.

24	Effectiveness	Overall, results were promising for the use of 3D-printing technologies to produce TT sockets in LICs. Very few devices were reported as loose, damaged, or broken. In addition, results from the ambulation, utility, residual limb health, and wellbeing portions of the PEQ showed similar ratings for both 3DPA and ICRC devices. Significant differences between technologies were observed, but these results varied between clinics. ICRC manufactured devices were rated significantly higher within the ambulation section's questions for ability to walk, ability to walk up and down stairs, ability to walk up and of device use per week. This ultimately resulted in an overall higher ambulation category rating for ICRC devices.	Cost and resources: the cost of production of a single 3DPA TT device is lower than a comparable ICRC device. These savings are attributed to a decrease in manual labor time during device alignment and fabrication that are performed in silico and by unattended 3D printers, respectively. Most importantly, the time-cost savings allows prosthetists to focus on other clinical duties, such as creating more devices and providing care for more patients.	Results indicated that 3DPA devices were returned with a "loose fit" more often than ICRC devices (11.48% vs. 6.56%), had a greater incidence of minor damage (3.29% vs. 0.00%), and a greater incidence of being broken (6.56% vs. 0.00%). Study hypothesizes that these incidences of device damage and/or failure were due to a combination of printer limitations, specifically small layer heights, and user unfamiliarity with ideal geometries for 3D printing.
25	Feasibility and acceptability	The participants all affirmed that the video information was presented in an understandable manner, and that the intervention was relevant to their current needs.	Attitude: The participants were cooperative.	Some precautions should be considered. Over half of the stroke survivors reported only moderate confidence in using the intervention.

Appendix 2. Critical appraisal summaries

Quality Assessment RCT Studies

Domains

D1: Bias arising from the randomization process.

D2: Bias due to deviations from intended intervention.

D3: Bias due to missing outcome data.

D4: Bias in measurement of the outcome.

D5: Bias in selection of the reported results.

Judgement

Low

Some concerns

High

To summarize the results of RoB assessment by domains, for the random allocation domain 8/10 (80%) studies had a low RoB and 2/10 (20%) had some concerns RoB. For the second

domain (bias due to deviations from intended interventions) 5/10 studies had low RoB, 4/10 had some concerns and one had high RoB. For the missing outcome data domain 9/10 (90%) had low RoB and 1/10 (10%) had high RoB. In the fourth domain (bias due to measurement of outcome) 8/10 (80%) studies had some concerns and 2/10 (20%) low RoB. In the last domain (selection of the reported results) 9/10 (90%) of the studies had low RoB and 1/10 (10%) had some concerns. Overall, the result of RoB assessment was highly impacted by the results of domain 4, which is explained by the aspect that due to the nature of the selected studies the outcome assessors were the participants, and this ended up lowering the overall assessment of the RoB.

Quality Assessment Mixed Method Studies

	Chory et al. (2021)	Simpson et al. (2021)	Terio et al. (2019)	Khatib & Hlayisi (2022)
Q5.1.	N	N	N	Y
Q5.2.	N	N	N	Y
Q5.3.	N	N	N	N
Q5.4.	Y	Y	Y	N
Q5.5.	Y	N	N	N

MMAT items: Y= Yes; N = No; N/A = Not applicable in this study; - = Can't tell based on the article

Q5.1 = Is there an adequate rationale for using a mixed methods design to address the research question?

Q5.2 = Are the different components of the study effectively integrated to answer the research question?

Q5.3 = Are the outputs of the integration of qualitative and quantitative components adequately interpreted?

Q5.4 = Are divergences and inconsistencies between quantitative and qualitative results adequately addressed?

Q5.5 = Do the different components of the study adhere to the quality criteria of each tradition of the methods involved?

The Quality assessment was performed by using MMAT tool. In 3/4 of the studies, the reasons for conducting a mixed method study were not clearly explained and the components of the

studies were not effectively integrated to answer the research question. In none of the studies it was described about the interpretation of the combination of the quantitative and qualitative results and the data was analyzed and interpreted separately. In 3/4 studies there was no divergence in the data, or the divergences were addressed properly. Only in one of the studies' the quality of the qualitative and quantitative components were measured to be high and for the rest of the studies the quality of both components was not possible to be measured as high quality. All and all, none of the studies were excluded from the analysis based on the MMAT checklist.

Critical Appraisal Checklist for Qualitative Research

	Gericke et al. (2021)	Chory et al. (2021)
Q1.	Y	Y
Q2.	Y	Y
Q3.	Y	N
Q4.	Y	Y
Q5.	Y	Y
Q6.	N	N
Q7.	N	N
Q8.	Y	Y
Q9.	Y	Y
Q10.	Y	Y

JBI Critical Appraisal Checklist for Qualitative Research items: N = No; U = Unclear; Y = Yes

Criteria for the critical appraisal of qualitative evidence:

Q1 = Is there congruity between the stated philosophical perspective and the research methodology?

Q2 = Is there congruity between the research methodology and the research question or objectives?

Q3 = Is there congruity between the research methodology and the methods used to collect data?

Q4 = Is there congruity between the research methodology and the representation and analysis of data?

Q5 = Is there congruity between the research methodology and the interpretation of results?

Q6 = Is there a statement locating the researcher culturally or theoretically?

Q7 = Is the influence of the researcher on the research, and vice- versa, addressed?

Q8 = Are participants, and their voices, adequately represented?

Q9 = Is the research ethical according to current criteria or, for recent studies, and is there evidence of ethical approval by an appropriate body?

Q10 = Do the conclusions drawn in the research report flow from the analysis, or interpretation, of the data?

Using the JBI Critical Appraisal Checklist for Qualitative Research, Gericke et al. (2021) study was appraised with a score of eight questions answering “yes” and two “no” to the quality criteria questions. Respectively following the appraisal checklist Chory et al. (2021) study was appraised with a score of seven questions answering “yes” and three “no” to the quality criteria questions. In both studies there was congruity between the stated philosophical perspective and the research methodology, research methodology and the research questions and research methodology and the interpretation of results. The congruity between the research methodology and the methods used was there in the Gericke et al. (2021) study but was missing in the Chory et al. (2021) study. Reviewing the studies, it was discovered that either of the studies did not include statements locating the researchers’ cultural or theoretical position, or the influence of the researcher on the research, which affected the assessment of determining the level of the quality of the studies. Both selected studies were assessed to be of moderate to high quality as the score ranged between 5 and 10 on the JBI Critical Appraisal Checklist for Qualitative Research. Therefore, neither of the articles were removed from this review due to lack of quality.