

# Research Landscape and Research Priorities in eHealth in four African Countries - A survey

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## Abstract

There is a huge interest by stakeholders in the potentials of eHealth. Accordingly, there is a strong demand from donors, and other stakeholders for eHealth research outputs to address infrastructural, policy, and human challenges. The BETTEReHEALTH project explores infrastructure, policy, and human factors impacting eHealth in Ethiopia, Ghana, Malawi, and Tunisia. This study applies the National eHealth Strategy Toolkit introduced by WHO and ITU to assess the conformity of the research landscape and research priorities of these countries with the building blocks defined in the toolkit. The status of ICT, policy, and human factors of partner countries indicates that there is a serious lack of policies and skilled workers along with infrastructural challenges. Collected data revealed that Infrastructure-Policy-Human is a fundamental triangle for successful eHealth implementation while Ethiopia, Ghana, Malawi, and Tunisia, as a sample representing Africa, suffer from lack of policies the most both at the governmental and research communal level.

## Keywords

eHealth, Infrastructure, Policy, Human Factor, BETTEReHEALTH

## 1. Introduction

There is a huge interest by local, national, and international actors in harnessing the potentials of eHealth in providing solutions and enhancing the quality and safety of health care delivery at different levels, particularly in the context of developing countries. Accordingly, there is a strong interest and demand from donors, consumers, and other stakeholders for research outputs that enable them to explore and address technical, human, policy, structural, and cultural challenges in implementing eHealth initiatives for the purpose of tackling health service challenges (e.g. lack of holistic, standardized, and interoperable systems) and improving performance, decision making and communication capabilities of health professionals at different levels [1]. As such, there should be cooperation and coordination between the actors to avoid isolated

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
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adaptation and non-interoperable implementation of eHealth systems. For instance, in Low and Middle-Income Countries (LMICs), or in other words, in developing countries, most of the time the standardization is left far behind from the fast-growing implementation, resulting in less effective isolated healthcare systems [2]. On the one hand, eHealth systems are dependent on two fundamental factors of health and information and communication technologies (ICT) which both require knowledge, coordination, and communication. On the other hand, clinical discoveries and ICT are changing rapidly and far outpacing the eHealth research due to the fact that the process of submitting a grant, designing, conducting the research, analyzing the data, and publishing the results takes a way longer time [3]. Hence, lack of a unified holistic view over the status of the body of knowledge and strategic alignment of health and ICT will impact technical infrastructure implementation, legislation, service accessibility, sociocultural factors, and financial resources [4]. As a result, a continuous eHealth research approach that perceives the ever-changing technological, scientific, and e-social environment is vital for the successful implementation of eHealth [3].

Considering the importance of research outputs for the involved parties and considering the significance of the status of the body of knowledge for an appropriate eHealth implementation, this study aims to explore the eHealth research status of four developing African countries that are part of the BETTEReHEALTH project (<https://betterhealth.eu/>) to provide implications for the coordination of stakeholders. This project addresses three strategic areas of public policy, technical factors, and human factors for the successful deployment, development, and implementation of eHealth in the partner countries of Ethiopia, Ghana, Malawi, and Tunisia. BETTEReHEALTH is a 2021-2023 project and is funded by European Union's Horizon 2020 research and innovation program under grant agreement No 101017450 (Norwegian Center for eHealth Research, 2021). This project includes 11 members from 7 countries, which are the Norwegian Center for eHealth Research, Norwegian Foundation for Industrial and Technical Research (SINTEF), University of South-Eastern Norway, Belgian company of Etablissements Lievens Lanckman, University of Oslo, Tunisian company of Cluster Sfax Health Tech, Ghana Health Service, Jimma University, University of Gondar, Health Information Systems Program in Malawi, and Helder Resultaat which is based in the Netherlands [5].

Since the environment challenges the eHealth research, researchers need to consider the interdisciplinary collaboration of environmental factors and the ideals of stakeholders that govern the research [6]. Accordingly, this study applies the National eHealth Strategy Toolkit introduced by WHO and the International Telecommunications Union (ITU) to assess the conformity of the research landscape and research priorities of the partner countries with the building blocks defined in the aforementioned toolkit. This toolkit categorizes the necessary building blocks of eHealth into seven groups (1-Leadership and Governance; 2-Strategy and Investment; 3-Services and Applications; 4-Infrastructure; 5-Standards and Interoperability; 6-Legislation, Policy, and Compliance; 7-Workforce) [5]. In this regard, an online survey has been designed and used to collect researchers' opinions for understanding the research agenda, research priorities, and research topics of eHealth researchers and research groups in Ethiopia, Ghana, Malawi, and Tunisia. This survey will be used as input to report the state of eHealth research in African partner countries of the BETTEReHEALTH project and improve their health outcomes through better implementation of eHealth.

eHealth is here defined as the use of systems and ICTs that support healthcare service pro-

vision, delivery, and management activities, resulting in a wide area of applications ranging from telemedicine to global research collaborations made possible via e-Infrastructures, world-wide systems of integrated advanced high-performance networking, and computing ICT [7]. Eventually, this study scrutinizes the research landscape and research priorities of Ethiopia, Ghana, Malawi, and Tunisia to extract the untouched or neglected areas of research by the body of knowledge in the above-mentioned countries. Accordingly, areas of focus of assessment are policy, technical, and human factors in the framework of the toolkit introduced by WHO and ITU. Related data will be collected via an online survey that is sent to top research group members of these countries. Extracted data will be analyzed to answer the question “Which of these areas of research are not addressed at all or properly in Ethiopia, Ghana, Malawi, and Tunisia?”. In the rest of this study, background and literature review, methodology and approach, results, discussion, and conclusion and future work will be presented.

## **2. Background and Literature Review**

eHealth was first ever defined in 1999 by Mitchell and referred to as an umbrella term embracing clinical, educational, and administrative purposes [7]. Exploring eHealth definition development through the years via different lenses indicates that all of them unitedly emphasize the use of ICT in the health sector. For instance, from an eHealth-research perspective, the use of ICT in the health sector empowers researchers with global research collaboration opportunities [7]. eHealth projects can have diverse goals, outcomes, technologies, and stakeholders ranging from remote monitoring, health information sharing, and learning to telemedicine and research [7].

### **2.1. eHealth Building Blocks**

In 2012, a toolkit was introduced by WHO and ITU to help governments initiate, develop, or revise their eHealth approach, planning, and monitoring. The national eHealth strategy toolkit is defined as “a practical, comprehensive, step-by-step guide, directed chiefly towards the most relevant government departments and agencies, particularly ministries of health and ministries of information technology and communication” and can be customized based on local preferences [5, 8]. This toolkit defines the seven essential building blocks of eHealth as in the following. Leadership and governance, strategy and investment, services and application, infrastructure, standards and interoperability, legislation, policy and compliance, and workforce. However, this study digs deeper into infrastructure, legislation, policy and compliance, and workforce due to the scope of focus. In this respect, infrastructure refers to essential hardware and software technologies that are used for sharing health information beyond the health sector boundaries to improve healthcare and health information management. Moreover, legislation, policy, and compliance concern necessary regulations for the deployment and development of eHealth. These rules are meant to monitor access, privacy, storage, and sharing of health information. Finally, the workforce points to health information technology and healthcare workers who, respectively, design, develop, and implement eHealth projects, and use eHealth project outcomes to deliver healthcare [5].

## 2.2. eHealth Status in Ethiopia, Ghana, Malawi, and Tunisia

First eHealth projects were implemented in Africa in the 1980s in the form of telediagnosis and clinical conferencing. Another example is the WHO eLearning programs provided freely for educational purposes in Africa. A 2015 study indicates that until then only 37 eHealth projects had been implemented in Africa with the help of 85 donors while Ethiopia, Ghana, Malawi, and Tunisia each had been, respectively, part of 11, 12, 5, and 9 projects [7]. From these 37 projects, 23 encompass health-related research goals while Ethiopia, Ghana, Malawi, and Tunisia each had been, respectively, part of 8, 8, 3, and 7 research projects [7]. From these 23 health research projects, 16 had Internet, 6 Mobile phones, 5 Free and Open-Source Software, 3 Satellites, 3 Personal Digital Assistant, 2 Distributed Computation, 1 Cloud Computation, 1 Geographic Information System, and 1 Telephone as the core technology [7]. This variation of participation and infrastructure in eHealth and eHealth research projects indicates that these four countries are a good sample to show the diversity of eHealth and eHealth research status across Africa. The Strength of BETTEReHEALTH is the diversity of the involved parties in Africa that together represent a holistic approach towards eHealth status in Africa. eHealth governance in Ethiopia is conducted by the Ministry of Health and Public Health Infrastructure Directorate, and in Ghana is conducted by an interagency body that includes the Ministerial Committee on eHealth and is chaired by the Ministry of Health. Moreover, Malawi conducts governance through the Ministry of Health and Population with the help of the Department for eGovernment in the Ministry of Informatics and Communication Technology. Finally, in Tunisia, the Ministry of Health is the governing body that gains help from the Tunisian Society of Telemedicine and eHealth, the National Authority for Protection of Personal Data, and the Ministry of Communication technologies. There are also private parties and donors that cooperate in the implementation of eHealth in all these four countries [5].

Regarding infrastructure, Ethiopia has provided the necessary ICT hardware and accessories at a country level while Ghana is trying to improve and coordinate its Information Systems and ICT infrastructure to overcome the poor quality of computing infrastructure in the public sector. In Malawi, a fiber network has been implemented as a communicational backbone for the future of mHealth, although frequent power outage is a challenge that has provoked the government to think of alternative sources of energy. Finally, in Tunisia, 51.5% of the households were connected to the Internet in 2019, and the adoption of ICT is heavily dependent on the users' digital perception and skills [5]. Regarding policy, unfortunately, there is no policy defining medical jurisdiction, liability, or reimbursement of eHealth services in any of these countries. Also, policies regarding patients' safety and quality of care are only addressed indirectly in Tunisia. Concerning access equity policies, only Malawi and Tunisia have addressed it briefly. In respect of innovation, risk management, and e-service policies, only Tunisia has introduced responsible bodies, and none of the countries have policies addressing eHealth outcomes and clinical effectiveness [5]. Regarding the human factor, Ethiopia suffers lack of sufficient eHealth personnel, Ghana also has health staff with no competent eHealth skills. In Ghana, the high density of computerization is impacted by the loss of ICT professionalism and training in the health sector. Malawi also lacks competent staff within the area of digital health but there are various related training programs at the university and college level and increasing access to computing devices in the health sector. As well, Tunisia also suffers from the same problem

which is lack of recognized digital health skills accompanied by the low implementation of eHealth systems. Though, there are related training programs at the country level [5].

Accordingly, although Ethiopia, Ghana, Malawi, and Tunisia have assigned responsible bodies for the implementation, deployment, and coordination of eHealth, there is still a need for capacity building and training both at the health sector and society level. Moreover, there is a necessity for eHealth standardization and policy designation to enable the successful implementation of eHealth in Africa. Also, infrastructure implementation as an enabler should be in line with other factors [5]. To address such issues, eHealth research must integrate relevant stakeholders with relevant research agendas [9]. In the eHealth context, the term “stakeholders” refers to patients and their caretakers, e-service receivers, the public, health professionals, governors, policymakers, research funders, and researchers. Therefore, research agenda priorities must be aligned with the needs of those being affected [1].

### **3. Methodology and approach**

A qualitative survey has been designed based on the mentioned WHO toolkit to collect data and measure the state of eHealth research in selected African countries. This survey extracts the research agenda, research priorities, and research topics of interest in the community of eHealth researchers of Africa. In this regard, the survey is divided into two sections namely, respondent identification, and organizational approaches to eHealth research. The first section explores location, qualification of respondents, primary areas of focus, and type of employer organization. In contrast, the latter section scrutinizes organizational approaches toward addressing and prioritizing different fields of eHealth research. Moreover, organizational research units are being assessed to pinpoint the structure of research departments along with their challenges, risks, and bottlenecks in conducting and implementing eHealth research at organizational and national levels. To reach a proper number of qualified respondents, rich enough for the purpose of this project, we used the regional hubs in Ethiopia, Ghana, Malawi, and Tunisia, personal and academic international networks, and project participants from the European partners were used to contact members of African universities, institutions, and organizations via email and phone. Then, the survey was explained and sent to them via an active online link. Online surveys are way more flexible than paper-based ones since the respondents can participate at any time they prefer and in any location. Hence, the Nettskjema online survey introduced by the University of Oslo has been chosen to overcome the time and distance challenges and to speed up the data collection. After a month of data collection from July to August 2021 via the designed online survey, the responses are collected in Excel and pdf files containing qualitative data. Afterward, the collected data is coded and broken down into more comprehensible smaller segments and is analyzed by eHealth experts to double-check its validity and reliability. Collected responses are explained next.

### **4. Results**

18 individuals from the countries that are participating in the BETTEReHEALTH project responded to the survey, where around 75% of them are Professors, Associate Professors, and Ph.D.

candidates in the fields of Informatics, Health Informatics, Computer Science, Bioinformatics, Information Systems, and Medical Sciences, and the rest have not stated their qualification. These respondents are working in the academic or research institutions located in Ethiopia, Ghana, Malawi, and Tunisia each with, respectively, 3, 4, 2, and 9 participants. When participants were asked to define the eHealth topics that are addressed within their organizations, they declared that Health Management Information Systems (HMIS), Electronic Medical Records, and Decision Support Systems are at the center of attention in their organizations while priorities differ from one organization to another. Table 1 shows the main addressed topics in the respondents' organizations and their prioritized topics within different countries.

In the following, participants were asked to reflect their personal opinion regarding preferred eHealth research topics, the future of eHealth topics, and challenges and risks for successful implementation of eHealth systems and research at the national and organizational level. As a result, participants' responses indicated that Electronic Health Record Systems that deliver a confidential, integrated, and secure digital service are way more important to be addressed followed by Intelligent Diagnosis Systems, Infrastructure, Health Data Science, and eHealth Services Availability. Moreover, participants projected that in the next five years the most prioritized topics are respectively, Electronic Health Record Systems, eHealth Data Science, eHealth Services, and Policies. Regarding the challenges, risks, and bottlenecks of implementing eHealth projects and research at the national and organizational level, participants declared that Data, Cost, Supply, Quality, and Acceptance are the most challenging factors at the national and organizational level. Table 2 shows the detailed information by country.

Finally, when participants were asked about research departments and approaches in their organizations, they indicated that all of their organizations consist of a research department focusing on eHealth topics with 2 to 20 members. Based on our sample, Tunisia has the biggest group of eHealth researchers followed by Ethiopia, Ghana, and Malawi. Research departments responsible for eHealth topics focusing on policy implementation, technical and human factor examination, pilot study consideration, eHealth topic identification, funding application, decision support, security enhancement, disease diagnosis, data analysis, robotic medical implants, monitoring, and training. Accordingly, Tunisia identifies eHealth topics by collaborating with socio-economic partners, asking the medical staff, following national priorities, recommendations of experts, competencies, and reviews. Ethiopia identifies topics via analyzing actual problems, asking experts, following national agendas, and pursuing funders' requests. Ghana extracts the gaps from literature, global health trends, industry, experts, and social interest. Malawi focuses on the request of funders, scholarly literature, and situation assessment to find gaps in eHealth.

## 5. Discussion

This study pinpoints addressed and prioritized research topics in each BETTEReHEALTH African participant country to explore its potential impacts on governance, policy, human resource, and infrastructure as well as interoperability and standardization of eHealth implementations.

The Ethiopian eHealth research community addresses mostly health information manage-

**Table 1**  
eHealth Topics

Country	Addressed Topics	Prioritized Topics
Ethiopia	Logistics Management Information Systems, Telemedicine Systems, Decision Support Systems, Health Management Information Systems, Electronic Medical Records	eHealth Implementation, Telemedicine Systems, Big Data, Data Quality, Mobile Health, Digital Health Applications
Ghana	Logistics Management Information Systems, Telemedicine Systems, Decision Support Systems, Health Management Information Systems, Electronic Medical Records, Client Communication Systems	Telemedicine Systems, Decision Support Systems, Technology Acceptance, Big Data, eHealth Capacity Building and Implementation, Monitoring and Evaluation
Malawi	Logistics Management Information Systems, Health Management Information Systems, Electronic Medical Records, Client Communication Systems	Design and Implementation of Electronic Medical Records, Community-Related Health Information Systems
Tunisia	<b>Logistics Management Information Systems, Telemedicine Systems, Decision Support Systems, Health Management Information Systems, Electronic Medical Records, Identification Registries and Direction, Client Communication Systems</b>	<b>Cardiovascular Disease, Secure Healthcare Monitoring, Patient Privacy, Anomalous Data Detection, Mobile Health, Liver and Breast Cancer Detection, Medical Implants like Bio Sensors, Robotic Diagnostic, Stroke Prediction, Intelligent Monitoring, Verification</b>

ment systems and their applications like telemedicine and decision support systems, and they prioritize implementation, data, mHealth, and digital applications. Basic infrastructural readiness has laid the foundation for implementation; however, policies are not addressed at all neither at the governmental level nor at the research communal level. Moreover, lack of sufficient eHealth workers is another challenge that has been neglected by the stakeholders. The research community also has notified the need for adaptation, policymaking, and mHealth while they indicate that infrastructure and lack of skilled workers hinder further development. According to these points and focused areas of the aforementioned toolkit, Ethiopia suffers lack

**Table 2**  
eHealth Topics and Status

Country	Preferred Topics	Next 5 year Topics	Challenges
Ethiopia	Design and Adaptation, Affordance, Telemedicine Systems, Mobile Health, eHealth Data Science	Policy, eHealth Services, Infrastructure, eHealth Data Science, Affordance and Availability	Data, Supply of Services and Equipment and Health Worker, Quality of Healthcare, Acceptance, Utilization, Efficiency, Cost, Accountability
Ghana	Telemedicine Systems, Infrastructure, Decision Support Systems, Policy, eHealth Data Science, Electronic Health Record Systems	Policy, Health Worker, eHealth Data Science, Telemedicine Systems, Electronic Health Record Systems	Data, Supply of Services and Equipment and Health Worker, Quality of Healthcare, Acceptance, Utilization, Efficiency, Cost, Accountability
Malawi	Decision Support Systems, Electronic Health Record Systems, Monitoring, Innovation and Sustainability	Policy, eHealth Data Science, Electronic Health Record Systems, Telemedicine	Data, Supply of Services and Equipment and Health Worker, Quality of Healthcare, Acceptance, Utilization, Efficiency, Cost, Accountability
Tunisia	<b>Intelligent Diagnosis, Electronic Health Record Systems, eHealth Services Availability, Infrastructure, eHealth Data Science, Monitoring</b>	<b>Automation, Infrastructure, eHealth Data Science, Intelligent Diagnosis, Electronic Health Record Systems, Telemedicine Systems, Decision Support Systems</b>	<b>Data, Supply of Services and Equipment and Health Worker, Quality of Healthcare, Acceptance, Utilization, Efficiency, Cost, Accountability</b>



of coordination between the government and the research community to be able to overcome mHealth infrastructure, policy, and workforce challenges. In this regard, policies should be implemented to align the research community and stakeholders' points of view, adapt and standardize different health information management systems, and strategize infrastructural and workforce readiness for the future implementation of mHealth. To make it happen, a strong mutual exchange of information and outputs is required between the governing body and the research community.

In Ghana, like Ethiopia, the research community addresses mostly health information management systems and their applications like decision support and telemedicine systems. Ghana's research community prioritizes implementation, acceptance, data, capacity building, and monitoring the most. System coordination and infrastructure improvement are being addressed by the government; however, policy is not addressed either at the governmental or research communal level. Also, lack of ICT professionalism of health workers is another challenging factor. The research community in Ghana has notified the need to focus on infrastructure, policy, data, and skilled workers. According to these points and considering the toolkit, Ghana also suffers lack of coordination between the governing body and the research community to be able to overcome acceptance, capacity building, and infrastructural adaptation. In this regard, policies are required to improve ICT professionalism and adapt its pace to infrastructural developments via training and acceptance elevation. To make it happen, like in Ethiopia, the governing body and the research community should be able to coordinate and exchange information and outputs.

In Malawi, the research community only focuses on health information systems and prioritizes the design and implementation of such systems. The futuristic approach of infrastructure implementation has prepared Malawi for further development of eHealth and mHealth; however, policymaking has been left far behind since only some minor regulations regarding access equity have been introduced. Regarding human resources, although Malawi has created academic pieces of training and programs, there is still a gap in the required number of skilled health workers to maximize outputs. The Malawi eHealth research community has recognized the need for innovation, sustainability, and policy while they also state that more health information worker is required. Considering these points, Malawi's government has prepared the infrastructural and academic foundation for a futuristic eHealth implementation, but professional workforce is hard to find. Possibly, lack of concentration both at the governmental and research communal level on the acceptance and eHealth culture has led Malawi's eHealth to this situation. In this respect, policies should be fortified in all aspects, especially cultural acceptance and movement towards digital health, to coordinate the government and research community's efforts and outputs towards maximizing the use of infrastructural and academic readiness.

The focus of the Tunisian eHealth research community also is on health information management systems and their applications such as decision support and telemedicine with a client-centricity while prioritizing security, privacy, monitoring, and digital diagnosis. Regarding infrastructures, only half of the households have an internet connection and ICT implementation is heavily culture-dependent. Policies only address security, quality, safety, innovation, risk, and e-service, and professional health work is scarce despite the availability of country-wide academic programs. The Tunisian eHealth research community has realized the need to focus on availability, infrastructure, implementation, and digital applications while they

indicate that equipment and health information worker is a challenge. It seems that Tunisia's government and research community are aligned regarding security and privacy which is the result of implemented policies; however, the government has neither prepared a futuristic infrastructural foundation nor addressed the cultural effects on digitalization. Accordingly, wider coordination of the government and eHealth research community covering these challenges prepares the ground for acceptance, implementation, and availability of eHealth.

## 6. Conclusion and Future Work

The BETTEReHEALTH project explores infrastructure, policy, and human factors in eHealth implementation in Africa. Accordingly, this study scrutinized the coverage of these motifs by the eHealth research community of Ethiopia, Ghana, Malawi, and Tunisia. An online qualitative survey collected the required data and revealed that Infrastructure-Policy-Human readiness and coordination is a must triangle in which any deficiency on any side can lead to a downfall of successful implementation of eHealth. For instance, lack of policies in Ethiopia and Ghana has led to the miscoordination of governmental and research communal approaches towards futuristic implementation of mHealth regarding required infrastructure and skilled workforce. Moreover, standardization and interoperability are impossible without a central regulated policy. Or in Malawi, despite infrastructural and academic readiness, lack of sufficient policies and human consideration has led to the hindrance of mHealth implementation and cultural congruity with digital health. Tunisia as an example clearly shows the importance of policies, areas in which policies are defined are covered by the research community. Policies as a central regulation coordinate the stakeholders' approaches and efforts and help interoperability and standardization; however, infrastructure and human factors are neglected by Tunisia's government leading to implementation and health information workforce challenges despite the availability of academic programs. As a result, future work should concern the thorough designation and implementation of eHealth policies as a central regulation and coordination factor. Policies as a foundation must be agile and flexible in addressing futuristic plans, situational struggles, and cultural transformations.

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