Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

# Exploring the Perceptions of Health Professionals towards Digital Health Hubs in Ethiopia: A Qualitative Study

**Ayenew Sisay Gebeyew**

ayu.uog@gmail.com

Debre Markos University

**Aynadis Worku Shimie**

Debre Markos University

**Abraham Keffale Mengistu**

Debre Markos University

**Bayou Tilahun Assaye**

Debre Markos University

**Gizaw Hailiye Teferi**

Debre Markos University

**Mitiku Kassaw Takillo**

Debre Markos University

**Muluken Belachew Mengistie**

Debre Markos University

**Andualem Fentahun Senishaw**

Debre Markos University

**Sefefe Birhanu Tizie**

Debre Markos University

**Research Article**

**Keywords:** Health hubs, digital, qualitative study, Ethiopia

**Posted Date:** November 12th, 2026

**DOI:** https://doi.org/10.21203/rs.3.rs-11358491/v1

**License:** This work is licensed under a Creative Commons Attribution 4.0 International License. Read Full License

**Additional Declarations:** No competing interests reported.

## Abstract

# Background

The transformation of healthcare information is rapidly shifting toward implementing digital health hubs that can effectively manage healthcare data. However, in resource-constrained settings, some healthcare organizations have limitations in fully implementing digital health hubs. In addition, the perceptions of health professionals towards digital health hubs were unexplored. Therefore, understanding health professional perceptions is essential for handling healthcare data effectively and efficiently using digital health hubs.

# Methodology

: A qualitative study was conducted at public hospitals in East Gojjam. Semi-structured interviews were used to obtain in-depth information on digital health hubs. A purposive heterogeneous sampling technique was used to select health professionals. Ten semi-structured interviews were conducted from July to August 2024. Using OpenCode software version 4.2, the data were coded and analyzed thematically.

# Results

Using an inductive approach, three main themes were identified: perception of health professionals toward digital health hubs, challenges related to digital health hubs, and alternative solutions. The findings reveal that while health professionals hold a positive outlook on the benefits of digital health hubs, it is compromised by a lack of functional digital literacy, technical problems, and infrastructure gaps. The theme of challenges related to digital health hubs has three subthemes. There are technical problems, human resource issues, and logistical constraints. These challenges shall be addressed by the three subthemes of alternative solutions, such as providing continuous training, management support, and digital infrastructure.

# Conclusion

This study finds that health professionals have positive perceptions of digital health hubs, shaped by prior digital experiences and the availability of current digital information in resource-constrained settings. However, technical issues, human resource problems, and limited logistics, such as digital infrastructure, might also be considered bottlenecks to improve health professionals' perceptions further. Therefore, responsible bodies should develop interventions informed by these practical insights to improve health professionals’ perceptions of digital health hubs.

## Introduction

Digitization in healthcare started in the 1960s in California by integrating computer applications into hospital settings[1]. Over the years, by using advanced technologies, routine healthcare activities have

transitioned into digital health with the aid of artificial intelligence and advanced digital wearable and wireless devices [2]. Digital health hubs are one of the growing healthcare technologies in the industry that can facilitate routine healthcare activities [3]. The intensity of healthcare information is radically increasing in healthcare settings[4]. Hence, healthcare information is stored and presented in a disintegrated manner. Consequently, health information requires leveraging digital health hubs to coordinate healthcare information to improve patient care and health outcomes[4, 5]. Digital health hubs aid healthcare providers by combining patient-generated data, practice-generated information, and other medical information to make informed decisions. Therefore, a digital health hub is a platform to store healthcare information and facilitate secure and prompt exchange of information between health professionals and their support networks using digital devices[6, 7]. ]. This is done after integration of each healthcare unit or digital health hub. Hence, the World Health Organization (WHO) require digital health hubs to achieve the aim of Sustainable Development Goals, particularly Goal 3, to improve health [3, 8]. For that matter, resourceful healthcare organizations have transformed healthcare practice from paper-based to digital systems [3, 9]. Currently, digital health provides a unique opportunity to deliver sustainable, effective, and high-value healthcare in a variety of settings and integrate different levels of healthcare organizations [3, 9]. As a study shows, digital health technologies such as smartphone applications, wearable devices, telemedicine, personal health records, electronic medical records, advanced computing sciences in big health data, genomics, and artificial intelligence have identified areas for the development of digital health[10].

According to the literature, digital health provides encouragement and the ability to self-manage patients with chronic conditions [10]. However, there are different constraints regarding the development of digital healthcare. Previous research revealed that issues related to data quality, evidence-based care, resources, and digital literacy were barriers to providing effective care in health settings[11, 12]. Other research found that access to digital health services was hampered by a lack of support and training, a lack of suitable devices, fears, and a lack of trust regarding digital platforms [13]. However, digital health and remote care are welcomed by health professionals [14], their perceptions were influenced by digital health adoption and opportunities for education and orientation [15].

Based on the WHO Global Strategy on Digital Health, healthcare digitization has begun in resource-limited settings[16]. A systematic review in the African context showed that adoption of digital health technologies has commenced in maternal and child health, infectious and non-communicable diseases, dermatology and surgery, and general health conditions [17].

However, despite growing digital health adoption in resource-constrained areas, there are gaps in achieving full healthcare digitization [3, 18]. A scoping review conducted in Africa, including Uganda, South Africa, and Kenya, showed that the practical applications of digital health are limited due to limited technical capacity, fragmented infrastructure, and inadequate regulatory support [19]. A study from Nigeria identified issues with electricity, lack of internet connectivity, use of obsolete digital technology, inadequate training, and staffing shortages, as challenges of digital health implementation [20]. Similarly, in South Africa, many digital health applications are in use, but there is poor integration of workflow and healthcare data, resulting in issues with digital health apps[21]. A scoping review on the adaptation and implementation of open-

source electronic health records (EHRs) in low- and lower-middle-income countries indicated that limited funding, sustainability, infrastructure, data privacy, and protection emerged as significant issues [22].

In Ethiopia, digitization was launched in 2016 to provide paper-free services through a digital or data-driven system[23, 24]. Currently, more than 100 hospitals are shifting from paper-based to digital systems[25]. The Minister of Health has introduced healthcare digitization to transform healthcare practice from paper-based to a digital system [4, 17]. Furthermore, electronic systems, such as SmartCare, electronic medical records, laboratory information systems, radiology information systems, pharmacy information systems, and the district health information system (DHIS2), have been implemented in each department. This aids in expanding the digital system using digital health hubs in healthcare organizations.

However, healthcare digitization has been running; most of the healthcare organizations have not started well throughout the country. Hence, there is a limitation of exploration studies regarding the perceptions of health professionals towards digital health hubs

Therefore, the main objective of this study was to explore health professionals' perceptions of digital health hubs in resource-limited settings in Ethiopia. The focus is on the lived experience of health professionals' perceptions about digital health hubs. Hence, the study aimed to uncover context-based insights to inform responsible bodies of digital health experts to guide basic digital health strategies and provide recommendations regarding intervention areas of digital health practice. Hence, based on the objective, the study had two main research questions. 1) How do healthcare professionals perceive digital health hubs? 2) What are the factors that influence healthcare professionals' perceptions of digital health hubs? The aim of the study was to address gaps in the development of digital health hubs and to inform future initiatives in digital health implementation in resource-limited settings.

# Methods

Study Design

Semi-structured interviews were used to obtain in-depth information on digital health data hubs. Qualitative thematic analysis was used, and the Consolidated Criteria for Recording Qualitative Research Checklist was used to guide the reporting of this study.

Setting

The study was conducted in East Gojjam, Ethiopia, which is 296 kilometers from Addis Ababa. Eleven public hospitals in this area have been established, including primary, general, and specialty referral hospitals, and more than 2,000 healthcare professionals have served the community.

Questionnaire design

A semi-structured interview was selected as a suitable method for the healthcare setting [26]. Hence, the selected method was help to organize questions sequentially both in follow up questions and multiple prob questions.

## Interviews guide development

The interview guide was derived from the aforementioned literature [27, 28]. The authors provided some opening information on digital health hubs, and the interview was modified depending on the participant's response (File S1). The interview guiding questions were complemented by using follow-up and probing questions. The questions were structured using clear words in Amharic language, following an open-ended approach. Hence, the interviewees provided rich and in-depth information. The interview guide began with easy questions, such as asking about their lived experience of health professionals about digital health, and then moved into in-depth questions for more detail. The interview guide covered health professionals' perceptions of digital health hubs, and influential and limiting factors regarding digital health hubs.

## Recruitment and sampling methods

This study was conducted at the East Gojjam Public Hospitals from July to August 2024. More than two thousand health professionals were working in this study setting. The interviews were conducted at Debre Markos Specialized Referral Hospital, Motta General Hospital, Dejen Primary Hospital, Debre Eliyas Primary Hospital, and Debre Work Primary Hospital. Study participants were recruited using various steps. First, the study investigators provided the documentation of ethical approval letter to hospital administrators. Then, after establishing rapport with the hospital administrators, the administrators cooperated by providing a list of health professionals. Then, healthcare professionals were approached depending on their position level. Meanwhile, the investigators used selection criteria such as different professions, work experience, level of education, and experience with digital data tools to pick the key informants from candidate persons. By considering the criteria, the potential participants were finally selected for interview using purposive heterogeneous sampling.

Regarding the sampling procedure, the authors estimated that 10 to 20 interviewees would be needed to conduct the study, considering the scope of the research topics. However, the sample was determined by data saturation. Health professionals involved in digital health apps were included as inclusion criteria. On the other hand, language barriers, unwillingness to give informed consent, and those unable to participate in person were excluded. Selection bias was managed by considering the inclusion and exclusion criteria. Further, the participants varied in educational background, years of service, and familiarity with digital health technologies. Thus, this helped us manage bias during participant selection.

.

## Qualitative training

Interviewers were selected based on professional backgrounds and experiences in digital health. All interviewers have a master's degree in health informatics. This aided the interviewers, who were more familiar with the research topic of digital health hubs. Not only that, but the interviewers were experienced in qualitative studies. To minimize errors and obtain higher-quality information, qualitative training was provided to the interviewers regarding the objective of the research topics, data collection methods, and procedures.

Before conducting interviews, five interviewers were trained in building rapport, active listening, using probing questions to facilitate thick description, and data triangulation, such as using multiple data sources by gathering data at different times of the week, collecting data from multiple levels of healthcare organizations like primary hospitals, secondary and tertiary hospitals, and gathering data from different types of health professionals. Furthermore, investigator triangulation was carried out by involving more than two researchers from data collection to findings interpretation.

In addition, the trained investigators routinely revised the topic list and probe items when relevant during interviews. In addition, a mock interview was administered with the aid of supervisors, from which feedback was taken. This helped us facilitate ease of understanding and reduce bias before delivering the actual interviews. Moreover, training was ongoing throughout the data analysis.

Data collection procedure

Five investigators, ASG, SBT, AKM, MKT, and BTA, were selected to administer interviews. These investigators have a Master's degree in Health Informatics and data science. All are male and currently work as researchers and lecturers at Debre Markos University and are experienced in digital health research. The interviews were conducted face-to-face, with interviewers working closely to build rapport and obtain rich information. The interviews were conducted in their healthcare organizations in a safe and quiet environment to ensure smooth communication and clear understanding. From each interview, only one key informant interviewee and a minimum of two interviewers were involved. During the interview, no one was present except the participants and researchers. Field notes were taken during the interview. Subsequently, the investigators presented the purpose of the study to the participants, and audio was recorded using a smartphone. Each selected key informant participant was interviewed until all questions were completed. Finally, after transcribing the audio into text, feedback was taken from all members or participants for the verification process and no changes were requested by all participants. Here, the interviewer's assumptions were set aside to reduce interviewer bias. In the end, the recordings were deleted for the sake of data anonymity.

Sample size and data saturation

Initially, the authors planned to interview up to 20 key focal participants; fifteen participants were enrolled and were willing to participate in the interview. However, the sample size was determined by data saturation [29]. The authors used two main approaches to ensure data saturation. In the early stage, saturation was checked during data collection by evaluating the information gathered from each key informant interview. During this stage, the authors distinguished how much information was or was not replicated. The interviews continued until more than triple replication of the recorded information was achieved. These replications were checked throughout the interview. The second technique was saturation in the analysis stage. The authors used inductive thematic saturation to develop codes and themes. Then, more than two authors coded and developed themes from the transcribed information individually. Later, each code and theme was checked together. Finally, similarities and differences were checked; any differences were resolved through discussion. After participant (PID_10) interviews, no new codes or themes were generated.

Therefore, the authors ceased data collection after interviewing ten participants. Therefore, because data saturation had been reached, the remaining five participants were not interviewed. Most interviews lasted between 25 and 30 minutes, as the participants were constrained by time. There were no non-participants or refusals during the interview, and no repeat interviews were carried out.

### Transcription and translation

Transcription and translation were conducted by ASG, SBT, and BTA. The interviews were conducted and transcribed in Amharic. Subsequently, the transcripts were verified with the audio records. Then, the transcripts were translated into English. During translation, exact word meanings were checked between Amharic and English. Meanwhile, some words were corrected to give full contextual meanings.

### Coding procedures, analyst triangulation, and reflexivity

Three investigators, ASG, SBT, and BTA were selected to code the research data. First, a codebook was developed from the raw data using an inductive approach as a framework. The team checked the drafted codebook using a sample transcript. Based on that, the code names, code definitions, and inclusion and exclusion criteria were modified. Subsequently, the investigators coded the data independently. Later, the team came together to verify discrepancies and disagreements between the individual coders and the code rules. Finally, the points marked as disagreements were resolved and refined through team discussion. The analysis was conducted using OpenCode software version 4.2. To check the reliability of the code, inter-coder agreement was calculated using a double-coded subset. Cohen's kappa was used to measure reliability; Cohen's kappa agreement was 88%. This indicates that the coder agreements were highly related. Regarding triangulation of analysis, ASG, SBT, and BTA participated. Hence, they have close familiarity with digital health applications in healthcare settings and have conducted various studies in this area. Therefore, potential biases such as preconceived notions about the topics or study participants, emotional reactions during interviews, and listening to what the investigators expected to hear were addressed by providing training. To harness the reflexivity of the study, investigators routinely assessed the participants, interpersonal ideas, methods, and contexts using memos. Finally, no change was requested after sharing the findings with the participants.

### Theme development

After coding and reviewing all codes, patterns were created based on the shared characteristics of defined codes. Next, the main themes were developed after a detailed revision of the patterns. Specific and similar patterns were identified from the main themes to form subthemes, as shown in Table 1. Finally, the investigators checked that the themes and subthemes fit the data well through detailed revisions.

Table 1
Main themes, sub-themes and codes developed by inductive thematic analysis

| Main theme (Synthesis 2) | Subtheme (Synthesis 1) | Code |
|---|---|---|
| Perception toward digital health hubs (DHH) | S1: Positive perception | C1: Ease of using digital health hubs |
| | | C2: Have benefits to use DHH |
| | S2: Negative perception | C3: Perceive DHH as insecure |
| | | C4: DHH exposes sensitive data |
| Challenges of DHH | S3: Technical challenges | C6: User-friendly issues |
| | | C7: Maintenance issues |
| | | C8: Searching problem |
| | S4: Human Resource Challenges | C9: Limited experts in DHH |
| | S5: Logistic constraints | C10: Limited digital infrastructure |
| | | C11: Poor availability of budget |
| | | C12: Limited digital investment |
| Solutions for improving perception | S6: Facilitate technology-based healthcare training | C13: Providing digital training |
| | S7: Management Support & Building capacity | C14: Closely working with team |
| | S8: Provide digital infrastructures | C15: Provision of digital service |

Quality assurance

This study ensures the validity and reliability of the research findings as well as transferability to other digital health settings [30, 31].

The credibility of the study was assured by clearly describing each phase of the research, using triangulation techniques such as data triangulation by asking questions to health professionals from different backgrounds and investigator triangulation by involving more than two researchers. Investigators built good rapport with interviewers prior to beginning the main interview. This immersive approach helped to obtain deeper insights from participants honestly. Moreover, data sources like interviews and confirming the availability of digital health infrastructures were used to strengthen the credibility of the data. Subsequently, the collected information from diverse data sources was converged into themes. Further,

trustworthiness was assessed by verifying the findings from different angles and including the findings in the results section using quotations.

The transferability of the study was evaluated by presenting detailed contextual information, sampling methods, and criteria for participant selection that were clearly articulated and presented. The study findings were consistent with real settings and other studies in the same situations, as reviewed by peer academics. Finally, the confirmability of the findings was checked by the participants and reviewed by supervisors and colleagues. Key informant professionals were assured by observing their professional identification card and asking pre-questions before entering into the actual interview. Throughout the interview, the investigators took notes and asked the participant reflexive questions.

# Results

Overview

Ten interviews were conducted in East Gojjam Public Hospitals. Regarding the interviewees' characteristics, most of the participants were older than 30 years, four out of ten were female, and five out of ten held master's degrees as shown in Table 2.

Table 2
Participant characteristics of health professionals about digital health hubs in Ethiopia, 2024

| Participant | Sex | Age | Healthcare Facility | Department | Level of Education | Work experience in years | Used digital data storage |
|---|---|---|---|---|---|---|---|
| PID_01 | Male | 35 | Dejen Primary Hospital | Pharmacy | Master's degree | 10 | OneDrive<br>Google Drive |
| PID_02 | Female | 30 | Debre Markos Referral Hospital | Optometry | Bachelor degree | 3 | Dropbox |
| PID_03 | Male | 38 | Debre Work Primary Hospital | Health Informatics | Bachelor degree | 6 | Google Drive |
| PID_04 | Male | 35 | Debre Markos Referral Hospital | Laboratory | Master's degree | 6 | Google Drive |
| PID_05 | Male | 34 | Motta General Hospital | Public Health | Bachelor's in Nursing, Master's in Public Health, Radiology assistant experience | 5 | Google Drive |
| PID_06 | Female | 37 | Debre Eliyas Primary Hospital | Midwifery | Master's degree | 7 | Google Drive |
| PID_07 | Female | 28 | Debre Markos Referral Hospital | Midwifery | Bachelor degree | 4 | Google Drive |
| PID_08 | Male | 34 | Dejen Primary Hospital | Public Health | Bachelor degree | 5 | Google Drive |
| PID_09 | Female | 30 | Motta General Hospital | Health Informatics | Bachelor degree | 5 | Databox<br>Google Drive |
| PID_10 | Male | 32 | Debre Work Primary Hospital | Pharmacy | Master's degree | 6 | Databox<br>Google Drive |

Qualitative Findings

In-depth interviews were conducted for this study. Participants were selected from various healthcare-related departments. Prominent individuals from healthcare organizations, particularly those working in planning and monitoring, laboratories, pharmacies, public health, midwifery, health informatics, and optometry, were included. Following the collection of extensive information, inductive thematic analysis was used to arrange the information structure. Three primary themes were identified. The first theme was the perception of digital healthcare hubs by healthcare professionals. Second, there are challenges associated with digital health hubs, which had three subthemes. These were: 1) technical issues, 2) human resource issues, and 3) logistic constraints towards digital health hubs. The final theme was alternative solutions for improving health professionals' perceptions of the digital health hub, which had three subthemes:1) facilitate technology-based healthcare training, 2) provide management support and build capacity, and 3) provide digital infrastructure (Fig. 1).

Figure 1: Themes of Health Professionals' Perception Toward Digital Health Hub in Ethiopia, 2024

Theme 1: Health professionals' perception towards the digital health hub

The main theme of health professionals' perceptions of digital health hubs was distinguished into positive and negative perception subthemes. Hence, the subthemes' operational definitions were concurrently matched with the text code. The texts were coded and defined as positive when health professionals had positive thoughts towards digital health hubs, such as being ideal to use, easy to use, effective to manage health data, and having good opportunities for further development, and negative if health professionals had a negative perspective on digital health hubs. The use case description of the perceptions of digital health hubs is as follows.

Positive Perceptions indicates that health professionals thought that digital health hubs have benefits and opportunities to use, such as improving access and convenience, aiding personalized care, and providing efficient and quality services. Alternatively, negative perceptions represent how health professionals perceive digital health hubs as insecure, providing misinterpreted information, and leading to unreliable decision-making.

The research findings show that digital health hubs are a key aspect of advancing and streamlining medical record access in healthcare settings. Compared with manual-based systems, health professionals can obtain swift information about a patient's record that has been obtained from different levels of healthcare organizations. An interviewee said, "*… healthcare activities working previously using paper are shifting to digital systems so that health professionals have perceptions on digital health hubs"* (PID_1). As probing questions within that interview confirmed, health professionals have a positive outlook on digital health hubs. To support this, a pharmacy professional remarked that "… this *century is the digital time. Processes that were previously conducted on paper are now becoming digitalized. Hence, it saves time and makes it easier to find the information. Therefore, we are now entering a digital world. As health professionals, we have a lot of … perception of digital health*" (PID_1). This is because the key informants believe that the systems are easier and more beneficial for providing quality care than manual-based systems.

Furthermore, throughout their journey, health professionals have gained knowledge of digital health applications through education at colleges or universities and gaining experience from senior experts. Hence, as interviewees PID_1, PID_4, and PID_5 confirmed, health professionals have a positive perception of digital health hubs. A health informatics specialist working on planning and monitoring said, "*I think that all health professionals have been passing through schools and practicing with their phones. When they continued their studies at universities, they were exposed to digital applications and graduation research papers. Hence, they had a positive outlook on digital health platforms"* (PID_3). This statement emphasized that the perceptions stem from health professionals' previous exposures with practicing healthcare applications, such as mobile health apps, district health information systems, and electronic medical records during their educational journey. For this reason, health professionals have a positive outlook on digital health hubs.

Another influential element that contributes to positive perceptions of digital health hubs is the presence of adequate information on how easily and quickly the system can provide services to patients and other stakeholders. As probing questions within that interview confirmed that health professionals are actually close to accessing digital health applications. Furthermore, one participant suggested that "*…digital systems help us as a data exchange tool from the laboratory to other departments, to the physician, and so on. Therefore, it makes things much easier for the user. First, the results are delivered to patients at the right time. As I understand it, most of them are aware of this. I think they have a better perception.*" (PID_4). Their concerns stressed that timely access to healthcare information might facilitate informed decision-making. Furthermore, a person who was 34 years old remarked that "*… I think all health professionals have positive insight into digital health hubs. Hence, I do not think they will hesitate to use the system if the right conditions are created*" (PID_5).

Another crucial point raised by the participants was the significance of digital health hubs, which surpasses the current system of health care delivery. In the current system, there are problems with handling medical records. Most records in organizations are paper based. Hence, health professionals waste time searching for patient folders and transferring folders to physicians for examination. Thus, this system requires time and space. Digital health hubs can help to reduce these problems. Hence, probing questions within that interview highlighted that health professionals have been inclined to use digital health hubs. A midwife said, "*Most health professionals are interested in using digital health hubs. When we look at digital health hubs from different angles, the benefits are significant; for example, they reduce the frequency of card transactions. Second, reduce complaints from the community by maintaining order. Third, they can remind us of forgotten and unreturned prescriptions, laboratory orders, and drug prescriptions. Therefore, I think it is very useful in this regard, and I think that health professionals are interested in using digital health hubs*" (PID_6). This idea emphasized that health professionals are more concerned about digital health hubs to build smooth relationships between patients and health care providers.

Although digitization is expanding as a strategy for global health organizations, there is currently a lack of functional digital health hubs in healthcare organizations. Hence, health professionals continuously request hospital managers to implement digital health hubs. Moreover, when health professionals engage in practice, their perception will improve. As a health informatics professional remarked, "*There will be a very*

*high perception and interest if digital health hub information is made available to the entire hospital staff, including health informatics, nurses, doctors, and other staff. All health professionals are considering using this system. Hence, I believe health professionals would be happy if the digital health hub is put into practice*." (PID_9). This highlights that although health professionals tend to use digital health hubs, their use is limited by the lack of implementation of digital apps in their settings.

Sustainable Development Goal three emphasizes that healthcare organizations must transform and be competitive in terms of quality and efficiency. Hence, digital platforms aid health professionals in developing positive perceptions of digital health hubs: "*Nowadays, there is no one who does not use digital apps like Telegram, Gmail, and others. This is the era of technology, and everyone wants to be competitive. Based on this scenario, they have both knowledge and an attitude of using digital health hubs*" (PID_6). Furthermore, a midwifery professional with four years of experience highlighted that "*We have shared innovative technologies regarding healthcare information. Hence, using a digital system makes work easier because it allows us to use our time efficiently and effectively. Subsequently, health professionals save time, and patients do not worry about their information being recorded. In this sense, health professionals are more likely to feel that using digital health hubs*" (PID_7). These ideas confirm that healthcare providers utilize different applications for information sharing both within and outside healthcare settings. Hence, they also gain additional experience in practicing digital health information.

Although most interviewees emphasized the benefits of digital health hubs, there is insignificant involvement in security measures such as using security techniques and identifying digital breach incidents or risks. Hence, some participants had negative perceptions of the healthcare data stored in these hubs. A participant who worked in health informatics explained that "*It might be difficult for some health professionals to address the security issues of digital health hubs. Hence, if training and awareness are not provided, they may refuse to use the system, and they will be exposed to digital* hackers" (PID_9).

In summary, digital health hubs are a core component of data integration in healthcare settings. Therefore, the theme "perception of health professionals towards digital health hubs" expresses health professionals' outlook on digital health hubs. Hence, the key informants highlighted that health professionals had positive perceptions because of their previous digital experience and acquiring information from the digital world. However, a small number of participants stated that some health professionals had negative perceptions of data security issues.

Theme 2: Challenges Related to Digital Health Hub

At this time, healthcare technologies are growing rapidly, and health professionals need instant communication. Although health professionals have a positive outlook on digital health, it is limited by the existing systems of healthcare practices. Therefore, the following points were raised by health professionals as challenges to digital health hubs in healthcare organizations. These challenges include technical, human resources, and logistical constraints.

# Subtheme 2.1: Technical challenges

Some applications have been implemented in healthcare organizations, such as Pharmacy Electronic Performance and Tracking Systems, to facilitate routine tasks. However, there are difficulties and faults in these systems. As probing questions within that interview confirmed, limited digital literacy poses a challenge A pharmacist professional explained that "*The Electronic Performance & Tracking Systems app has been providing services for the pharmacy unit. Every transaction ends with digital apps using digital computers. However, knowledge gaps remain. Uh... they want assistants to fill in the limitations. Uh ... there is also a skills gap in setting up and interpreting healthcare data. The person who developed the software was not nearby to fill the gap by providing continuous training"* (PID_1). This emphasizes that the absence of formal training in their setting may limit their technical skills in using digital health applications. Hence, informal training, such as watching consecutive training on YouTube, is not sufficient to achieve competence in using digital apps.

Another main concept raised was regarding digital security. Although digital health technology was introduced for processing healthcare data, security issues have occurred due to the problem of system user-friendliness. Hence, follow-up interviews emphasized that user-friendly access to the security interface would reduce the chances of digital data loss. To support this with evidence, an optometrist stated, "*It is known that technology has both benefits and harms. Problems may arise if the user is not guided by knowledge regarding data issues. Therefore, it is everyone's responsibility to use it securely to prevent data damage*" (PID_2). Health professionals highlighted that filling knowledge and skill gaps in digital health technology may make the system easier to access, and user confidence also increased in preventing the occurrence of digital risks. A professional who was 34 years old mentioned that "*… in terms of skills, it is difficult to say that all professionals have digital skills, to manage the system properly…*" (PID_5). Additionally, a health informatics professional working on planning and monitoring stated that *"… however, data breach or data hacking may happen, health professionals certainly do not stop using digital apps. Instead, they find assistants to solve the problem and inquire about maintaining such types of issues"* (PID_3).

Currently, the data are found in a disintegrated way, which is vulnerable to risk, either by cyber or offline means. This is because no authorized person can manage or be accountable for the risk that occurs in such cases. Hence, as highlighted by probing questions within that interview, "*… as a whole, there is risk in the digital world; in this scenario, some implemented digital health systems were placed in a disintegrated way. This means that the apps are not interoperable with other systems. Searching for and accessing data quickly are also problems for organizations. Hence, owing to the fragmented problem, data may be lost. Fragmentation of the system and human error are other issues that lead to the loss of healthcare data. Beyond that, if the system is centralized, it is easy to back up and restore the data by adding data protection techniques*" (PID_6).

In summary, the subtheme "Technical challenges" expresses that health professionals have limitations in handling faults that occur within the systems. This is due to the fact that health professionals have a gap in acquiring digital knowledge and skills. This may impede the advancement of health professionals' perceptions of digital health hubs.

## Subtheme 2.2: Human Resource Challenges

In healthcare settings, frequent system failures are a serious issue and disrupt daily healthcare tasks. Furthermore, protecting data from online attacks requires a guarantee of cybersecurity. However, a lack of digital health security skills among medical workers increases their susceptibility to online threats. PID_1 stated, "*…doubt will remain. Professionals have been hired to address these issues. Health informatics professionals are available for this purpose. However, there is still doubt about other professionals' opinions. If digital apps are corrupted, they cannot do anything because there is a skill problem.*" (PID_1). This highlights the need for expert healthcare professionals in digital applications to facilitate healthcare tasks. However, some professionals are working, and there are still insufficient skilled professionals to prevent risks and manage doubts that may arise in a certain activity. Electronic systems are now implemented in healthcare settings, especially in specialized and general hospitals. These systems require professional expertise in digital health technology. However, there is a shortage of expert professionals and a gap in providing continuous training for the use of digital health applications. Midwives also emphasized that " *digital health hubs are not fully implemented at our institution. …there is a lack of experts in this setting*" (PID_6). Furthermore, a pharmacist professional criticized, "*However, the system is in progress*; there *is no formal training*" (PID_1). A person who was 34 years old focused on"*… I do not believe there are many expert professionals in digital health applications to perform their routine activity*" (PID_5). This highlights that the digital health application practice is limited to some departments. There are also limited skills in using digital health security tools such as passwords, two-step authentication, backups, and biometric techniques.

In summary, the subtheme "human resource challenges" expresses the gap in healthcare professional performance, which limits their perceptions of digital health hubs. However, digital health has been implemented in different healthcare units, and there is a shortage of professional experts in digital applications. This leads to health professionals being ill-equipped to handle doubts in digital health practice.

## Subtheme 2.3: Logistic constraints

Running digital health hubs simplifies routine activities regarding health records to provide the right service within and across organizations. However, there is a significant problem with running a digital system in resource-limited settings. This is due to the lack of available resources for connected digital health throughout the country. Although some electronic health applications are working within health organizations, they are not connected and do not share data to facilitate routine healthcare activities, and some systems do not sustainably provide services. A participant suggested that " *In some rooms, digital systems have started. For example, we started with image transfer from one class to another, but it did not go far; we thought that if this were completely digital, it could make a lot of work easier. However, it has not yet happened because it might require a large budget for the specialist and providing digital technology infrastructure*" (PID_5). However, this emphasizes that digital applications have begun in some units; the sustainability issue is occurring due to insufficient funds and a shortage of specialists to maintain the implemented systems.

Public hospitals face many challenges in running digital health hubs. The main problem in running the system is the lack of trained experts in digital health and digital infrastructure. As PID_6 confirmed, "*I have*

*tried to talk to the higher managers personally about making a digital hospital. However, they mentioned the following issues. The first main issue is that we have an inadequate digital system. Second, we do not have a sufficient budget to fix issues such as network installation, marketing network cables, and digital apps. In our view, the main reasons are the lack of hiring trained experts, the lack of providing digital health apps, the lack of networking infrastructure, and the budget. Hence, healthcare stakeholders should find a solution to this problem to make it fully digital and sustain the system*" (PID_6). To be specific, digitalization in healthcare units is limited by insufficient digital resources and budgets. Operating delays occurred due to the small number of laptops and tablets in healthcare organizations. Therefore, adequate financing of healthcare digitization is necessary to create full digitization and ensure the sustainability of the system. To strengthen this suggestion, a health informatics professional said, "*There is a lack of resources, and we cannot provide better service using digital health. However, if a budget is available and the system is adjusted for the future, we do not think it will be burdensome to use a digital system*" (PID_8).

In summary, the subtheme "logistic constraint" expresses the scarcity of digital infrastructure holding up health professionals' perceptions of the system. However, digital apps are working in some healthcare units, and there is a gap in integration within and across healthcare settings. This is due to the unavailability of budgets, insufficient digital resources such as digital computers and tablets, and a lack of digital installations in healthcare organizations.

Theme 3: Alternative Solutions for improving HP perception towards DHH

Currently, digital hospitals are prioritized and aligned with the broader objectives of the World Health Organization. Thus, an integrated digital health system is required across the country. To create Connected Health Ethiopia[23], the following solutions were highly emphasized by key health professionals. Such solutions include providing adequate digital infrastructure, facilitating digital training, producing experts, and improving management. Here, solutions are provided in detail to advance health professionals' perceptions of digital health hubs.

## : Facilitate technology-based healthcare training

*Subtheme 3.1*: Facilitate technology-based healthcare training
Digital health applications have been introduced and implemented in healthcare organizations. Hence, health professionals need training to access and use digital health hubs efficiently and effectively. A health informatics specialist said that "*…the institution is also paying great attention to the digital health hubs. Although digital health hubs have started, it is difficult to implement them fully due to the current situation [peace instability]. Hence, routine training is required for all health professionals to produce qualified experts.*" (PID_3). Similarly, a public health professional said, "*It may take time to provide training in the initial phase. After getting trained professionals, … I think the work will be done quickly and smoothly.*" (PID_8). A health informatics professional with five years of experience emphasized that "*It may be difficult to start right away at the current level. Because … nothing has been implemented so far, if it is prepared in the future, everything will be employed after training.* (PID_9). Health professionals suggest that field-specific digital health training is required to strengthen digital healthcare practices. Furthermore, on-site support and regularly planned

and well-structured training sessions help health professionals use digital health technologies. They also emphasized that "… in *our current situation, there is a shortage; I do not think health professionals' knowledge is sufficient … the hospital staff in all departments do not have access. … if they get enough training, they will use it, and it will be beneficial for the hospital and the staff"* (PID_9).

## Subtheme 3.2: Management Support & Building Capacity

The management system of healthcare organizations should be transformed into a digitized one. This is achieved by creating a connected hospital and improving the culture of information use to provide quality service. The ability of a healthcare manager should be considered a model for other health professionals. This shows the power of a good management system and builds the ability of health professionals to have better perceptions of digital health. A pharmacist said, "*Even if there is a positive outlook to use digital health hubs, the reason for putting it into practice is different. As a solution, if the relevant responsible body, such as our hospital manager, sees our problems, sets the agenda we need, discusses it thoroughly, and comes to a solution for forming a digital hospital.*" (PID_1). A participant explained that "The *institution should be qualified first to become a complete digital system. Health professionals should also be qualified; this can be achieved through good leadership platforms in healthcare organizations. Then, a fully digital system will be implemented*" (PID_5).

# Subtheme 3.3: Provide digital infrastructures

Digital health infrastructure, such as electricity, computers, network cables, digital data hubs, and digital applications, should be provided to create an integrated digitized health system. This would facilitate the efficient performance of routine activities in the future. A person with a bachelor's degree in pharmacy said, "*The first thing is providing infrastructure, particularly electricity, digital health apps, and internet connections for implementing digital applications. Hence, health professionals can easily access, organize, and use digital data for the right clinical purposes. Moreover, using a digital health platform, they share and create awareness among people about the disease and other related conditions*" (PID_10). The participant also emphasized that "*…infrastructure like the facility's lighting, connection problems, computers, digital rooms, and other similar devices should be provided to work with digital apps in the digital century*" (PID_10).

To summarize the last theme, it was suggested that digital hospitals would improve healthcare professionals' perceptions. Hence, it is necessary to provide digital infrastructure, such as digital health apps, digital computers, stable electricity, and Internet connections. Furthermore, providing digital training, smoothing management practices, and building health professionals' abilities will contribute to improving their perception.

## Discussion

The main purpose of this study was to explore health professionals' perceptions of digital health hubs. Hence, in this study, two main research questions were explored to improve perceptions towards digital health hubs. In this context, the first research question was how health professionals perceive digital health

hubs in resource-constrained areas. The findings demonstrate that health professionals have positive perceptions of digital health hubs. This is because digital technologies are growing rapidly, and health professionals have gained digital knowledge in routine healthcare tasks. Furthermore, health professionals are a key part of digital health initiatives to connect each healthcare unit to form digital health hubs. In this sense, health professionals have positive perceptions about digital health hubs to support healthcare practice.

As previous studies show, most of the electronic health (eHealth) applications are implemented in healthcare organizations[32, 33]. Further, as per the Ethiopian Federal Ministry of Health (MoH) plan, healthcare organizations, such as primary, secondary, and tertiary hospitals, should be interconnected to create Connected Health Ethiopia (CHE)[34, 35]. Hence, this plan supports health professionals in having positive perceptions. Previous studies show that health professionals have sufficient perceptions regarding digital health hubs[27]. As the researchers mentioned, health professionals need to master digital app skills and use digital devices such as computers, smartphones, and tablets to be competent in providing digital health services using digital health applications such as electronic health records (EHRs) and electronic appointment systems[27]. Furthermore, health professionals perceived that digital health applications are designed to be simple and well-functioning[12, 27, 28]. Therefore, as a result of providing quality service for healthcare clients, study participants placed higher emphasis on improving the current status of professionals' perception of digital health hubs.

Additionally, this study investigated the facilitating aspects that support health professionals in having positive perception. The first enabling expectation was that health professionals have acquired information from the digital world, such as using Google Drive, Telegram, and other data storage and communication media. This highlighted that using digital data storage applications has an impact on motivating health professionals to store healthcare data by establishing digital hub platforms in healthcare organizations. This finding is consistent with prior research that familiarity with digital applications were a prerequisite for improving the perception of health professionals towards the application of digital health hubs [20]. Hence, the interviewees stressed that health professionals should work with any digital technology that has secured broadband and a positive impact on their routine healthcare activity.

The second facilitating aspect was that health professionals acquired computer skills throughout their education journey and had connections with digital health applications such as electronic medical records, smart care, and mobile health apps. This emphasis on the digital experience of health professionals led to a positive outlook on digital health hubs. As other studies explain, health professionals need to be informed about the latest digital health solutions that are available and in use, and the contents of various digital health services[11, 27, 28].

Challenges and improvement areas on Digital Health Hub

There are challenges in advancing health professionals’ perceptions and using digital health hubs in healthcare settings. This study identified three main challenges. These include technical challenges, human resources, and logistical constraints.

One of the prominent issues limiting health professionals' perception of digital health hubs was logistical constraints. As discussed with the health professionals, the main issues in the healthcare organization were a scarcity of digital computers and tablets, network installation and connectivity issues, and a lack of implemented digital health applications in each healthcare department. Hence, a lack of provision of digital infrastructure restricted the expansion of digital health hubs and was a bottleneck for the advancement of health professionals' perception. Research has highlighted that inadequately integrated digital platforms led to information fragmentation and limited the quality of healthcare services[36]. This was due to the limited provision of digital infrastructure, which widened the digital divide and inequity in care. Other studies also emphasized that limited structural drivers, such as inadequate connectivity and limited experience of stakeholders in digital technology, affect the opportunity for investment in digital technology to advance healthcare practice [11, 28, 33, 36]. Participants in this study recommended that state-based access and literacy in digital health technology are key determinants for improving the perceptions of health professionals towards digital health hubs.

Other challenges exist in the health system, such as a shortage of professional experts regarding digital health hubs. By its nature, a health or hospital information system is more holistic and complex. Therefore, health professionals should handle health data using digital health apps. However, due to a shortage of well-digitalized healthcare systems and experts, it is difficult to deliver effective services. These results are consistent with previous research showing that the lack of unified and standardized data interoperability was the most frequent obstacle to digital care continuity. This was due to the presence of digital health dividers across healthcare organizations and the absence of a standard policy [36, 37]. Furthermore, another study also illustrated that although health professionals have positive perceptions, their perceptions were restricted by inadequate skills to solve technical problems [11, 27]. As highlighted by the participants, to close this gap, healthcare organizations should adopt standard and interoperable digital healthcare services.

The third main challenge was the scarcity of budget and gaps in capacity building regarding digital health applications. However, although digital health applications have been introduced into marketing, healthcare organizations are unable to fund and implement digital health applications. The previous study also highlighted that the primary obstacles to implementing standard digital health hubs were the inability to get funds within and across the country[37]. Hence, the implementation and sustainability of the systems were limited due to governance issues and incentive problems [37]. As the participants recommended, such barriers should be solved by providing the best strategic policy and accessing funding by working closely with macro and micro institutions throughout the world. Another issue was the inadequate ability of health professionals to use digital health apps. This challenge was not only due to a lack of continuous digital training, but also the presence of heavy workload and lack of system user-friendliness. Hence, a lack of familiarity with innovative digital health technologies creates a gap in further improving health professionals' perceptions of digital health hubs. As previous studies elucidate, health professionals must pay special attention to improve interaction with digital technology and require digital health skills in communicating with the patient, writing messages in digital environments, and using video channels to interact[11, 27]. In addition, however, creating interaction through digital health was perceived as challenging; health professionals should fill those skill gaps [27, 32]. Participants recommended providing

ongoing digital training to help health professionals become more proficient in digital health technology, which will improve their perceptions towards digital health hubs.

Limitations of the study

Regarding the study limitations, the study was conducted in a limited geographical scope. Some participants had little experience with digital applications. While saturation was reached regarding general perceptions, the small number of representatives per specific profession (e.g., only one person from Optometry) means that profession-specific nuances might not have been fully captured. The studies were limited in using multiple data sources, such as review documents, training records, usage logs, and policy or information technology documents. Further, it was conducted once in a single zone of the country, and there was a gap in using back translation during the interview. In addition to this, even though the interviewers-controlled bias by removing leading questions, response bias, such as social desirability bias, may have occurred in the research studies. Because the interviewees were part of the health care system, they may have placed more emphasis on a positive view of the research objectives. While their perceptions were positive, the functional lack of digital literacy suggests a gap between attitude and their ability towards digital health hubs.

Implications for Research and Practice

For Practice

The practical implications of the study were that improving the perceptions of health professionals can be achieved by providing well-organized training. This helps health professionals improve their perceptions and provide the right service to healthcare clients and stakeholders. Hence, by improving their perceptions, digital health hubs may be user-friendly and efficient.

For Research and future perspectives

To ensure digital health for all, future studies should focus on health professionals in digital health centers. Future studies should broaden the scope by including private healthcare clinics, public healthcare centers, health posts, and specialized teaching hospitals, as well as different zones and regions of the state. Further, conducting a longitudinal study may aid in measuring the potential variations in health professional perceptions towards digital health hubs over time and outline the policy of digital healthcare practice. Moreover, researchers should use multiple approaches, such as reviewing documents, training records, usage logs, and policy or information technology documents, and investigate the rate of perceptions by including different study populations, such as healthcare students, patients, and other healthcare stakeholders. Using mixed methods will improve the outcomes of future studies.

## Conclusions

This study explored the perceptions of health professionals towards digital health hubs. By acknowledging the limitations, the findings revealed that health professionals have positive perceptions of digital health hubs. This is due to previous digital experiences and the presence of adequate information from the digital

world. However, in resource-constrained settings, there are challenges to improving their perception further. Such identified problems include a lack of professional experts, limited digital infrastructure, and poor capacity-building practices. These might be considered challenges for improving perceptions of digital health hubs.

The authors specifically suggested that East Gojjam hospitals implement local policies to enhance the perception of health professionals by offering digital computers and healthcare apps, supplying regular electricity, and enhancing health professionals' ability to access digital health hubs.

Hence, as healthcare organizations, improvement in healthcare professionals' perceptions of digital health hubs will be required to ensure a digitally health-connected Ethiopia. As perceptions depend on local contexts, follow-up is required in future research. Therefore, responsible bodies such as the Federal Minister of Health, policymakers, and higher healthcare administrators should take interventions based on the uncovered insights to advance the perceptions of health professionals towards digital health hubs.

## Abbreviations

CHE: Connected Health Ethiopia

DHH: digital health hubs

DHIS: district health information system

eHealth: electronic health

FMoH: Federal Ministry of Health

IT: Information technology

WHO: World Health Organization

## Declarations

# Ethical Considerations

The study was conducted after obtaining ethical approval on May 04/2024 from the College of Medicine and Health Science, Debre Markos University, with reference number: DMU/IRERB/0019/2024. The study was conducted in accordance with the rules of the Declaration of Helsinki. Written informed consent was obtained from all ten participants before data collection. The interviewees participated voluntarily, and no compensation was offered. After collecting and handling the rich data, the data were de-identified according to the Debre Markos University research and technology transfer directorate code of conduct, following data protection rules.

**Consent for publication**

It is applicable for publication

# Funding

The authors declared that no financial support was received for this work.

# Author Contribution

ASG, AWS, AKM, GHT, SBT, MBM, BTA, AFS, MKA: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Interpretation, Writing – original draft. ASG: Project administration, Resources, Software. SBT, GHT, BTA, MKA: Supervision, Validation, Visualization. Finally, all authors have been involved in writing, reviewing, and editing the paper, and all agree with all aspects of the work in the paper.

# Acknowledgment

First of all, I would like to thank the Almighty God for His enduring grace, guidance, and protection that He bestowed upon us during this research paper. Then, I would like to express our heartfelt gratitude to Debre Markos University, College of Medicine and Health Science, for initiating our research in the field of healthcare digitization. Next, we would like to forward our deepest gratitude to our colleagues for providing invaluable guidance throughout this study. Their insights and expertise have played the greatest role in shaping this research. Finally, we appreciate the encouragement from our friends whose support kept us motivated throughout the research process.

# Data Availability

The datasets generated or analyzed during this study are available from the corresponding author on reasonable request.

## References

1. Kreidler ML. accessed May 1,. The Development of Healthcare and Information Technology. https://www.ebsco.com/research-starters/information-technology/development-healthcare-and-information-technology (2026).
2. Blix M, Levay C. Digitalization and health care. Eso expertgrupp. 2018;44:13–35.
3. Labrique A, Agarwal S, Tamrat T, Mehl G. WHO Digital Health Guidelines: a milestone for global health. NPJ Digit Med. 2020;3(1):120.
4. Oke GI, Sibomana O. Adoption of Digital Health Technology in Nigeria: A Scoping Review of Current Trends and Future Directions, *Advances in Public Health*, vol. 2025, no. 1, p. 4246285, 2025. https://doi.org/10.1155/adph/4246285

5. Baird A, Nowak S. Why primary care practices should become digital health information hubs for their patients, *BMC Family Practice*, vol. 15, no. 1, p. 190, 2014/11/25 2014. 10.1186/s12875-014-0190-9
6. Knotnerus HR, Ngo HTN, Maarsingh OR, van Vugt VA. Understanding Older Adults' Experiences With a Digital Health Platform in General Practice: Qualitative Interview Study, (in English), *JMIR Aging*, vol. 7, p. e59168, 2024, 10.2196/59168
7. Al Meslamani AZ. Technical and regulatory challenges of digital health implementation in developing countries. Volume 26. ed: Taylor & Francis; 2023. pp. 1057–60.
8. World Health Organization. Targets of Sustainable Development Goal 3. https://www.who.int/europe/about-us/our-work/sustainable-development-goals/targets-of-sustainable-development-goal-3 (accessed June 15, 2026).
9. Abernethy A et al. The promise of digital health: then, now, and the future, *NAM perspectives*, vol. 2022, p. 10.31478/202206e, 2022.
10. Taylor ML, et al. Digital health experiences reported in chronic disease management: an umbrella review of qualitative studies. J Telemed Telecare. 2022;28(10):705–17.
11. Slevin P, Kessie T, Cullen J, Butler M, Donnelly S, Caulfield B. Exploring the barriers and facilitators for the use of digital health technologies for the management of COPD: a qualitative study of clinician perceptions. QJM: Int J Med. 2020;113(3):163–72.
12. Wilson S, et al. Recommendations to advance digital health equity: a systematic review of qualitative studies. NPJ Digit Med. 2024;7(1):173.
13. Kaihlanen A-M, et al. Towards digital health equity-a qualitative study of the challenges experienced by vulnerable groups in using digital health services in the COVID-19 era. BMC Health Serv Res. 2022;22(1):188.
14. Muehlensiepen F, et al. Digital health transition in rheumatology: a qualitative study. Int J Environ Res Public Health. 2021;18(5):2636.
15. Jarva E et al. Aspects associated with health care professionals' digital health competence development: a qualitative study, 2022.
16. World Health Organization. Global strategy on digital health 2020–2027. https://www.who.int/health-topics/digital-health#tab=tab_1 (accessed May 2, 2026).
17. Manyazewal T, Woldeamanuel Y, Blumberg HM, Fekadu A, Marconi VC. The potential use of digital health technologies in the African context: a systematic review of evidence from Ethiopia, *npj Digital Medicine*, vol. 4, no. 1, p. 125, 2021/08/17 2021. 10.1038/s41746-021-00487-4
18. Abera M. Impact of digitalization: a qualitative study on impact of digitalization within organizations in Ethiopia. Technische Universität Wien; 2025.
19. Kamuhanda S, et al. Adoption, barriers and opportunities of interoperability and eHealth standards in Africa: a scoping review, (in eng). BMJ Health Care Inf. Feb 26 2026;33(1). 10.1136/bmjhci-2025-101678.
20. Okeke EB et al. Barriers and facilitators to digital health adoption: a thematic analysis of healthcare professionals' perspectives in rural Oyo State, Nigeria. BMC Digit Health, 3, 1, p. 85, 2025/11/18 2025, 10.1186/s44247-025-00227-8

21. Arendse KD, et al. Health Care Workers' Perspectives on the Barriers and Facilitators to Digital Health Technology Use to Support Symptomatic Cancer Diagnosis in Southern Africa: Qualitative Study, (in English). J Med Internet Res. 2025;27:e68412. 10.2196/68412.
22. Bostan S, Johnson OA, Jaspersen LJ, Randell R. Contextual Barriers to Implementing Open-Source Electronic Health Record Systems for Low- and Lower-Middle-Income Countries: Scoping Review, (in English). J Med Internet Res Rev vol. 2024;26:e45242. 10.2196/45242.
23. Minstry of Health -Ethiopia, Digital Health BluePrint. 2021. [Online]. Available: https://extranet.who.int/countryplanningcycles/sites/default/files/public_file_rep/ETH_Ethiopia_Digital-Health-Blueprint_2021.pdf. Accessed on: May 2,2026.
24. Denboba W, et al. Strengthening Ethiopia's health information system: a journey to unified DHIS2. Ethiop J Health Dev. 2024;38(2):1–6.
25. Ethiopian News Agency. 2023. Ethiopia Targets Universal Hospital Digitalization by 2030: Ministry of Health. https://www.ena.et/web/eng/w/eng_8034652 (accessed June 25, 2026).
26. Gill P, Stewart K, Treasure E, Chadwick B. Methods of data collection in qualitative research: interviews and focus groups. Br Dent J, 204, 6, pp. 291–5, 2008/03/01 2008, 10.1038/bdj.2008.192
27. Jarva E, et al. Healthcare professionals' perceptions of digital health competence: A qualitative descriptive study. Nurs open. 2022;9(2):1379–93.
28. Lennon MR et al. Readiness for Delivering Digital Health at Scale: Lessons From a Longitudinal Qualitative Evaluation of a National Digital Health Innovation Program in the United Kingdom, (in English), *J Med Internet Res*, Original Paper vol. 19, no. 2, p. e42, 2017, 10.2196/jmir.6900
29. Moore OA, Aguinis H, Darden TR. Defining, assessing, and reporting saturation in qualitative research: Review and recommendations. Leadersh Q, p. 101950, 2026.
30. Ahmed SK. The pillars of trustworthiness in qualitative research. J Med Surg Public Health. 2024;2:100051.
31. Ghafouri R, Ofoghi S. Trustworth and rigor in qualitative research. Int J Adv Biotechnol Res. 2016;7(4):1914–22.
32. Zainal H, Hui XX, Thumboo J, Fong W, Yong FK. Patients' Expectations of Doctors' Clinical Competencies in the Digital Health Care Era: Qualitative Semistructured Interview Study Among Patients, (in English), *JMIR Hum Factors*, Original Paper vol. 11, p. e51972, 2024, 10.2196/51972
33. Richardson S, Lawrence K, Schoenthaler AM, Mann D. A framework for digital health equity, *npj Digital Medicine*, vol. 5, no. 1, p. 119, 2022/08/18 2022. 10.1038/s41746-022-00663-0
34. Biru A, et al. Strengthening digital health local capacity: driving forces and milestones in Ethiopia. Oxf Open Digit Health. 2025;3. 10.1093/oodh/oqaf024.
35. Abera WS. Enhancing Data Quality and Information Use in Routine Health Information Systems: the Case of the Federal Ministry of Health. Ethiopia, University of South Africa (South Africa); 2025.
36. O'Connor L, Dunkel L, Weitz AC, Walkey A, Lindenauer PK, Soni A. Digitally delivered, systemically challenged: A qualitative study of health system readiness for digital care. PLOS Digit Health. 2026;5(1):e0001193.

37. Cresswell KM, Bates DW, Sheikh A. Ten key considerations for the successful implementation and adoption of large-scale health information technology. J Am Med Inform Assoc. 2013;20(13):e9–e. 10.1136/amiajnl-2013-001684. no. e1.

## Figures

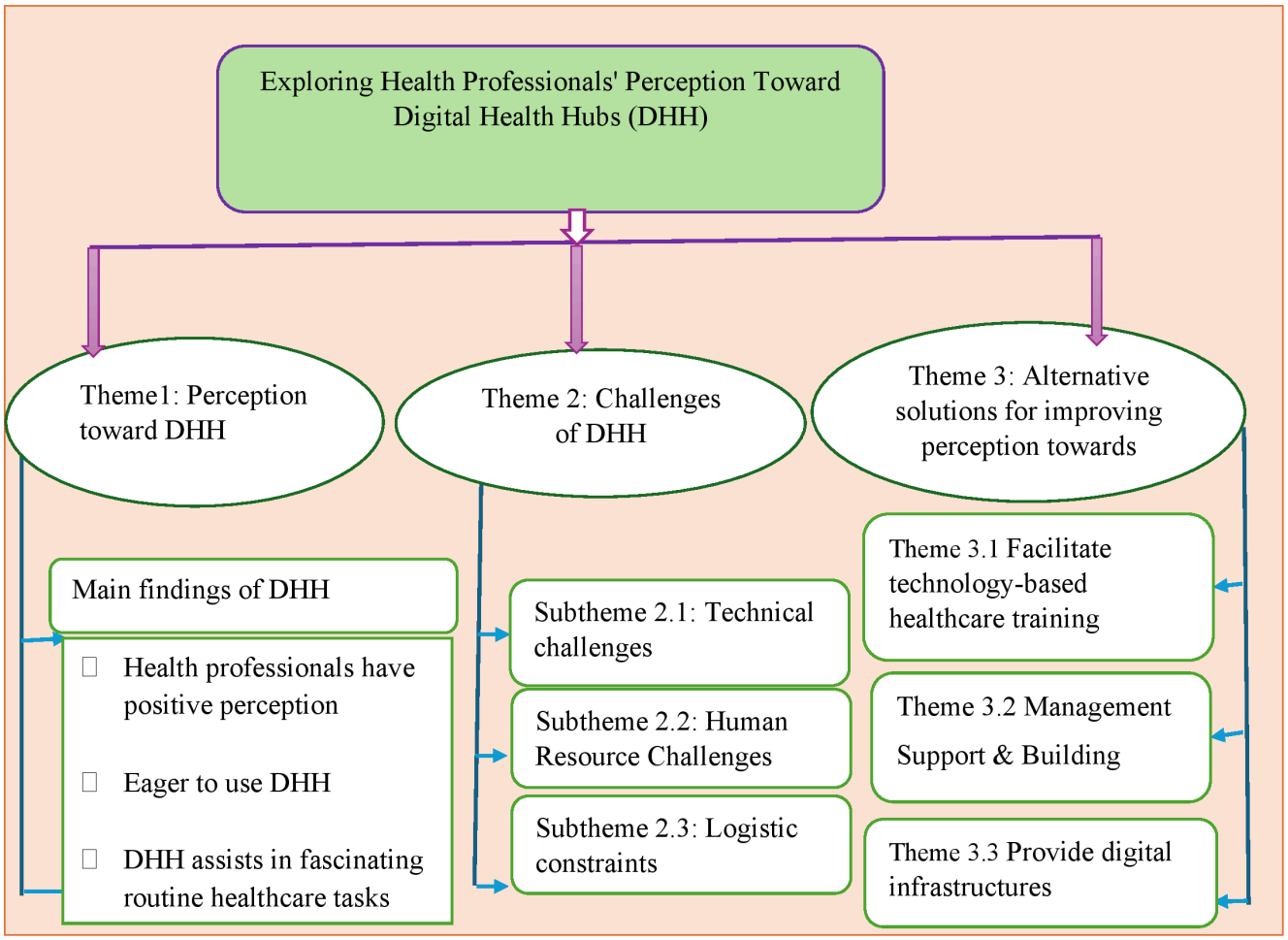



**Figure 1**

Figure 1: Themes of Health Professionals' Perception Toward Digital Health Hub in Ethiopia, 2024

## Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- FileS1.docx