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The Implementation of AI Self-Triage systems as a Digital Health Solution for Primary Healthcare in Kenya: Challenges and Prospects

By

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DECLARATION

I declare that this thesis is my original work and has not been submitted to any other college, institution or university other than the University of Nairobi for academic credit.

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DEDICATION

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ABSTRACT

Digital innovation has brought about huge paradigm shifts on how services are rendered to end-users in many sectors of the Kenya economy. Information and technology is seen to hold more potential within the healthcare sector by enhancing access to healthcare, cutting down operational cost and revolutionizing patient care. The purpose of this study was to develop a framework that will guide the implementation of the AI self-triage system within the healthcare sector in Kenya. Existing framework for the implementation of AI-based self-triage systems within healthcare sectors are meant for developed countries and are not adequate enough to be applied in developing country like Kenya. The study use embraced an epistemological view of things in undertaking grounded theory. The grounded theory approach was adopted in the collection and analysis of data for purpose of delivering a data driven model for implementation of AI-self-triage systems. Being a relative new field and topic, the study used snowball and saturation sampling to interview 10 respondents where aspects such as hindrances to quality healthcare, self-medication, experience in utilization of AI-based self-triage systems and recommendations on use and adoption of the self-triage tools were interrogated. Analysis of the data was by using NVivo software version 11 where codes, categories and themes were discovered from the underlying data. From data analysis where initial, axial and selective coding were embraced, the study uncovered five themes and 15 codes which formed the basis of memoing and the establishment of relationships. The identified themes include: hindrances to access to quality healthcare, prevalence of self-medication, inefficiencies at healthcare facilities, existing self-medication tools and their efficacy and requirement for adoption of AI self-triage systems. The developed framework highlights factors behind the preference of self-medication within the society and establishes the preference for AI-based self-medication. The framework takes into consideration end-user preferences for AI-self triage systems and how these preferences influence requirements for implementation of AI self-triage systems. From the framework prerequisites for the implementation of self-triage systems within the Kenyan health sector have been outlined. The model proposes key aspects such as policy, IT infrastructure, presence regulatory organizations and efficacy of AI self-triage systems as key requirements for their implementation. Findings of the study may in future influence policy formulation and shift the focus of digital innovation within healthcare from operational oriented to patient-centered systems and tools. Proper implementation of AI-based self-triage tools within the health sector may promote safe self-medication and enhance access to quality healthcare.

1   INTRODUCTION

1.1   Introduction/Background

Globally, access to healthcare services among the citizenry has been regarded as the "foremost human right." The universally adopted resolution A/RES/70/1 of the 2014 UN General Assembly established the 2030 Agenda for Sustainable Development that envisions a world where universal and equitable access to healthcare is assured for all persons of all ages (Assembly, 2015). Consequently, governments globally acknowledged the need for provisioning healthcare services to reduce the global burden of morbidity and mortality. However, Peter O. Otieno et al. (2020, p. 2) state that access to primary healthcare services among the citizenry in Kenya's low and middle-income levels has been challenging. As per the last census, the annual growth rate of Kenya's population was set to 2.26%, corresponding to an increase in demands for healthcare services. Annually, the average rate of urbanization is 27.51% meaning more persons are migrating to towns, thus resulting in overpopulated cities and cities. Therefore, there is a need to formulate healthcare policies that are alive to population growth and demographics to improve healthcare accessibility. (Konstantina, Stella, Kleoparta, Aggeliki, & Alexandros, 2020, p. 39) states that governing bodies' healthcare policies have not enhanced healthcare accessibility or promoted curative, preventive, and rehabilitative services. It is paramount that governments strengthen healthcare systems by improving the healthcare workforce, enhancing public health outcomes, and pushing for equitable access to quality healthcare among the people. However, the existing challenges of the Kenyan healthcare systems are systemic and crosscutting. Since devolution, the healthcare industry in Kenya has seen a reduction in funds, thus affecting resourcing of existing healthcare facilities and the construction new facilities to meet healthcare demands (Masaba, Moturi, Taiswa, & Mmusi-Phetoe, 2020). Underfunding has also contributed to the scarcity of medical supplies forcing patients to procure the medicine from private facilities.

Furthermore, due to poor remuneration, healthcare workers have continually been on a go-slow or strikes, leading to the closure of healthcare facilities. The WHO has stipulated that globally, the recommended ratio between skilled health workers and the population is 1.74 per 1000 population. This is equivalent to 17.4 per 10,000 in Kenya (Organization, 2019). Muthuri, Senkubuge, and Hongoro (2021, p. 2) highlight that the decline in the health worker-to-population ratio in Kenya has been attributed to neglect of healthcare system development, brain drain, deplorable working

conditions, inadequate human resource practices, low and delayed salary, and recurrent industrial strikes. As a result, well-equipped and established public healthcare facilities in both urban and rural areas in Kenya lack qualified healthcare staff, forcing patients to wait in long queues or seek alternatives. Qualified medical personnel have opted for private practice or joined well-established private hospitals with dignified pay and a better working environment. The availability of medical supplies among all healthcare facilities in Kenya is critical in optimizing healthcare accessibility by presenting an opportunity for the citizenry to access healthcare when needed. As stated in (Kiplagat & Musyoka, 2021, p. 3), statistically, counties have invested considerably in availing critical equipment and essential medicine in healthcare facilities. However, some crucial medical supplies essential to primary healthcare are still inadequate. The existing gaps in funding coupled with supply chain challenges at KESMA have contributed to existing gaps in quality care. Generally, existing challenges in the healthcare system in Kenya have primarily contributed to the inaccessibility of healthcare services by making healthcare an expensive and scarce commodity (Peter O. Otieno et al., 2020, p. 9).

1.2   Statement of the Problem

Universal healthcare in Kenya is the core of the government's effort to strengthen health systems, improving accessibility and availability of healthcare services to all regardless of their financial status. The government, through UHC, aims to ensure the healthcare system is well funded, facilities are established, fully equipped, medical personnel is well remunerated, and primary healthcare is accessible to all people without discrimination. Otieno, Kiroro, Runyenje, and Kamau (2021, p. 1) highlight a huge unmet and unexpressed demand for healthcare among the citizenry, which stems from healthcare gaps related to accessibility and availability and acceptability. Currently, existing gaps have contributed to delays in seeking appropriate care, enhanced severity of illnesses, and reduced prognosis. Additionally, the cost of healthcare services has ballooned over time, thus being a financial burden to all citizens' predominantly low-income households. Existing ICT-related efforts in enhancing access to quality primary healthcare have proved not practical and sustainable in meeting the demand for healthcare. The ever-increasing primary healthcare deficit has resulted in mushrooming of unorthodox means of acquiring healthcare services, for instance, self-medication and the existence of un-approved medical facilities and practitioners.

Public and private healthcare providers have incorporated eHealth and telemedicine to streamline healthcare processes, reduce cost, enhance quality, and reach out to persons with unmet healthcare needs (Christie, 2020). Telemedicine has gained traction among providers who render specialized healthcare services, meeting patients with chronic diseases. Existing Telemedicine initiatives have been through online video conferencing and call centers. Both eHealth and telemedicine have not been effective in meeting the considerable healthcare deficit among the population due to underlying systemic challenges within the healthcare sector (Mbugua, 2016).

Densely populated countries such as the US, UK, and China have streamlined their healthcare systems, national telemedicine infrastructure, and self-triage options to enhance access to healthcare among the citizenry. Self-triage or symptoms checkers were embraced to reduce over-reliance on medical professionals, reduce medical visits, and reduce the cost of healthcare (Montenegro, da Costa, & da Rosa Righi, 2019). Unlike telemedicine, the adoption of AI-led conversational agents triage systems has proved cost-effective as they leverage mobile applications accessible to all citizens.

Regarding Kenya, the realization of AI-led self-triage systems is a possibility. According to Mureithi and Nyaguthii (2021, p. 5), digital penetration and literacy in Kenya have been on the rise, meaning the public has access to digital technical technology and better understands their operation. Telemedicine initiatives have proved to be costly, as it requires the deployment of ICT infrastructure within the country. Leveraging digital penetration and literacy among citizens in delivering AI-Led conversational self-triage systems will enhance access to primary healthcare. Accessible to all citizenry on the web or smartphone, the AI-self-diagnostic conversation agents will provide medical consultation to the citizenry and make referrals.

1.3 Purpose of the Study

This study explored implementing and using a mHealth AI-based self-triage conversational agent to provide cost-effective primary healthcare in Kenya. The study emphasized implementation, adoption, and acceptability issues within the Kenyan population.

1.4 Objectives of the Study

The study's broad objective was to explore the implementation and use of AI self-triage digital mHealth solutions for primary healthcare diagnosis to increase access and reduce the existing healthcare deficit. Specific objectives include:

- To evaluate the effectiveness of mHealth and eHealth in enhancing access to primary healthcare among the Kenyan population.
- To evaluate requirements that necessitate implementing and adopting the AI self-triage system for primary healthcare.
- To assess the public's readiness and perception regarding the utilization of AI self-triage systems for primary healthcare.
- To establish a model for implementing and rolling out a mHealth based AI self-triage system for primary healthcare.

1.5   Limitation of the Study

This study encountered the following challenges:

- There was little understanding among the Kenyan medical professionals and the public knowledge around AI self-triage conversational agents.
- There was limited study around AI self-triage conversational agents in an African context.

1.6   Research Questions

In regards to the objective of the study and the problem statement, the research sought to answer the following questions:

1. How does the Kenyan population presently use eHealth and telemedicine applications to access primary healthcare?
2. What is required for seamless implementation and use of "an automated, online" self-triage system in the Kenya Health sector?
3. How ready is the Kenyan health system for the implementation and use of AI Self-triage systems to deliver primary healthcare?

1.7   Justification

This study aimed to explore aspects implementation of AI health Chabot in the Kenyan healthcare system to enhance equitable access to quality and primary healthcare services. Access to direct healthcare services among the citizenry has been highly challenging due to healthcare infrastructure gaps, inadequate resourcing of healthcare facilities, insufficient staffing, and poor quality of healthcare services. Population growth has led to increased demand for healthcare services, but existing challenges have resulted in a considerable healthcare deficit.

In the meeting, the healthcare gaps and ensuring healthcare services are accessible to all; the government commenced implementing a universal healthcare coverage program. According to Okech and Lelegwe (2016, p. 219), UHC in Kenya is founded on enhancing financial protection among the citizenry, increasing the quality of health services, enhancing coverage in the informal sector, and enhancing access among the underserved population. Consequently, the government has implemented eHealth initiatives supporting UHC, i.e., mobile access to NHIF, comprehensive national implementation of ERM systems, and adoption of telemedicine in remote delivery of specialized healthcare services. There is a massive opportunity to upscale existing eHealth initiatives to enhance equitable access to healthcare services by leveraging digital penetration. Therefore, the study explores the position of mHealth in supporting UHC and further assesses the place of AI health Chabot's in providing personalized healthcare services, specifically self-diagnosis of common diseases. Tremendous opportunities lie within the utilization of AI, specifically conversational agents, in replacing doctor-patient interactions, cutting down hospital visits, pushing for correct self-medication practices, and cutting costs for healthcare.

This study's audience included stakeholders & policy makers in the ministry of health within the Kenyan government wither national or county. The Kenyan government encourages investors and development partners to establish ICT-related health initiatives to enhance healthcare access in Kenya through its eHealth policy. Therefore, insights acquired from this study shall provide foundation knowledge on the prospects around implementation and use of eHealth initiatives. This study highlighted the prevalence of self-medication and assessed how AI self-triage systems could minimize associated risks.

2   LITERATURE REVIEW

2.1   Introduction

Equitable access to healthcare among the population in Kenya has been entrenched in the 2010 constitution of Kenya. Despite the government's efforts and other stakeholders in the health sector, accessibility levels are still low. This literature review emphasizes evaluating existing efforts to equitable healthcare, outlining system and cultural barriers, and assessing how the population navigates around accessibility issues. Further, the research shall identify digital health solutions around healthcare access and gaps yet to be met by digital health solutions.

2.2   Universal Health Coverage (UHC) Ambitions in Kenya

Despite the existing challenges in access to healthcare among the population, governing bodies have set up initiatives such as Universal Health Coverage in the recent past. Moses et al. (2021, p. 2) outline that UHC is a means to establish a well-managed health system that is adequately financed and responsive to the population's needs, thus making healthcare equitably accessible to all. The government's push for universal healthcare coverage (UHC) has emphasized onboarding all citizens on healthcare insurance for healthcare affordability purposes. More Kenyans have been onboarded on the National Hospital Insurance Fund. Still, healthcare providers have reported delays in reimbursement due to poor governance at the fund and narrow benefits schemes, thus affecting their cash flows. As a result, healthcare providers have to balance between generating revenue and supporting UHC initiatives. Hence, healthcare providers have since imposed user fees leading to catastrophic out-of-pocket healthcare spending among the citizenry, which weighs heavily on the healthcare financial burden field. However, the push for UHC in Kenya has improved maternal care by making maternal health services accessible across government facilities free of charge. Nevertheless, UHC remains a distant goal in Kenya.

Moses et al. (2021, p. 2) declare that progress in UHC can be realized by emphasizing the improvement of healthcare systems performance and enhancing the efficient use of existing limited resources. Inadequate healthcare financing and declining external funding have resulted in limited staff, medical supplies, and medical infrastructure across public facilities. The Kenyan healthcare system requires functional financial management systems and better governance at facility levels to impact on quality of healthcare services and efficient use of resources (Moses et al., 2021, p. 11).

2.3   Barriers to Equitable Healthcare in Kenya

A study conducted by Chelogoi, Jonyo, and Amadi (2020) outlined social-cultural factors affecting access to healthcare as 1) Households' perception towards healthcare services provided which saw more leaning towards private facilities, 2) Household income levels where low-income earners preferred public facilities due to affordability 3). Household education levels were where learners opted for private facilities while others went to local facilities where they communicated in regional dialects. 4). All households lack faith in public facilities as they lack essential facilities. Due to the high cost of healthcare in Kenya, low-income households have limited access to quality care resulting in massive inequalities. According to Howland (2020, p. 2), access to quality healthcare among the population in Kenya has resulted in increased uptake of indigenous healing as people are shying away from biomedical treatment. Most citizens, especially low-income households in urban and rural areas, have used herbs and self-self-medication practices. Mushrooming of unlicensed medical facilities and counterfeit drugs in the market are the contributing factors that push for the rise of self-medication and the use of herbs (Howland, 2020, p. 9).

2.3.1   Self-Medication a Consequence of Inaccessible Healthcare

Currently, the Kenyans who lack access to healthcare facilities have resorted to self-medication. Yadav and Rawal (2015, p. 139) state that in low-income countries such as Kenya, the citizenry opts for self-medication to curb the disease burned due to the lack of proper medical facilities. Self-medication entails using drugs that have not been recommended, prescribed, or controlled by a licensed clinical officer. Onchonga, Omwoyo, and Nyamamba (2020, p. 1150) highlight an increased number of online searches for self-medication in Kenya during the pandemic. Self-medication is most common in countries with fewer medical practitioners and constrained healthcare, forcing patients to look for alternative healthcare means. Self-medication is triggered by long waiting times, challenges in securing appointments with medical practitioners, health workers' strikes, facility closure, medical stock outages within facilities, and delays in getting treatment during emergencies (Onchonga et al., 2020, p. 1150). NT and Habib (2021, p. 1) outline some of the benefits of self-medication, including reduction of health expenses, reduction of waiting time, reduction of the load on medical services, better treatment of minor illnesses, essential in treating emergencies and enhanced access to health on remote areas. However, unregulated and prolonged self-medication might pose diverse effects on the population's health.

Due to an overload in the medical system caused by the pandemic, people have opted for self-medication to reduce exposure to COVID-19 and access instant healthcare. The consequences of unregulated or prolonged self-medication may include allergic reactions emanating from wrong self-prescription, treatment failure due to uptake of wrong medication, addiction to medicine, may trigger mental health diseases, and increased healthcare costs for prolonged illnesses (NT & Habib, 2021, p. 2).

2.4 ICT Initiatives around Equitable Access to Healthcare

2.4.1 Telemedicine for Healthcare Accessibility

Kangethe (2018, p. 1) states that telemedicine entails remote interaction between patients and doctors via an ICT infrastructure to provide healthcare. Telemedicine can be either "store or forward" or real-time, depending on the signal strength between doctors and patients. Several healthcare providers have applied telemedicine in offering instant & quality healthcare services to persons living in remote areas. For instance, the AMPATH consortium developed a telemedicine infrastructure for oncology services, which decreased operational costs, brought patients from low-income households, and maximized physician resources (Mbunya, Asirwa, & Felker, 2018). Hence, telemedicine plays a crucial role in enhancing access to healthcare among the citizenry in both urban and remote areas. However, the telemedicine adoption level within the country has decreased over the years as minimum investment has been made in establishing robust infrastructure, training of clinicians, and equipping facilities (Mbugua, 2016, p. 107). The adoption of telemedicine among healthcare providers has not proved effective in enhancing healthcare accessibility among the citizenry hence the rise in self-medication and mushrooming of unlicensed healthcare facilities. Consequently, the cost of healthcare in Kenya has risen considerably high. Njagi et al. (2020) reported that the inequities in healthcare services stem from a social-economic aspect where only the rich can access healthcare while the poor can forgo care.

Additionally, the only healthcare services accessible to the low-income earners are below standards due to understaffing, under-facilitation, and unavailable medical supplies. There is a close relation between digital penetration in Kenya and the growth of eHealth initiatives targeting to enhance the accessibility of healthcare services among the population. Bakibinga et al. (2020, p. 2) outline that development in ICT within the country has enhanced digital innovation for Kenya's wellbeing. Hence, Kenya has seen a growth in ICT infrastructure for health information

systems (HIS), m-Health, e.g., M-Tiba, and e-learning for education and knowledge sharing. Kenya has access to mobile phones and smartphones, and increased digital literacy through digital penetration.

2.4.2   EHealth initiatives in Kenya

To navigate through the challenges faced by the Kenyan health system, public and private stakeholders have realized the existing benefits of ICT in improving access to healthcare services. However, existing obstacles such as underfunding, few demotivated workforces, and poor infrastructure have not made ICT adoption an easy task (Thaiya, Julia, & Joram, 2021). Presence of ICT4D initiatives such as digitization of the NHIF, development and commissioning of the Kenya Health Interoperability Framework that interfaces all Electronic Medical Records (EMR) systems and District Health Information System (DHIS) have enhanced medical referral and reporting across public healthcare facilities. However, Thaiya et al. (2021, p. 49) state that policy and strategy gaps within the MOH support accessibility, integration, interoperability, usability, and standardization of ICT4D interventions in the healthcare sector.

Equally, eHealth has increased adoption among public and private stakeholders in the Kenyan health sector in the recent past. An assessment conducted by Njoroge, Zurovac, Ogara, Chuma, and Kirigia (2017, p. 2) concerning eHealth initiatives in Kenya reveals that their core objective among public and private healthcare facilities is to cut operational costs, enhance the quality of service, and increase the accessibility of healthcare services. Hence, the national eHealth strategy was founded on five specific health information systems, mHealth, eLearning, and telemedicine. Unlike other eHealth initiatives, mHealth projects have been successfully implemented in the Kenyan health sector due to the low implementation cost and increased digital penetration in rural and urban areas. Existing mHealth initiatives have utilized USSD, SMS, and mobile apps to effectively connect patients with health practitioners and broadcast health information (Njoroge et al., 2017, p. 8). mHealth possesses significant possibilities for overcoming challenges such as inadequate infrastructure, unskilled staff, insufficient or unreliable power supply, and scarce funds to sustain projects. Njoroge et al. (2017, p. 8) further explain that the absence of sustainable funding for eHealth projects, the lack of a regulatory framework that supports innovation, and the absence of patient safeguarding frameworks are some of the gaps that hinder the adoption of eHealth projects within the Kenyan health sector. However, eHealth initiatives, specifically

mHealth, possess the massive potential to enhance healthcare access. Hence, development partners and key stakeholders can leverage digital penetration to ensure these initiatives' cost-effectiveness and sustainability.

2.4.3   Effectiveness of Telemedicine, eHealth, and mHealth in meeting healthcare needs

The national eHealth Policy 2017-2030 has highlighted the ambitions of the Ministry of Health (MOH) in enhancing the adoption of technology in healthcare delivery. The policy document – highlights a significant increase in the development and implementation of ICT initiatives that are geared towards the delivery of healthcare services. Karari et al. (2011) evaluated the uptake of 'the Uliza' HIV telephone consultation service in the Nyanza province and highlighted significant successes in navigating around logistical and structural barriers in enhancing access to quality healthcare. Findings of a study conducted by van der Kop et al. (2018) regarding the effectiveness of the 'WelTell/SMS' application developed by a non-profit to enhance HIV patient retention revealed that Text Messaging offered more personalized communication to patients contributing to retention rates. A study meant to assess the feasibility and acceptability of iMACC, a family planning decision aid application for women in Kenya, outlined high adoption rates amid doubts about its usefulness and attitude and behavioral change (Dev et al., 2019). Adopting eHealth, more specific aspects of mHealth within the Kenyan health sector, has proved effective in navigating systemic challenges such as funding, under-equipped healthcare facilities, digital literacy concerns among healthcare professionals, and Most eHealth initiatives in the health sector are donor-funded. Therefore, non-involvement of government leads to the non-sustainability of these initiatives hence hindering their effectiveness.

The above cases highlighting successful eHealth, mHealth, and Telemedicine initiatives undertaken in Kenya agree with the Kenya National eHealth Strategy 2016-2030 assertion that Kenya's health sector is receptive to technological innovation. The eHealth Policy's vision is to establish an enabling environment for sustainable incorporation and efficient use of eHealth products and services in all aspects of healthcare delivery in Kenya. The government intends to enhance equitable healthcare access using ICT, push for patient-centered healthcare, standardization, and integrations of eHealth solutions and enhance participation from all stakeholders. In a study, Cheruiyot (2018, p. 2) evaluated the state of eHealth in Kenya and highlighted underlying issues such as poor infrastructure, low digital literacy among healthcare

workers, inadequate qualified personnel, lack of enough funding from the government as critical hindrances towards the full realization of eHealth in the health sector. Due to a lack of government involvement and the absence of required policy, numerous eHealth initiatives put forward by stakeholders lead to duplication (Juma, Nahason, Apollo, Gregory, & Patrick, 2012). Duplication has resulted in stakeholders' non-consolidation of eHealth efforts, hence unnecessary competition and low adoption.

2.5   AI Self Diagnostic Digital Health Technology, a component of mHealth

By leveraging digital transformation and complementing the existing mHealth technologies, access to healthcare can be enhanced by developing the self-diagnostic application. Nadarzynski, Miles, Cowie, and Ridge (2019, p. 2) state that AI is a natural language processing system that offers virtual conversational agents that mimic human interactions. Health-Chabot's running on natural language processing and machine learning have proven effective in increasing access to healthcare, enhancing doctor-patient communication, and managing the increase in demand for health services such as remote testing, medication adherence, and teleconsultation. According to Divya, Indumathi, Ishwarya, Priyasankari, and Devi (2018, p. 2), the rise in the cost of healthcare and the inability to access quality healthcare sets health-Chabot as the most effective tools for cost-effective healthcare, establishing personalized care enhanced patient engagement. Three components that make up a health-Chabot for self-diagnosis purposes include validating end-users symptoms accurately mapping systems with existing records in the database, and compiling a personalized diagnosis and referral to patients (Divya et al., 2018, p. 2). Hence, self-diagnostic health-Chabot can predict the disease depending on patients' symptoms and recommend available treatment, home remedies, and referrals.

Razzaki et al. (2018, p. 7) conducted a study that evaluated the correctness of AI triage and diagnostic system against several doctors. The study revealed that the triage and diagnostic system consultations correctly identified conditions compared to human doctors in precision and recall. Hence, the study concluded that the AI triage system was more accurate and safer than an average human doctor. Human doctors are prone to biases and may not agree on methods; hence AI triage systems with self-learning capabilities are more accurate and freer of biases. A study conducted by Nadarzynski et al. (2019, p. 6) concerning the acceptability of AI-led Chabot systems for healthcare perspective was low because of accuracy concerns. Still, at the same time, end users

loved anonymity, privacy, instantaneous response, and availability. Acceptability of AI-led triage systems is founded on a multi-faceted approach comprising several dimensions, including burden, effectiveness, cognition, and emotional intelligence/response. To address accuracy concerns, You and Gui (2020, p. 1362) recommended that functions of AI-led diagnostic systems should refer to patient's history in the diagnostic process, allow users to enter symptoms at different levels, possess shorter response time, provide support to users with diverse healthcare conditions and avail channels for follow-up.

2.5.1 Cases of Adoption of Health Chatbots/Conversational Agents in Real-world Setting

Field Safi, Abd-Alrazaq, Khalifa, and Househ (2020) conducted a technical review that many jurisdictions globally have embraced health chatbots in providing emergency and non-emergency care and convince of self-care for the citizenry. Montenegro et al. (2019, p. 8) explain that the context within which AI conversational agents have been adopted in healthcare includes assurance of medical diagnosis, treatment of medical diseases, e.g., mental health, implement preventive measures, and offer health literacy enabling patients to have an understanding of medical concepts. According to Verzantvoort, Teunis, Verheij, and van der Velden (2018), the National Health Service (NHS) in the UK approved the adoption of the **Babylon app, NHS111 Online**, which offers symptoms, checkers, self-diagnosis, and above all, enhance the public's ability to make correct healthcare decisions. Adoption of the self-triage application by the UK's NHS was backed by the need to reduce overcrowding and overburden of the NHS, enhance remote access to healthcare and push for a cost-effective healthcare (Chambers et al., 2019). Before adopting the personalized self-triage system, the Netherlands had already adopted Telephone Triage systems guided by the National Triage System (NTS). Upon realizing NTS's critical role, a self-triage application, "Should I see a doctor," was introduced, resulting in massive uptake among all demographics, according to a study conducted by Verzantvoort et al. (2018). During the pandemic, China embraced using the "**China's- DoctorBot,**" an AI-Led web and smartphone self-triage application to enhance access to healthcare for high-risk persons and reduce unnecessary clinical visits, thus relieving pressure on the healthcare system (Fan et al., 2021, p. 2). Due to the increase in the need for personalized healthcare, private investors in global health have developed AI-led self-diagnostic systems running on the web serving global online users, e.g., Baidu, Buoy Health, Tencent, Ada Digital Health Ltd, and Sensely.

Insights from countries that have to incorporate any form of self-triage or symptom checker reveal that these digital solutions are successors of a robust telehealth infrastructure. For instance, the Babylon app is a derivative of the data and infrastructure of the NHS111. The "Should I See a Doctor app" (NHS App) is founded on the National Triage System. Lastly, these applications enjoy full support from governing bodies and have seamlessly been integrated into the national health system.

2.5.2   Prerequisites for the Implementation of AI Self-triage systems in Kenya

The National eHealth policy identifies requirements for adopting eHealth initiatives as legal and ethical, infrastructural needs, and policy frameworks. Implementing an AI self-triage system within the health sector may require more than policy, funding, framework, and legal aspects. The USAID report on the state of adoption of IT in global health describes use cases for adopting AI in the health sector as a virtual health assistant, clinical decision support, and population health (Artificial Intelligence in Global Health: Defining a Collective Path Forward, 2021). The report identifies prerequisites that necessitate adopting digital health solutions for AI.

AI self-triage systems rely on data, which forms the knowledge base for the machine-learning algorithm. In a low-resourced context such as the Kenyan healthcare system, where compliance to health data reporting is low, it might hinder realizing a National Health Triage Database (NHTD). The effectiveness of AI self-triage system inpatient diagnosis relies on the correctness of the health data containing symptoms, diseases, home remedies, etc. There is a need for healthcare system interoperability to consolidate all data collection and sharing in the health sector. The Kenya eHealth policy 2016-2030 expresses the need for legal and ethical aspects in establishing a successful enabling implementation of eHealth initiatives. The government intends to enforce adherence to the Kenya Communication Act (2012), eHealth Strategic Plan (2011-2017), ICT policy, and the Data Protection Act 2012 in providing a legal framework for eHealth adoption. USAID explains that adoption of AI within there is a need to create and enforce regulations and policies that will enhance adoption but safeguard data and patients. Equitable access to healthcare requires proper provisioning of resources across all parts of the country. Therefore, AI self-triage systems should be equitably accessible to all citizens. This shall require a multi-stakeholder approach to enhancing existing infrastructure in healthcare centers and ensuring the availability of the self-triage system onto widely used devices such as mobile phones. The eHealth policy

stipulates that eHealth solutions like AI self-triage systems should be incorporated into existing technology for smooth adoption and utilization.

2.6   Critical Analysis

Existing challenges in the Kenyan healthcare system, explicitly funding, infrastructural, and inadequate staffing, pose major hindrances to healthcare accessibility in Kenya. Healthcare costs have been considerably high, forcing households to acquire healthcare from unlicensed facilities, embrace self-medication, and procure herbal medication. However, these approaches expose households to misdiagnosis and overdosing, leading to death or drug resistance. Therefore, to enhance access to healthcare and, at the same time, navigate through existing challenges, stakeholders have implemented several eHealth initiatives, most specifically mHealth projects, due to digital penetration. ICT-related initiatives' health outcomes and sustainability have not been realized due to sustainable funding, lack of regulatory framework, absence of government support for sustainability, and difficulties scaling initiatives to a national scale. The absence of government support in developing and commissioning eHealth initiatives has led to duplication and a non-coordinated approach among stakeholders. Most eHealth initiatives in the health sector have not proved sustainable in enhancing access to healthcare due to the inability to counter underlying issues within the health sector. As a result, there has been continual growth in citizens' health care deficit, resulting in increased self-medication and mushrooming of unlicensed, unorthodox healthcare options.

The increased rate of self-medication among the citizenry pushes for the need to adopt a mHealth technology that can leverage existing eHealth initiatives in safeguarding persons from risks of self-medication. Mobile-based AI self-diagnosis Chatbots pose enormous potential in leveraging existing self-medication habits by providing trusted and personalized medical diagnoses. Mobile-based self-triage systems have proved effective in countries like the UK, the US, and China to provide primary healthcare, reduce hospital visits, and deliver cost-effective healthcare services. In Kenya, mHealth initiatives pose huge potential resulting from ever-increasing digital penetration and access to mobile phones. Therefore, implementing a mHealth based AI self-triage system in Kenya would prove a sustainable self-medication option for a vast population in Kenya. However, its realization requires a multi-stakeholder approach in establishing self-medication regulations, setting up a National Health Triage System, legal frameworks, and overall

infrastructure to ensure equitable access to the triage system. Kenya lacks regulatory and policy frameworks, adequate infrastructure, quality healthcare data, and sustainable support from development partners and the government to adopt AI self-diagnosis health Chatbots.

3 RESEARCH METHODOLOGY

3.1 Introduction

Melnikovas (2018, p. 33) alludes that research methodology is a systematic process that communicates the researchers' intentions in resolving the research problem through data collection, interpretation, analysis, and interpretations, after which conclusions are drawn. This chapter is integral to the research project as it ensures consistency between the chosen approaches, tools, techniques, and underlying philosophy. Hence, this chapter shall communicate the plan or blueprint to answer all research questions and attain the objectives.

3.2 Research Philosophy

About the research onion, research philosophy provides a framework that forms the foundation of beliefs and assumptions used to develop knowledge during this research. Therefore, research philosophies provide critical assumptions about how this research project shall view the world. This research shall adopt an interpretivism paradigm. Park, Konge, and Artino (2020, p. 41) highlighted that interpretivism is founded on subjective ontological deductions, which states that reality is constantly evolving and socially constructed. In this study, knowledge and facts are relative and subjective. Through interpretivism, this research adopted epistemology in discovering regularities or facts that are measurable and observable.

Further, the study embraced the interpretivism approach founded on the fact that human actions/behavior can be explained or interpreted through a deep understanding of their actions and interactions. Additionally, the research examined the relationship between collected data, after which generalizations and conclusions were drawn. Due to limited research within the research's domain, this research adopted abduction regarding theory development.

3.3 Research Design

The effective undertaking of this study required the adoption of inductive research. The study intends to gather data, analyze and conclude concerning the adoption of AI self-diagnosis system in enhancing access to primary healthcare in the Kenyan healthcare sector. The dynamic state of the healthcare sector in Kenya required the study to employ approaches that answered questions such as what, who, when, how, and what. Inductive reasoning or coding was adopted in the research, where data collection and analysis involved themes and codes. The study domain was healthcare; hence, a cross-sectional study collected data from the population at a specific time.

This study intended to collect non-numerical data through open-ended conversations with research subjects. Therefore, the methodological choice shall be Qualitative. The study adopted qualitative methods in answering the following research questions.

1. How does the Kenyan population presently use eHealth and telemedicine applications to access primary healthcare?

2. *What is required for seamless implementation and use of "an automated, online" self-triage system in the Kenya Health sector*

3. How ready is the Kenyan health system for the implementation and use of AI Self-triage systems to deliver primary healthcare?

3.4   Research Area

The area of study setting was Nairobi City County. Being the capital city, Nairobi is home to people from various countries, capturing all demographics needed for this study. The general population was drawn from the town where respective health practitioners and pharmacists were involved in the study.

3.5   Target Population

Due to the extensive nature of the study, insights and data were acquired from various stakeholders in the healthcare sector. To understand the citizenry's plight for quality and affordable primary healthcare, the study shall engage a random sample of persons living within densely populated areas in Nairobi. The population provided insights on how their self-medication options and how mHealth technology can necessitate safe self-triage options. Healthcare professionals, specifically medical doctors or clinical officers within selected areas in Nairobi, were indulged in the study. This target population provided the analysis with patient diagnosis trends, assessed eHealth use cases within their day-to-day interactions with patients, and evaluated AI self-triage systems. The study assessed the prevalence of self-medication within Nairobi. The customer service team at pharmaceuticals within Nairobi interact with persons who self-medicate or offer on-counter prescription; hence, they were engaged to understand self-medication habits better and assess how technology can be used. In evaluating the government's efforts to enhance UHC through mHealth, the study engaged the Kenya National Medical Practitioner Board (KMPDU) representative. In addition, policymakers within the MOH were employed to assess the technological, regulatory, and legal framework needed to realize AI self-medication. In summary:

- General Population in low-income areas in Nairobi

- Medical professionals, specifical doctors

- A representative from the Nairobi County Ministry of Health or KMPDU

3.6   Sampling and Sampling Procedures

The nature of the study's target population demanded the use of sampling methods that led to the acquisition of correct and factual data and provided flexible data collection approaches. The study used:

- Snowball Sampling

    Etikan, Alkassim, and Abubakar (2016) state that snowballing sampling commences from selecting convenience samples containing initial subjects who then serve as seeds through which one subject will recruit another matter. Due to accessibility issues around doctors, pharmacists, and policymakers, the study defined an initial sample upon which each subject referred us to appropriate models. The form of snowball sampling that was adopted was discriminative in that not all participants will be required to refer or recruit another subject. The study ensured unbiased probing and data collection before engaging the topics to wave issues from the initial sample of medical professionals, pharmacists, and MOH policymakers.

- Saturation Sampling

    Saunders et al. (2018) attribute the popularity of saturation sampling in qualitative health-related studies to its ability to enable further probing of subjects until no additional data can be acquired. Due to the nature of the survey, saturation sampling guided the extent to which probing and data collection was undertaken regarding inductive thematic saturation. All subjects were probed, both initial and referrals, and data shall be analyzed until no new themes and codes emerge from the study.

3.7   Data sources and collection

Effective data collection is paramount to acquiring insights from the target population. However, the effectiveness of the data collection process was seen through keen consideration of the target population and the viability of each technique. This study intended to acquire different insights from various target groups; therefore, interviews were the most appropriate data collection techniques.

3.7.1 Interviews

Both semi-structured and unstructured interviews were used in data collection. Unlike questionnaires, interviews provided respondents with a chance to give feedback concerning other aspects of the project. To ensure the effectiveness of interviews in data collection, the study set time limits for each discussion, carefully selected respondents, gently probed respondents about their opinions and appropriately recorded feedback. Additionally, the interviews considered the target population's demographics, as it is critical in analyzing the acquired feedback.

3.7.2 Validity and reliability of the instruments

Validity and reliability are critical in ensuring a measurement instrument's quality and integrity and quality. Mohajan (2017, p. 5) explains that reliability and validity enhance research transparency and decrease researchers' biasness, especially in qualitative research. To guarantee the accuracy and correctness of the adopted instruments, the research ensured inclusivity in respondents' selection and practical communication skills. In assessing the validity of each instrument, this study considered both face and content validity. Face validity sets whether the adopted instrument appears appropriate and can give good measure. Content validity systematically examined the content acquired from each device against the behavior of each sample size. Validity and reliability checks were conducted periodically, and improvements were made to the instruments.

3.8 Data Analysis

Data analysis involves cleaning, inspecting, transforming, and modelling data to identify critical information, propose conclusions, and guide decision-making. Data analysis is essential as it defines how the study answered the research questions. This study utilized qualitative data analysis methods. Qualitative data analysis involves consolidation of related data, data exploration, and creation of initial codes, reviewing the codes, combining them into various themes, and cohesively presenting the themes. In drawing inferences from the data, they focused on the research objectives and demographics in establishing relationships and compiling conclusions.

This study adopted a grounded theory approach to data analysis. Field (Mayer, 2015) stated that the grounded theory approach to qualitative data analysis aimed to develop a theory or conceptual framework from data. The grounded theory involves the systematic development of theory founded on data that has been systematically collected, transformed, and analyzed. Therefore, the

study adopted a comparative study, which uncovered similarities in themes and codes underlying the acquired data. The study constantly undertook a comparative study and found the evolving theory until theoretical saturation was reached. Due to the time-consuming nature of the grounded theory analysis, the study adopted automated tolls such as NVIVO to help analyze the data, especially for comparative research.

Data analysis commenced by developing and identifying codes that lie within various themes within the study. Some of the applicable pieces within the study included self-medication prevalence, technological use in self-medication, AI in health and AI self-medication. Coding commenced by organizing raw data collected and making sense of it, then establishing linkage between categories and codes, and lastly, formulating a storyline by connecting the identified regulations. Data interpretation effectively applied approaches such as identifying repeated words and phrases, comparing primary and secondary data, and searching for missing information.

Purposive sampling

Generating/Collecting data

| Survey | Interviews | Focus groups | Other data |

Initial coding

| Coding | Category identification |

Intermediate coding

| Selecting core category | Data saturation |

Advanced coding

| Storyline | Theoretical coding |

Grounded theory

Theoretical sensitivity

Theoretical sampling

Concurrent data collection & analysis

Constant comparative analysis

Memoing

3.9 Ethical Considerations

Ethical consideration entailed aligning a research study towards key recommendations that ensured that the research gave respondents informed consent and respected their rights. The following ethical considerations were essential to this research:

- Informed Consent (Voluntary participation)

The principle of informed consent ensures that respondents are not coerced into participating in the research. Therefore, the analysis shall inform all respondents on aspects of the study to make their judgment.

- Anonymity

Additionally, the study ensured all respondents remained anonymous; hence any identification or name was not provided or captured. All respondents were referred using their designation.

- Deception

Deception was highly discouraged. All researchers were advised to disclose the core objective of the research and carefully select the target group to deter deceptive respondents.

4   DATA ANALYSIS AND INTERPRETATION

4.1   Introduction

This section presents data collected during interviews, focus group discussions, and observations. This study adopted a qualitative approach guided by grounded theory. Most data collected are qualitative. The study adopts the data analysis approach indicated in the research methodology chapter.

4.2   Sampling

The research targeted respondents with varying demographics, including gender, age, and income levels, as they influence behavior regarding access to healthcare. The study targeted the public, medics, and policymakers. The crowd was critical to the investigation as they provided relevant data. The following categories of the citizenry were interviewed:

Informants	Age	Number
Male	18 to 25	3
	25 to 40	2
Female	18 to 25	3
	25 to 40	3

Respondents' database

Table 1: Respondents' Database

ID	Gender	Age Group	Occupation
RP_101_DA	Female	25 to 40	Employed
RP_102_JO	Female	25 to 40	Employed
RP_103_GC	Female	25 to 40	Employed
RP_104_DK	Male	18 to 25	Self-employed
RP_105_RO	Male	18 to 25	Student
RP_106_EK	Male	18 to 25	Student
RP_107_TN	Female	18 to 25	Unemployed
RP_108_RA	Female	18 to 25	Employed

RP_109_LN	Female	18 to 25	Student

Mostly all informants hailed from Nairobi City County. The study emphasized age as most youths below 25 years are unemployed, resulting in financial constraints. The research targeted persons above 25 years employed to evaluate the healthcare habits of persons with medical insurance or access to finances.

The study acknowledged the fact that demographic factors such as age, income levels and occupation had direct influence on one's healthcare access option. These factors guided respondent identification even though the study relied on snowball sampling. The study strictly ensured all respondents have prior knowledge in AI self-medication and through snowball sampling key informants were identified and interviewed. After each interview, the study sought to seek referrals or linkage to any protentional respondent who had prior experience in self-medication using AI self-triage systems e.g Ada Health or any Online symptoms checker.

The following data collection segment involved analyzing the public's inputs by medics and collecting medics' insights concerning AI self-medication tools. Also, policymakers further analyzed medic inputs, thus proposing policy and infrastructural needs.

4.3 Data Collection Procedure

Before commencing the data collection process, they sought approval from the National Commission for Science, Technology, and Innovation (NACOSTI). Upon acquiring the research approval from NACOSTI, data collection commenced as the approval certificate was shared with each respondent before the interview began.

The data collection strategy for this research was mainly in-depth interviews and participant observations. There were considerable hindrances to conducting focus group discussions; hence, most advanced level interviews, medics, and policymakers involved sharing insights from data collected from the public. All participants had to sign an informed consent form expressing their willingness to participate in the training. Data collection tools (interview guide) and observation guide for all categories of respondents guided all interviews. Data collection tools were analyzed and reviewed before commencement to ensure all aspects of the research have been captured. For in-depth questioning of respondents' feedback, we did not limit ourselves to the premise set in the

interview guide but instead went overboard to gain the most out of each interview session. Observations were quite structured as we focused on the interaction between pharmacists and the public at different facilities.

4.4   Data Collection Analysis and Memoing

The study adopted the Grounded Theory approach in data collection, analysis, and memoing. The approved schedule and guide guided every data collection activity. This question was strategic as it triggered respondents' stories and thinking as they opened up to several experiences regarding access to healthcare. Most interviews were done remotely, and others face to face for respondents with substantial time constraints. We stayed in contact with respondents even after data collection in case of a clarification.

All remote and face-to-face interviews were recorded on an audio file and then transcribed before analysis commenced. Before the investigation began, we gathered all the data from participants and inspected them to understand the look and feel of the data to a logical flow of underlying ideas. This process involved cutting out unwanted segments in the transcripts, re-ordering conversations, and identifying gaps and errors in each transcript. Data collection and analysis was guided by the critical analysis conducted in the literature review questions. Through critical analysis, the study identified key research questions and objectives which need to be attained and answered.

4.5   Initial Coding

Having collected and transcribed all interviews into text, I emphasized the respondent's narrative and noted changes in narration from one participant to another. This enabled clarity in data presentation and identification of underlying themes supported by informants' experiences or narratives. Theme development was guided by Vaismoradi, Jones, Turunen, and Snelgrove (2016), thus involving reading through each transcription, translation, and labelling, relating and knowledge establishment, and lastly, developing a story. Initial coding entails giving meaning to pieces of data through the constant comparison technique, which involves comparing and contrasting respondents' experiences and grouping them into categories.

Coding and analysis were undertaken using NVIVO, an automated qualitative data analysis tool. The tool is rather expensive but powerful and structured, enabling better identification and

alignment of respondents' experiences into codes. Codes can be further broken down into sub-codes enabling better linkage of respondents' experiences. The following list of codes and concepts emerged from a respondent:

Healthcare cost, On-counter prescription, Misdiagnosis, E-diagnosis, Mobile application, Hospital visits, Long queues, Herbal medication, Prescription cost, Language, Medical data, Medical privacy, Low severity symptoms, Medical insurance Prescription re-uses, Internet, Symptoms checker, Google search engine, Ecommerce Pharmacies, Telemedicine, Feature phone, Regulatory body, Medical specialist, Patient protection policy

4.6 Code Categorization

In qualitative analysis, codes are considered the lowest representation of the raw data in interview scripts. The codes categorization process commenced to further research and bring out the ideas found in this study. The categorization process kept in mind the overall picture of the study; hence the codes were further grouped into high-level groups that will steer the research forward. Codes categorization was done concurrently with the data collection and codding process until saturation was realized. The codes were categorized as follows:

a. Reasons for avoiding hospital (self-diagnosis or alternative diagnosis)
   - Cost of Healthcare
   - Fears of Misdiagnosis
   - Time Constraints
   - Lack of Personalized Care

b. Existing healthcare access options
   - Herbal Medications
   - Hospital Visits
   - Self-medication
   - On-counter Prescription

c. Reasons for opting for self-medication
   - Inaccessible Medical practitioners & facilities
   - Cost of Healthcare
   - Availability of Drugs
   - Low Symptoms Severity

d. Self-Medication Existing Options
   - Prescription Re-use
   - On-counter prescription
   - E-diagnosis

e. E-diagnosis
   - E-diagnosis Effectiveness
   - E-diagnosis Correctness

f. Recommendation on Adoption
   - Integration to Healthcare
   - Language
   - Medical Data

- Target Demographics
- Cost of prescription
- Technology

g. Requirements for Implementation
  - Policy requirements
  - Technical requirements
  - Resource requirement s

4.7   Memo writing

According to (Razaghi, Abdolrahimi, & Salsali, 2020), theoretical memoing forms the foundation of qualitative study, as it involves writing up, theorizing and providing a substantive meaning of raw data in the form of interview scripts. It consists in writing analytics that offers an analogy of the data and channeling it towards a theoretical direction. This study has expounded on codes and categories during memo writing. In order to capture and correctly communicate the experiences drawn from the data collected, the study adopted a thematic approach in memoing which grouped commend codes and categories.

4.7.1   Access to Formal Healthcare

Access to healthcare is a thorny issue for persons living in urban areas. Our respondents are Nairobi dwellers who have faced challenges in accessing healthcare in one way or another. During interviews, we noted varying factors that hindered respondents from accessing healthcare services and, above all, acquired an understanding of how they navigate around these challenges. Healthcare is critical, and in one way or another, one has to find a means to get treatment or remedy for the illness for wellness purposes. The two subthemes were further probed.

4.7.1.1   Reasons for avoiding visiting medical centers

The majority of the respondents said that cost of medical consultation is among the major hindrance to quality healthcare. Cost became an issue for respondents who do not possess medical insurance cover or any finances that is most likely unemployed. Cost of medical consultation was sighted as a blocker to respondents who couldn't afford it due to financial constraints. However, the employed respondents claimed that the long queues, slow processes at the facility levels and nature of work are among the hindrances to access to healthcare. Notably, one respondent claimed that she avoids going to the hospital as she has experienced misdiagnosis at the facility level. In

another twist, one respondent alluded to the lack of personalized healthcare at the facility level as among the issues that push them away from accessing quality healthcare services.

A summary of the respondents' inputs and feedback are as follows:

Table 2 : Reasons for avoiding visiting medical centers

Theme	Code	Quotation	Reference
Reasons for avoiding visiting medical centers	Time constraints	*"At the hospital, you have to be patient. Yeah, you have to be tested first. After testing, you have to see the doctor. The doctor, you see that process is slow. So going to the pharmacy is the only one process."* *"One of the ways I access healthcare is through pharmacists. I go for a counter prescription. Yes, that's how I access drugs."*	RP_101_DA
	Time constraints	*"I avoid hospital visits where I will spend more time being attended to, and I might need to go for a lab test. So, I opt to end over the counter because of its convenience and saves time."* *"What makes me not go to a hospital is because of the time I will have to spend on the long queues. Hospitals have reduced paperwork, but the processes and steps have not been reduced; hence one might speed much time in these steps before getting actual help."*	RP_102_JO
	Fear of misdiagnosis	*"There are many misdiagnosis cases at the hospitals."*	RP_103_GC
	Personalized healthcare	*"I think the last time I have been to anything healthcare was to the pharmacist for antibiotics. I had a bacterial infection."*	RP_104_DK

|		*"I will say the hospital, but I will be lying. I rarely do that. I will say then that I get most of my services from the chemist."* *"The chemist has a personal touch and is likely to know me better. Unlike hospitals"*	
	Cost of Healthcare	*"I can do it by myself and not seek the help of any form, which would require consultation fees."*	RP_105_RO
	Cost of healthcare	*I also prefer going to the chemist when I am broke. I know hospitals can be expensive."*	RP_106_EK
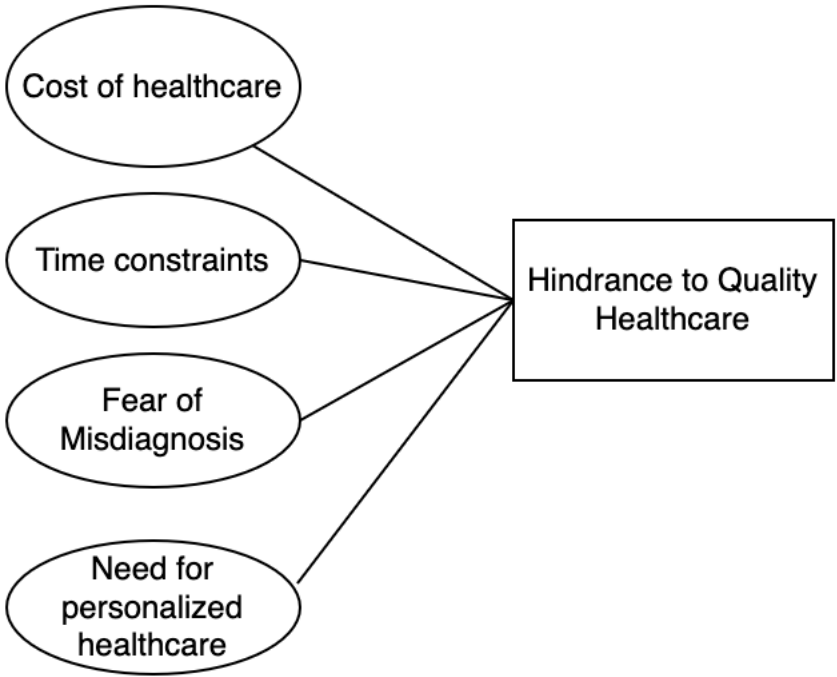
Figure 1 Hindrances to quality healthcare

4.7.1.2 Existing solutions around access to healthcare

The majority of respondents who alluded to facing hurdles in accessing healthcare services had devised means to access medical consultation and acquire medicinal products. Depending on age and occupation, most students and self-employed persons do not prefer accessing healthcare

services from the hospital. For instance, RP_106_EK and RP_108_RA are self-employed; they prefer using the Google search engine to understand their medical condition, get medical consultations and procure medicinal products from local pharmacies. On the other hand, respondents who own medical insurance prefer self-medication over hospital visits. They alluded this to the convenience and accessibility of pharmacists, which favored time constraints associated with their work. Almost all respondents expressed knowledge of using Google Search Engine and on-counter prescription to access medical consultations. However, the choice between hospital visits and unorthodox means of accessing healthcare services lies entirely on the severity of the symptoms.

Table 3: Existing solutions around access to healthcare

Theme	Codes	Quotation	Reference
Existing Healthcare access options	On-counter prescriptions	*"I Googled my symptoms. After checking my symptoms on Google. I proceeded to go to the pharmacy to ask pharmacy attendants about my symptoms and the treatment that I can receive for the symptoms."* *"One of the ways I access healthcare is through pharmacists. I go for a counter prescription. Yes, that's how I access drugs,"*	RP_101_DA
	On-counter prescription	*"I do get common symptoms of something, you know. If you eat something in you, your stomach starts to pain, you directly know. It has to be something I ate. So, you would get to the counter and purchase the meds."* *"The advantages of you doing such is because you're trying to take a shortcut to avoid hospital visits where I will spend more time being attended to, and I might need to go for a lab test. So, I opt to end over the counter because of its convenience and saves time."*	RP_102_JO

		"Going to the hospital for treatment consumes time."	
	Self – medication / On-counter prescription	*"There is the Google online platform where I go in there's this Dr. Mayo's clinic, especially in Google where you go there. And then after that, you type in, you make sure you type in your, how you're feeling your symptoms and everything, then get feedback on what it could be"* *"Afterwards, you can go to the pharmacy and buy some drugs."*	RP_103_GC
	On-counter prescription	*"I will say the hospital, but I will be lying. I rarely do that. I will say then that I get most of my services from the chemist."*	RP_104_DK
	On-counter prescription	*"I always pay a visit to a pharmacy either in town or here in the estate."* *"Pharmacists are like your neighborhood duka, and there is no way the pharmacist will lack a solution to the problem you explain."* *"I have always considered pharmacists to be equal to doctors. There is a little chance that they misdiagnose you."*	RP_105_RO
	Self-medication	*"I usually walk myself to the chemist if it is not serious or go to a hospital when I think I am getting worse."* *"As I said, I have used Google to check my condition then gone to the chemist to get the drugs. There are times I store Panadol in the house. I can re-use that whenever I have a headache."*	RP_106_EK
	Self-medication	*"I had a headache after a night out, so I took some pain killers to get better."*	RP_107_TN

|		*"I knew the reason behind the headache. It was too much drinking. My only solution was to take Mara Moja."* *": I always use Google to check out symptoms, and I also use Better Me to monitor my cycle."*	
	On-counter prescription	*"The level of sickness because sometimes it is too much like the other day the flue was too much I had to go. But sometimes I don't go to the hospital. I go to the chemist and tell them how I feel, and then I buy over the counter."*	RP_108_RA
	Self-medication	*"Besides asthma, there are these minor complications I usually find help to from the internet."* *"I have a hospital I usually go to in case I need their services. I can also go to the chemist to buy medicine if I know what could be the issue."*	RP_109_LN
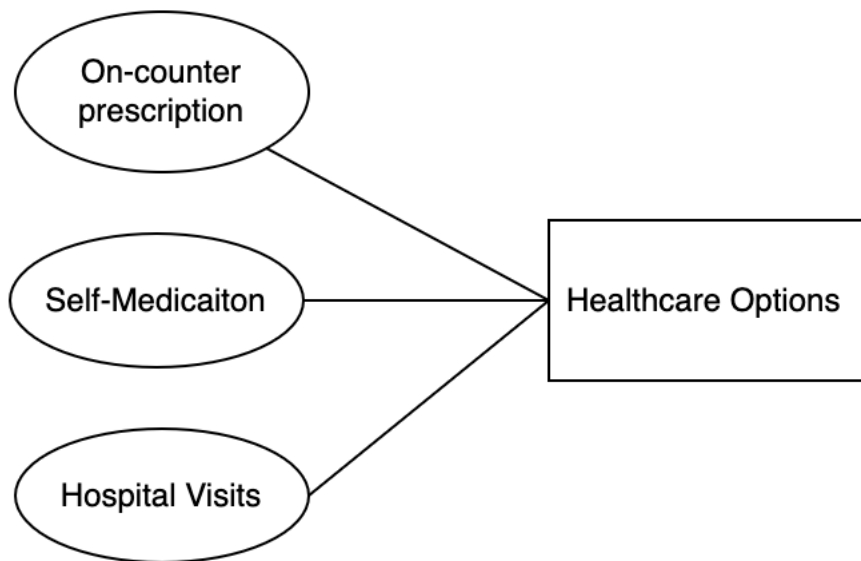
Figure 2 Healthcare options
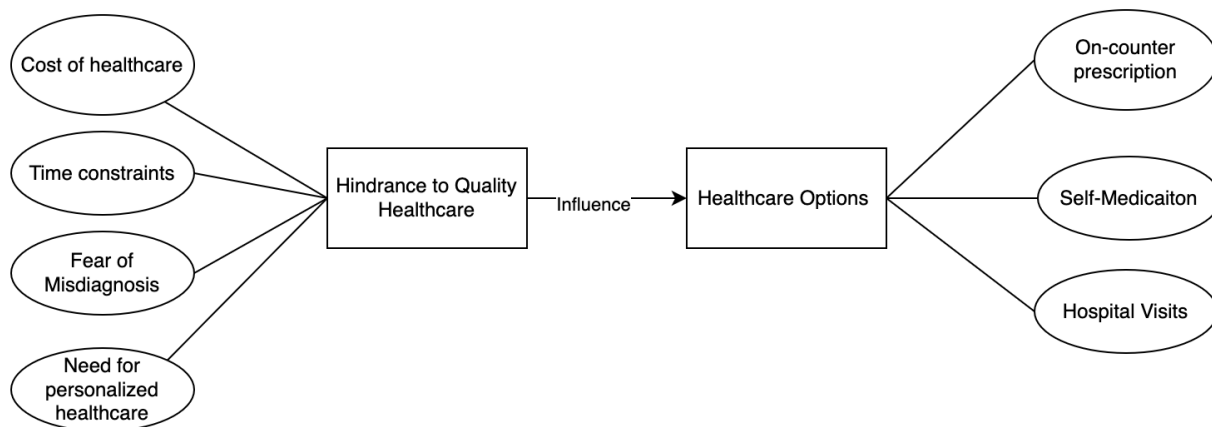
Figure 3 Relationship between hindrances to healthcare and healthcare options

4.7.2   Self-Medication

Self-medication was the foundation of this research study. Having acquired an understanding of respondents' issues in accessing healthcare and mirroring that to the unorthodox means of

healthcare access. It was necessary to understand their experience in self-medication as one of the unorthodox means of accessing healthcare. The study ensured all participants had a better understanding of self-medication before asking for their expertise and some of the technological tools. Therefore, the study probed for the following:

4.7.2.1   Reasons for opting for self-medication

In Kenya, research shows that factors that push for self-medication include the availability of on-counter drugs, high cost of clinical services, the high price of medicines, and financial inaccessibility lack of available medical practitioners as critical contributors toward self-medication. Regarding the findings made from the study, one of the factors leading to self-medication is disease severity. For instance, RP_102_JO/107-TN claimed to choose to self-medicate whenever their symptoms are not severe. Additionally, most employed respondents with access to medical insurance self-medicate whenever they cannot access medical facilities that accept their insurance provider. Feedback from RP_105_RO has highlighted one of the facilitating factors of self-medication. The cost of medical consolation and medicinal products have contributed to respondents' choice of self-medication.

Additionally, there is a culture among persons below the age of 25 to disregard hospitals unless severe cases arise; hence most respondents felt safe self-medicating. Notably, the mushrooming of pharmacies around estates and the availability of drugs has contributed to self-medication. Most respondents opted to first acquire medications from pharmacies before seeking services from hospitals.

Table 4: Reasons for opting for self-medication

Theme	Code	Quotation	Reference
Reasons for opting for self-medication	Low Symptoms Severity	*"I am not worried because it depends on the level of seeking and the level of sickness, or what can I say this sickness or the level on how you are sick? Is it severe? Is it just headaches to see if we can?"*	RP_101_DA

		"Yes, I self-medicate depending on the sickness, the level of illness." *"Because I have been using the same medicine for the same illness."*	
	Low Symptoms Severity	*"So, the time when they decide to self-medicate is when I know it is not Serious. There is an instance where you saw certain that you're ill because you took bad food. In such instances, I end up self-medicating over the counter coz it will work fast. It is so daring that one can Google symptoms and know what medication to purchase."* *"Again, I self-medicate depending on the level of illness."*	RP_102_JO
	Inaccessible Medical practitioners & facilities	*"Because even like, even though I have a medical cover, your work sometimes can be tedious. Yeah. So, the little time that you have, you may want to rest. You don't want to waste it at the hospital. Yeah. So quickly, you just go to the Google platform. If it's nothing serious, then you're. Okay,"*	RP_103_GC
	Cost of healthcare	*"I self-medicate because I know myself and health and because it is fast and cheap."*	RP_105_RO
	Cost of healthcare	*"I mainly go to the hospital when I am really sick or consult either Google or the Chemist when I have no money and think I can handle it locally."* *": I needed privacy, so I felt self-medication would be right."*	RP_107_TN

	Low symptoms serverity	*"I self-medicate myself almost every month because there are these pains, the cramps, I don't usually see the need of going to the doctor."*	RP_108_RA
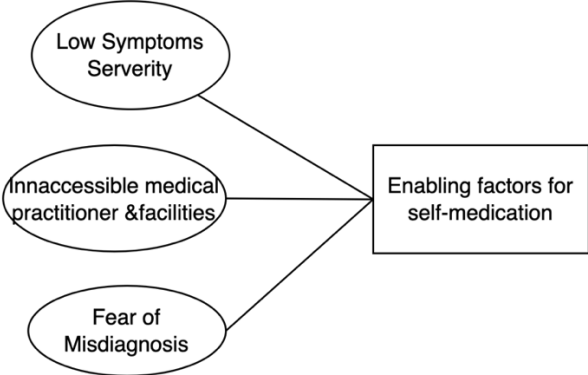
Figure 4 Enabling factors for self-medication

4.7.2.2 Existing self-medication options

Most respondents proved comfortable with their preferred self-medication options about the factors mentioned above. In this subtheme, the study aimed to identify the existing self-medication options to assess their prevalence in Nairobi. Key demographics were kept in mind while interviewing the respondents. Due to the persistent challenges regarding access to healthcare, the citizenry has embraced unorthodox means of accessing healthcare. About the quotes below, RP_101_DA claimed that she rarely falls ill, and mostly her symptoms are repetitive; therefore, in most cases, she re-uses her prescription upon which she procures medication from a nearby pharmacy. Almost all respondents have experience in on-counter prescriptions. On-counter prescription is the most appropriate and effective means of accessing medicine and medical consultation. It can be seen, respondents with access to health insurance also prefer on-counter prescription, citing that it is most accessible and offer instant medical relief compared to a hospital visit. Respondents noted that they first evaluated symptoms severity and availability of medical services before self-medicating.

Table 5: Existing Self Medication Options

Theme	Code	Quotation	Respondent
	Prescription Re-use	*"Because I've been using the same medicine for the same illness. So, I re-use my old prescriptions."*	RP_101_DA
	On-counter prescription	*"I Googled my symptoms. After checking my symptoms on Google. I proceeded to go to the pharmacy to ask pharmacy attendants about my symptoms and the treatment that I could receive for the symptom."*	
	E-diagnosis	*"Such instances I end up self-medicating over the counter coz it will work fast. It is so daring that one can Google symptoms and know what medication to purchase."*	RP_102_JO
	On-counter prescription	*"I Google almost anything, say only if you noticed and it will tell you what kind of medicines you can take. So, it's become that life has become that simple, as simple as a Google, and you can get what medication you can take to suppress what you're going through"* *"Another example, my friend's kid had a fever at it was almost at 3:00 am, we googled the symptoms and got medication after which we ordered the drugs from GoodLife eCommerce website. Do you know in less than an hour the medication was delivered?"*	
	E-diagnosis	*"On a more frequent basis. Eh, nowadays, I use an online platform, which is mostly Google. I'm not Google and Doctor Mayo's clinic, which is also online on Google as well. So, I use that one mostly then describe my symptoms as much as possible on how I*	RP_103_GC

		feel then afterward, if I feel it is not helping me as much, then I seek a doctor's opinion."	
	On-counter prescription	*"I trust the chemist's view of my condition anytime."* *"The ability to know you are sick and what to take to make yourself better."*	RP_104_DK
	On-counter prescription	*": I use my own judgment to use between going to the hospital and chemist. I also prefer going to the chemist when I am broke. I know hospitals can be expensive."*	RP_106_EK
	E-diagnosis	*"I use Google to understand my symptoms, purchase drugs from local duka and chemist."*	RP_107_TN
	Herbal medication On-counter prescription	*"Home remedies like herbs. There are these herbs that I have used to treat myself of different conditions over the years like the flue."* *"It is quick. You do not have to go through all that process of consultation. The herbs are easily accessible, and for the other drugs, they are found at your local chemist."* *"I did not have money for consultation. Pharmacists are also not sure what best treatment to use for acne. So, I went to Google because I felt it was the easier way."*	RP_108_RA
	E-diagnosis	*"I use my phone to log into the internet to browse on health."* *"The internet has a lot of information on the illness you might be looking for."*	RP_109_LN
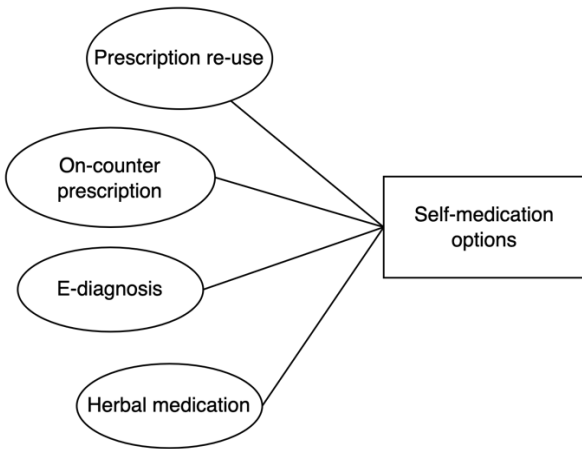
Figure 5 Self-medication options
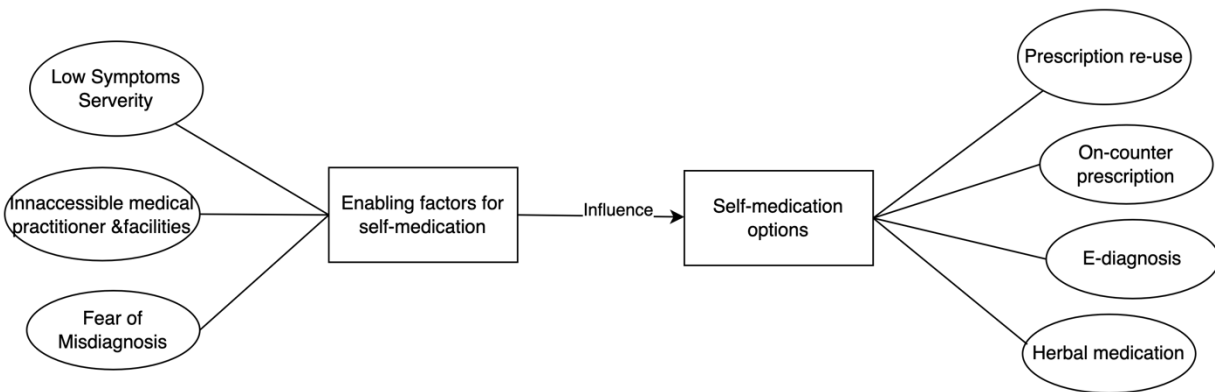
Figure 6 Relationship between self-medication enabling factors and self-medication options

4.7.3   Hospital Visit

In order to address a question regarding existing technological solutions geared towards healthcare accessibility, the study questioned respondents on their experience at the hospital level. In this, we probed existing technological solutions ad further assessed if they were patient-focused.

4.7.3.1   Technological prevalence

A huge percentage of respondents had interacted with technology or any form at a facility level. It is noted that most technological solutions adopted at the facility level are meant to digitize manual processes at the facility rather than complement healthcare service delivery. Respondent RP_102_JO explained how technology had transformed billing as many insurance companies have adopted biometrics in patient identification. Even in technology, most healthcare facilities are still

stuck with their traditional processes leading to long lead times. Outside medical facilities, most healthcare players, e.g., GoodLife Pharmacy, have developed technological solutions in eCommerce to purchase medical products and mobile applications related to reproductive health. There is significant growth of technology within the healthcare sector, aiming to streamline internal processes and enhance healthcare access.

Table 6: Assessment of eHealth at Health Facility

Respondent	Quotation
RP_101_DA	*"No, I did not interact with any technology at the hospital."*
RP_102_JO	*"The technology, how it came in was you have to book, and you have to book the appointment online. So, the organization that I work for has linked us to get Gertrude Hospital. And so, there is a link that Gertrude sends us, so we click on the link, and you book a COVID 19 vaccination session."* *"Yes. Again, it would be like sometime in August or September when I had to go to the hospital because I was done with it. I interacted with technology when processing my medical insurance for medical services. This was the only technology I interacted within the medical field."* *"We have telemedicine and especially during the Covid scene where I work, the research such as we do enable us to travel a lot. So, because of the traveling, you have to have a COVID test taken and we work with this COVID center. You go online, you book an appointment with them, and then a doctor call you. The doctor is calling you to confirm the dates you are traveling. Samples"* *"Additionally, there is a huge number of low-income earners; hence they cannot afford to visit the hospital where they interact with these technologies for healthcare purposes. Hence, most of them are locked out of these healthcare technologies at either private or public facilities. So, technology at the healthcare level is not fully accessible and available for all citizens.* *"*

RP_106_EK	*"I can think only the likes of M-Tek and M-Tiba, but those are for insurance."*
RP_107_TN	*"I use "Better Me."* *"The app I am telling you about is perfect because it will tell me if there are any red flags with my period."*
RP_108_RA	*"I know one that is called Zuri, but it is for contraceptives, pharmacy, and family planning."* *"You download the app on your phone, and then you start asking questions. There are those questions that pop up, and you select as appropriate. These questions are usually close to whatever you are looking for."*

The data above explains that most technological solutions at healthcare facilities are centered towards streamlining internal processes such as billing and handling medical records. There is less evidence on the presence of point of care technologies hence no impact is made on ease of access to healthcare services. However, outside healthcare facilities, technological solutions such as Zuri, Goodlife ecommerce website and Livia telemedicine tool are quite popular and applicable among the respondents. Therefore, the study notes the gap in healthcare providence technological solutions within the healthcare system.

4.7.4 AI Self-Medication Tools

AI self-medication tools are the core subject of this study. The study aimed at exploring existing AI self-medication tools from the end user's experiences. The study noted that most respondents had interacted with web or Google search engines as a tool for self-medication. There was the need for respondents to interact with AI self-medication tools; hence before interviews, respondents had to watch demo videos on the most common mobile app symptoms-checker and even install the app and play around with it. In this case, I recommended that respondents install Ada and operate it before the interview commencement. However, I realized most of the e-diagnosis tools available on Google are running on AI and ML algorithms hence the discussion broadly focuses on Google and the application.

4.7.4.1   Existing e-diagnosis tools

Regarding the findings below, a huge percentage of the respondents were comfortable using the Google search engine in understanding their symptoms. However, all respondents failed to remember the specific site they consulted about their symptoms. Respondents mentioned websites such as Dr. Mayo and Quora as their preferred medical information/consultation. Self-medicating respondents mentioned that they would first Google their symptoms, understand its severity before heading to the pharmacy or hospital. RP_103_GC mentioned that she felt comfortable googling her symptoms before heading to the hospital as it helped her engage with the medics to avoid the chances of misdiagnosis. However, none of the respondents were conversant with AI self-medication mobile applications. In order to acquire concrete feedback, the study presented Ada Health, a self-triage mobile application, to the respondents, after which they compared the application's functionality with the Google search engine. This enabled respondents to provide conclusive insights regarding the remaining aspects of the study.

Table 7: Existing e-Diagnosis Tools

Respondent	Quotation
RP_101_DA	*"I Googled my symptoms. After checking my symptoms on Google. I proceeded to go to the pharmacy to ask pharmacy attendants about my symptoms and the treatment that I can receive for the symptoms."*
RP_102_JO	*"Such instances I end up self-medicating over the counter coz it will work fast. It is so daring that one can Google symptoms and know what medication to purchase."* *"Another example, my friend's kid had a fever at it was almost at 3:00 am, we googled the symptoms and got medication after which we ordered the drugs from GoodLife eCommerce website."*
RP_103_GC	*"There is the Google online platform where I go in there's this Dr. Mayo's clinic, especially in Google where you go there. And then after that, you type in, you make sure you type in your, how you're feeling your symptoms and everything, then get feedback on what it could be."*

RP_104_DK	*"I have known Google ever since I started using a smartphone and knowing that the internet could help in predicting my health."*
RP_105_RO	*"The only technology I know of is the internet. As in I Google, get to see what is wrong with me, then go get the meds."*
RP_106_EK	*"I can think only the likes of M-Tek and M-Tiba but those are for insurance. I think you are looking for the ones you use for diagnosis and prescription. Oh. And I also know of My-Dawa, an app you can use to order drugs online."*
RP_107_TN	*"I have never heard of any other tool. Maybe Google but I have never used a tool designed specifically for that job."*
RP_108_RA	*"I think I had used it when I was suffering from acne. I went to the internet and tried to find out why I had acne. I found out how to treat them, the best cream to use, and the best home remedies for acne. I knew about it through Quora and Google "*

In reference to the technological tools mentioned by respondents, the study noted that existing AI self-medication tools are open source. Respondents with experience in self-care using technology have become comfortable in using both medical and non-medical tools for as long they acquire medical advice and diagnosis Also, most respondents access these tools from the comfort of their phones which speaks about the availably and ease of access of these tools

4.7.4.2   Assessment of e-diagnosis correctness

The majority of respondents acknowledged using the Google search engine and other websites as their preferred e-diagnosis tool. In this segment, the study focused on respondents' assessment of the correctness of their preferred e-diagnosis tool. According to the feedback gathered, tools such as Google, Quora, and Dr. Mayo are among the most preferred open-source self-triage tools. However, some respondents, e.g., RP_103_GC, have encountered instances where google provided them with incorrect diagnoses. In scenarios where the e-diagnosis tools have provided inaccurate analysis, respondents went a step further and sought medical consultation from medical professionals to ascertain the actual illness.

Table 8: Assessment of e-Diagnosis correctness

Respondent	Quotation
RP_101_DA	*"Every time I use this, it just gives me a rough idea. Picture."* *"Like I say, it's not the best idea, but it gives you a rough, a rough a rough idea of what your symptoms are about. So I think it's something you can keep using"*
RP_102_JO	*"I can say I use Google because we it is the trusted, reliable and informed tools. It provides you with all information one needs to understand about their illness. It can even give you feedback from other people who had the same illness".*
RP_103_GC	*"And I would say, eh, one or 2% failure rate"* *"Yeah. Most of the times google gave me the correct answer and they should see the look on the doctor's face"*
RP_104_DK	*"There is a possibility that I might get either exaggerated or wrong results."*
RP_105_RO	*"Google can be misleading. There is a day I Googled my symptoms and thought I had something close to a serious STI. Like HIV. That freaked me out. I had to get tested. Luckily I found out that I was negative."*
RP_106_EK	*"There is a time I used Google to diagnose myself. It turned out it was a misdiagnosis. I had to treat typhoid that was already in its advanced stages."* *"I should say 90 percent because it is only 10 percent that I have been at fault on finding out what is wrong with me and drugs."*
RP_107_TN	*"They are very convenient though effectiveness and accuracy remain subjective. You just go back to the house hoping that everything will be alright."*

| RP_108_RA | *"it is quick for me and 99 percent accurate because the drugs I take for cramps they work immediately"* |

In this segment the study delved deep into the respondents' experience about the accuracy of the medical advice and diagnosis presented by the AI self-triage tool. Majority of the respondents mentioned that their preferred e-diagnosis tool was 90% accurate in assessing their illnesses. However, this is not guaranteed as one respondent claimed that despite its correctness, the e-diagnosis tool might give incorrect diagnosis. These insights were critical in advising the study's direction in assessing the aspects that contribute to the correctness of AI self-triage systems.

4.7.4.3 Assessment of e-diagnosis Effectiveness

Apart from assessing the accuracy of the identified e-diagnosis tools, the study went a step further and assessed the effectiveness of each identified tool. Effectiveness was founded on how the e-diagnosis tools proved helpful in respondents. Almost all respondents acknowledged that they preferred e-diagnosis options that were easy to use. Despite its usefulness, RP_101_DA said that she used Google to get a rough idea of her illness but could not rely on the tool as a single source of truth. RP_102_JO mentioned that her preferred e-diagnosis tool is quite useful to emphasize its usefulness relies on the inputs she provided. Hence incorrect symptoms might result in an inaccurate diagnosis, impacting on tools usefulness. Aspects of information security and data privacy came up as RP_102_JO expressed concerns about financial and personal information submitted to the e-diagnosis stools.

Table 9: Assessment of e-Diagnosis Effectiveness

Respondent	**Quotation**
RP_101_DA	*"I found it useful, kind of useful. However, it didn't give me the exact, it was giving me what I say. My idea or it was giving me a rough idea. Not exactly what I wanted or what I was suffering for, but it was giving me a rough idea"*

RP_102_JO	*"My concern about the application is that the questions such as weight, height, and other aspects change from time to time hence one needs to key in correct Interviewee ion to get a correct medical diagnosis."*
	"Another concern is when the application asks some questions in which I cannot provide correct Interviewee hence I might not get the correct diagnosis."
	"In addition, I am not guaranteed of the security of the information I provide to the app like bank details and persona details."
	"In addition, I would trust the application if at all I trusted the issues I keyed in during the symptoms checking process. I also would trust the application if at all it gives me more friendly diagnosis and not some diseases that are serious."
RP_103_GC	*"On Google. I type in, how I'm feeling exactly. So I go to Google, type in my symptoms, exactly how they are, and get exactly what it could be suffering from. So that if it's actually serious and they happened to go to a doctor and then we explain the same thing. I always verify doctors' diagnosis using google."*
RP_105_DK	*"The only technology I know of is the internet. As in I Google, get to see what is wrong with me, then go get the meds"*
RP_106_EK	*"I find that Google is easy for me to use. I just search and make guessing on the diagnosis then going to the nearby chemist for medication."*
RP_107_TN	*"I use these apps because they are easily accessible and personal."*
	"These are the closest options and easiest to me."
	I mainly go to the hospital when I am really sick or consult either Google or the Chemist when I have no money and think I can handle it locally.
RP_108_RA	*"It is easier for me to operate and get answers. I do not have to go somewhere to talk to a physician about my condition. The other things are that it is private and confidential."*

The study assessed the informant's perception on the usefulness of e-prescription tools as means of accessing primary healthcare. Most respondents understood usefulness as the ability to acquire

medical advice from these tools at any given time. Majority mentioned that tools are accessible, easy to use, offer confidentiality and privacy of one's medical information and above all reliable. However, some respondents expressed lack of trust in the tools as they had doubts in some of the recommendations provided by the tools. From this data the study got background information on AI self-medication which guided further probe on how to guarantee their e-diagnosis effectiveness

4.7.4.4 Perception on Use

The study posed a question concerning the adoption and use of e-diagnosis systems. The study benchmarked with the Ada Health mobile application. Before this segment of the interview respondents had interacted with Ada Health thus comparing it with their preferred e-Prescription tool. The study intended to understand the respondents feel if a tools similar to Ada Health was to be rolled out in Kenya. This enabled us understand their perception and recommendation on how aspects such as security, correctness, effectiveness can be enhanced. Most respondents expressed readiness to adopt self-triage systems as a medical diagnosis. However, there were valid concerns around the actual use cases. For instance, respondent RP_101_DA expressed concerns about the self-triage systems' actual use-case, claiming that the systems might not meet her end-to-end healthcare needs as she will still have to go to the hospital or visit pharmacy for an on-counter prescription. RP_102_JO raised concerns about using language that will accommodate both literate and illiterate persons and, above all, customize the self-triage systems to be accessible even in feature phones. RP_103_GC was keen on the data used within these systems, thus recommending that for better diagnosis, the self-triage systems should operate on medial data contextualized within the Kenyan context. She also recommended that the application collect as many symptoms as possible before arriving at a medical diagnosis.

Additionally, she expressed the need for medical referrals within the application to capture emergency cases and minimize the risk of misdiagnosis. Other respondents said they would use the self-triage systems if they guarantee data privacy and do not rely on the internet. Lastly, the cost for medical consultation and referral also came up as a concern for adopting and using self-triage systems among the respondents.

Table 10: Perception on Use of AI-based Self-triage

Respondent	Codes	Quotation

RP_101_DA	Integration to health system	"I think I'll not embrace it. 100%. Why? Because it's not giving me the treatment, okay, they're just giving me that rough idea of the treatments, but they're not. You're not giving me any treatment, like, I'll still have to go to the pharmacist. I will still have to go to the doctor, for example, I'll search for my symptoms, you have given me the illness and the treatment, can I re-use them when I go to the house to the hospital?"
RP_102_JO	Language	"One should consider the language because not everybody has been educated."
RP_102_JO	Technological inclusion	"Also, when launching these technologies, one needs to find a way to incorporate feature phones so as to take care of the low-income earners."
RP_103_GC	In-depth analytics	"I think maybe the app could have questions, like maybe want to ask if too many. And I feel I can a history of maybe hereditary diseases, for example, like, like diabetes concerning. Yeah. And then also just I think the tools should collect as much information as possible. Yeah. Would be good"
RP_103_GC	Contextualization	"I think it can be adopted, but I think it has to be like really contextualized. Yeah. To that particular area. Like African

		contexts that they're a bit different. So you're totally contextualized to that area"
RP_103_GC	*Integration to healthcare*	*"Hence on-counter prescription might be risky hence the application should refer such persons to the hospital. Overall, one needs to be referred to a doctor so as to minimize risk associated to self-medication of serious illnesses"*
RP_104_RO	*Personlization*	*"I would like to see the application more personalized to my needs and accuracy concerns could be addressed."*
RP_106_EK	*Ease of use*	*"In regards to the Ada health App, I recommend that you make the application easy to use and fast in giving medical prediction just like google"* *"It should be available on a mobile phone"*
RP_107_TN	*Mode of Access*	*"They consume internet bundles. Without the internet I cannot access them"*
RP_109_LN	*Guaranteed privacy*	*"As long as there is guaranteed privacy."*
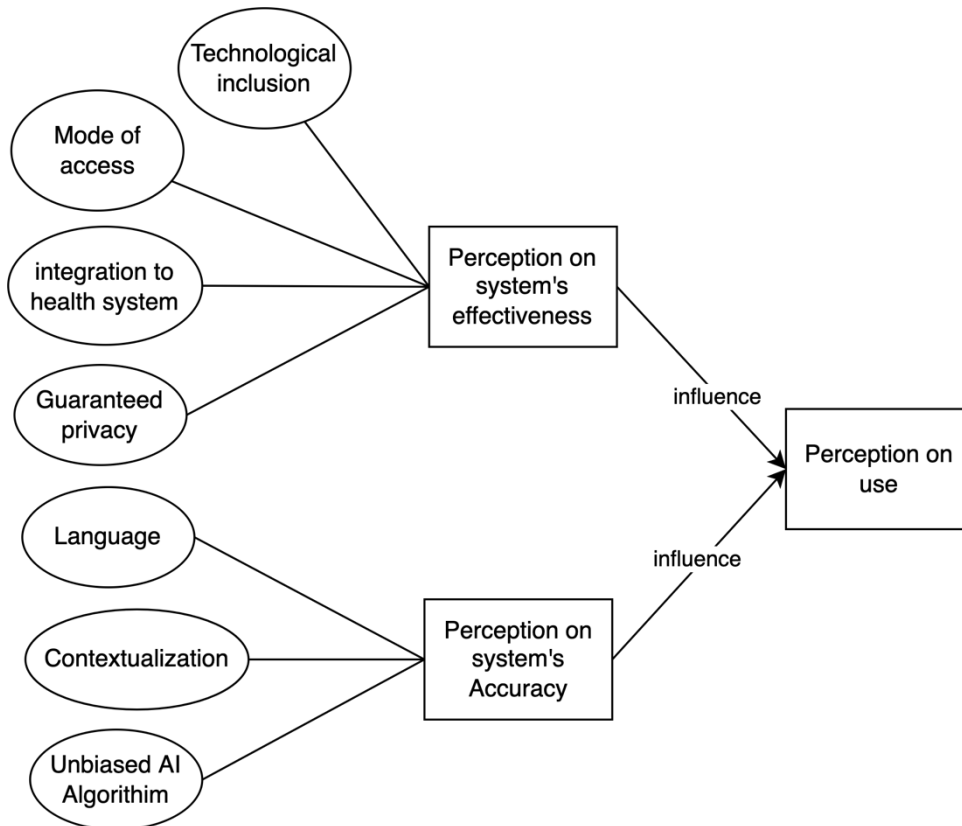
Figure 7 Perception on use of AI self-triage

Evidently, end-users' perception on use of AI self-triage systems similar to Ada Health encompasses a number of aspects around accuracy and effectiveness. The language within which the self-care tool is built on, the ability of the tool to conduct in-depth analysis of provided symptoms and their contextualization to Kenyan population may affect their correctness. Additionally, they mentioned that offline access, consideration of feature phones, integration to healthcare and privacy may influence the applications usefulness. These findings guided the study into inquiring about requirements for adoption and implementation of AI-based self-triage tools in Kenya.

4.7.5   Requirements for AI Self-Medication

This segment of the study aimed to evaluate the current efforts regarding the adoption of mobile health technologies within the health sector and establishing the requirements for the implementation and realization of AI self-triage systems. We sought to triangulate some of the recommendations put forward by the general public with the insights acquired from an interview

with a representative of the Kenya Medical Practitioners, Pharmacists and Dentists Union (KMPDU). While assessing the applicability of the AI self-triage system within the health sector, the representative confirmed some of the systemic challenges that are underlying within the healthcare sector and how the AI self-triage systems can be using used to enhance access to quality care.

> *"Okay, the Kenyan healthcare system is quite dynamic and vast. To be honest, we face many challenges, especially the public sector, which has messed up healthcare quality. This has, in turn pushed many citizens to self-medication or use other means to access healthcare. Therefore, I see the application coming in to meet the needs of the self-medicating persons. If well designed can offer medical prescriptions for primary diseases, which will help reduce hospital visits and medical consultations. I see quite a huge impact towards safe self-medication and maybe in future the application can be implemented to offer medical referrals after diagnosis of some serious cases."* KMPDU Rep

A considerable percentage of the citizenry in Kenya has resorted to self-medication to navigate through access challenges. The representative has alluded to the fact that the AI self-medication system would provide medical prescriptions to primary illnesses, thus reducing chances of misdiagnosis.

4.7.5.1   Technical Requirements

The study sought to understand the KMPDU representative's insights on how best AI self-triage applications could be adopted within the Kenyan healthcare system. Recommendations from the general public were that they would love to access the AI self-triage system from a mobile phone, mostly feature phones to enhance inclusivity and accessibility. Our discussion with the KMPDU representative demystified technical requirements into both medical and technological. Regarding medical it was mentioned that there was a need to have medical data that is relatable to Kenyan population.

> *"Yes, I am quite aware that AI models run on <u>medical data.</u> I think the question should be does the health sector have data? Answer is No, there has been no <u>consolidation of data related to patient triage</u> within the health sector. However, we would welcome efforts related to the consolidation of patient triage data."* KMPDU Rep.

From the interview it was noted that presence of national triage data is essential for the realization for the AI diagnostic model. However, the underlying gaps within the health sector have hindered efforts in consolidation of patient triage data. Additionally, it has been noted that there are no efforts in the consolidation of medical data most specifically a combination of symptoms and diseased together with the process flow on patient diagnosis. Lack of medical data poses a huge hurdle in the development and implementation of an AI based disease diagnosis model.

> *"If the AI self-triage system was to be implemented in Kenya, then the best means of making the triage system available to all citizenry is through the most basic mobile phone and an easily accessible web application. This is so as to enhance equitable access to all citizenry and above all enhance ease of use."* KMPDU Rep

In a scenario where medical data was made available and a fully-fledged national triage data was made available, we assessed the infrastructural requirements. In agreement with the proposals made by the general public, the KMPDU representative proposed the need to have the algorithm accessible from feature phone and web application.

4.7.5.2 Policy Requirements

In assessing all requirements for proper implementation of the self-triage system, the study placed emphasis on the determination of guidelines and laws that regulate tech-based solutions within the health sector. Hence, during the interview with the KMPDU representative, we posed a question on the existing regulations around mHealth and prescriptions systems.

> *"Policy provides guidelines and framework on how processes and procedures are to be executed. In the ministry of health, there are several policy documents including: the Kenyan National eHealth Policy 2016-2030 and the Kenya Standards and Guidelines for mHealth Systems Policy. To my knowledge, the eHealth policy provides guidelines on the implementation of electronic health systems. The mHealth guidelines, which is more applicable to our subject matter, provides guidance on the development, implementation, adoption of mobile health technologies within the health sector"* KMPDU Rep

It was noted that the presence of the policy guidelines around mHealth system would provide further guidance on the development and implementation of mHealth based systems. Contents of

the document speak to the government's ambitions in encouraging development and roll-out of mHealth system and existing government support. We noted existing regulations around mHealth stipulate guidelines on implementation and adoption of mHealth systems but there was no guideline meant to safe-guard end-users of mHealth solutions.

"Yes, there are a number of excerpts within the policy document that speaks to the needs of the end-user and their protection. They are: emphasis on <u>protection of privacy</u> *and confidentiality, the adherence to the* <u>sharing and disclosure</u> *of health information as per the Health Bill 2016 and ownership of the mHealth technology should be guaranteed."* KMPDU Rep

The AI based patient diagnosis tool, will collect patient's personal identification data, consolidate them with medical data to ensure personalization and predictive analysis before issuing medical prescription. There is need for such mHealth application to guarantee privacy and confidentiality of end-user's data and above all embrace the stipulations contained in the Health Act 2016. The Health Act 2016 stipulates that information concerning patients in this case end users of mHealth solution should be placed confidential and can only be disclosed when a court order has been issued. In case of medical related complaints, the Heath Act 2016 has provided guidelines within which one should follow in raising medical related complaints.

"As we speak, there are <u>no policies around misdiagnosis</u> *within the medical sector, but we hope that the AI self-triage systems will at least consider aspects of misdiagnosis and find means of mitigation."* KMPDU Rep

In our discussion we noted that the health bill is not adequate in safeguarding end-users from mis-diagnosis. Most end users fear misdiagnosis and hence there is need to establish more laws and regulations that focus on protecting end users from misdiagnosis as a result of a fault in the AI model. Currently, there is no structure or approval body put in place to oversee the development and rollout of medical algorithm within Kenya. The study has noted the need to have such regulatory body in place to approve medical algorithm and push for their integration within the healthcare system.

"I will first speak on what we have, privacy and data protection policy, implementation of mHealth policy and most important the Health bill. However, in relation to what I know

about the AI self-triage systems, I think you need <u>policy regulation</u> on electronic patient diagnosis which will address issues around misdiagnosis and approval of the medical algorithm." KMPDU Rep

According to the inputs put forward by general public on the need to use the prescriptions acquired from the AI based patient diagnosis system on hospitals and pharmacy. Also, most of them had suggested that they needed medical referrals from the mHealth solution in case of medical emergency. Therefore, proper implementation and realization of the AI-based patient triage system requires them to interface with existing health institution to enable end-to-end access of healthcare services. In our conversation with the KMPDU representatives we noted the need for linkage and referral from the application as means of healthcare integration.

> *"First in all depends on how vast the AI self-triage tool will be implemented. Will the system be integrated within the health sector? Integration entails, linkage of patient diagnosis to health professionals or pharmacies so that the e-prescription can be used for further treatment. If there will be linkage, then I am certain that the self-triage systems will be adopted for its ability to offer sound medical diagnosis and prescriptions"* KMPDU Rep

4.7.5.3 Resource Requirements

Development, implementation and support of AI based patient diagnosis system may need the presence of human resource spanning from IT team, medical team and communications team for end-user support and social marketing. The study inquired from the KMPDU representative on some of the minimum resource requirements needed for the realization of the AI based patient diagnosis system. However, resource requirement is dependent to ownership of the self-triage system.

> *"Oh, thanks for the clarification. Most innovative initiatives that come from the government always override existing resources e.g., IT infrastructure and human resources. However, for a private organization, they will need to set up a number of <u>systems and structures</u> in place so that they can adequately support the initiative and gain trust from the public"* KMPDU Rep

Evidently, ownership influences resource requirements, if the system is owned by the government, then there will be less resource needs as the MOH has already set up systems and personnel in every aspect of the healthcare sector. However, if a private organization own the system, then there will be needed to set up a team of medical experts, IT experts, legal experts in order to support development of the algorithm, IT infrastructure and address legal matters. Also, a 24hrs tool free call center should be put in place to support end users and cater to emergency cases.

> *"First the company should be registered in Kenya and be recognized by the Kenyan government, secondly, they need to set up a team of medical experts who will handle address medical related issues concerning the <u>AI algorithm</u>, a team of IT experts will be required to oversee the <u>IT infrastructure</u> and above all communications and <u>end-user support</u> team should be established and operate on 24hrs basis to provide assistance to end-users. If you will integrate aspects of medical referrals onto the system, I am sure the resource needs might be higher than what I just stated. What am saying is that resource needs are tied to the scope of the AI self-triage system."* KMPDU Rep
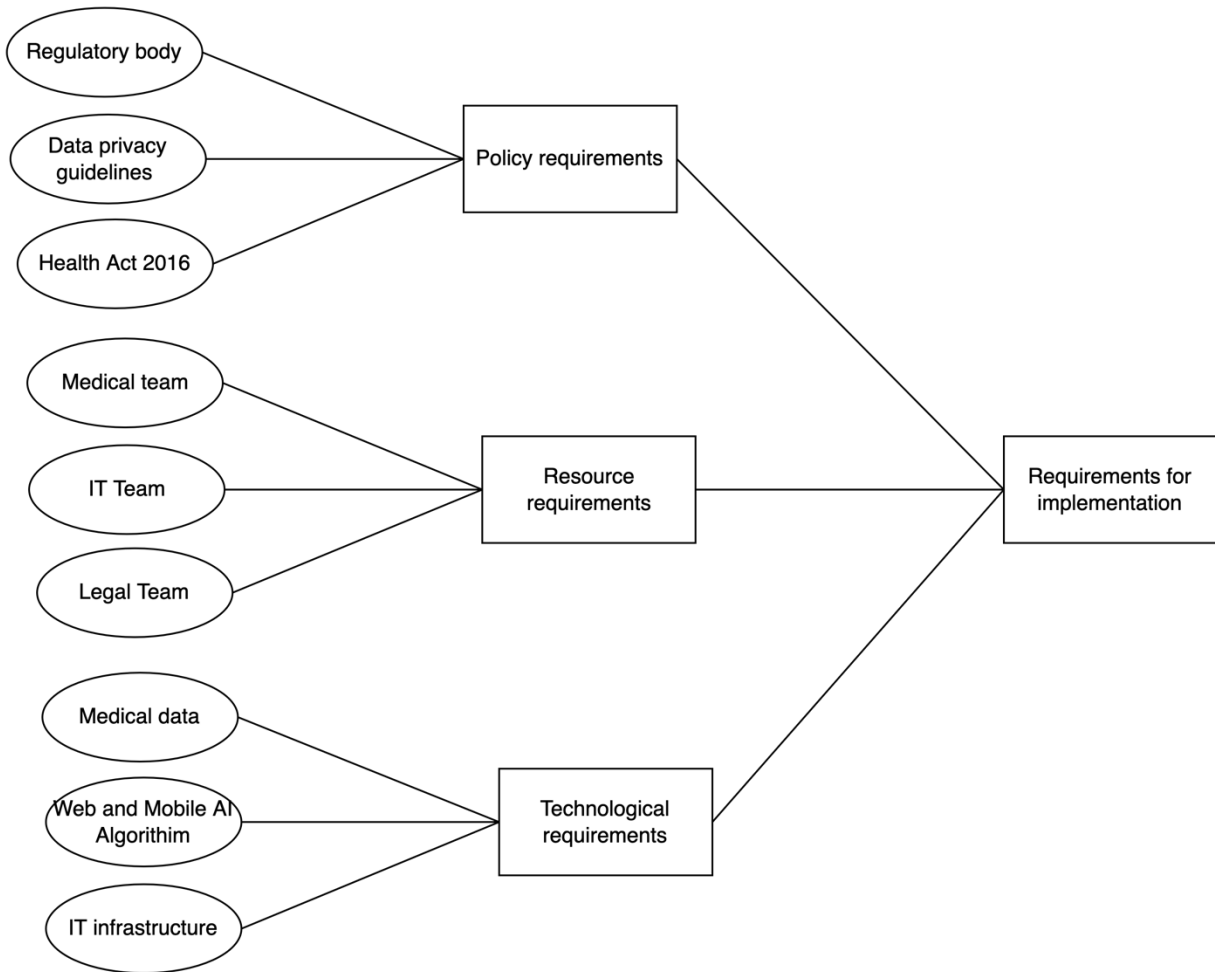
Figure 8 Requirements for implementation of AI self-triage systems in Kenya

5 DISCUSSION

5.1 Theme 1: Access to Formal healthcare

The setting of the study was the Nairobi city county, thus bringing to light the impact of high population on access to quality healthcare. This study has uncovered several underlying issues within the population hinder access to quality healthcare. Among them are time constraints, fear of misdiagnosis, cost of healthcare and need for personalized care. A study conducted by Peter O Otieno et al. (2020) revealed that most urban dwellers in Kenya, mainly in the informal settlements, are exposed to poor hygiene conditions, overcrowding, poor housing, overcrowding and inadequate healthcare services. Recent studies have revealed that the burden of illnesses among urban dwellers is considerably high due to the unavailability of preventive and curative interventions. Field MBANGUA (2021) conducted the study on critical factors that hinder access to quality healthcare in Kasarani. Hindrances mentioned in the survey include healthcare costs, under-equipped healthcare facilities, long queues, and a lack of professional doctors to offer specialized care at the facility level. Existing healthcare access challenges have resulted in the mushrooming of small substandard healthcare clinics operated with non-qualified and certified healthcare personnel. Additionally, there has been a massive increase in retail and pharmaceutical outlets that sell medicinal products to the general public to meet the healthcare deficit.

The cost of healthcare emerges from the underfunding of the healthcare system and people lacking access to health insurance leading to substantial financial burden on the population. As a result, huge inequities in access to healthcare services result in huge unmet healthcare needs within low-income households. Response acquired from the study proves that the cost of healthcare is among the key factors that influence one choice for healthcare services. The study noted that the citizenry has opted for alternatives for seeking healthcare services to navigate the above-stated challenges. A majority of the study subjects opt for on-counter prescription and self-medication to access healthcare services more cost-effectively. Njagi, Arsenijevic, and Groot (2020) explain that healthcare cost within the Kenyan health sector is a massive contributor to the increased healthcare deficit in Kenya.

According to Snowdon, Alessi, Bassi, DeForge, and Schnarr (2015), personalization of healthcare services involves putting in place measures to enhance patients' experience throughout the healthcare journey. Most respondents alluded those infrastructural challenges within healthcare

facilities leading to unsatisfied patients. Most medics in public and private are overwhelmed by the number of patients they attend to within a day; hence they lack a chance to engage their patients to understand their medical history and offer more personalized care.

A study conducted by Wafula, Wesonga, and Wanzala (2021) on the prevalence of diagnostic errors within the country of Bungoma revealed that patient misdiagnosis is premised upon: delayed diagnosis, missed diagnosis, absent diagnosis, wrong diagnosis, misinterpretations of laboratory results, unmatched diagnosis and wrong order of investigation. It is sad to note that most of these factors are expected within the healthcare industry due to reduced patient ratio. Additionally, the Kenyan health sector lacks a straightforward approach towards safeguarding patients from misdiagnosis; hence fear of misdiagnosis is legitimately a hindrance to accessing quality healthcare.

5.2 Theme 2: Hospital Visit

The study noted that most respondents expressed concerns about the effectiveness and efficiency of service delivery within public and private health facilities. It was pointed out that most respondents encountered long queues, delays in accessing health consultation, absence of required medical production, and misdiagnosis cases, which hindered timely access to quality healthcare. However, most health facilities have embraced technology to streamline internal operations for better service delivery. On the contrary, most respondents who engaged with the operational technologies at the health facilities highlighted that the digitized processes are not patient-centered hence delays in accessing healthcare services. According to Ravaghi, Afshari, Isfahani, and Bélorgeot (2019), the efficiency of most public health facilities in the study proved inefficient, thus locking out a huge population from accessing timely care. This study intended to assess existing inefficiencies at a facility level to ascertain the role of health facilities in hindering access to quality healthcare. The study has noted that most respondents opted for self-medication to navigate the inefficiencies at the health facilities.

5.3 Theme 3: Self Medication

Respondents who self-medicate acquired medical products from physical and online pharmacies, making on-counter prescription the preferred cost-effective healthcare option. Brata, Gudka, Schneider, and Clifford (2015) defines self-medication as individuals treating self-recognized illnesses or systems without consulting a healthcare professional. In the study, Brata et al. (2015)

noted that persons within low-income areas self-medicate due to the financial burden and readily available community pharmacies. Most respondents were comfortable seeking medical services through self-medication, after which they would acquire medicinal products through on-counter prescription. Data collected from this study shows that there exist numerous self-medication options among the being home remedies, purchase of over-the-counter drugs, use of E-diagnosis tools and use of herbal medication. As the severity advises seen earlier, one's choice of healthcare option of symptoms, availability of preferred healthcare fecality and most importantly, finances.

According to Malik, Tahir, Jabbar, Ahmed, and Hussain (2020), self-medication is considered an extensive healthcare option which motivates self-care initiatives leading to the enhancement of illness preventive measures and stabilization of long term illnesses. The rise of self-medication within developing countries is pushed by the increase in the economic burden on patients, unreliable healthcare system and availability of drugs, both prescriptive and non-prescriptive. The study noted that the rationale of self-medication is premised upon patients' symptoms severity. Hence illness with mild symptoms is usually treated through self-medication, but severe symptoms lead one to visit hospitals. Similarly, a study by Yeika et al. (2021) assessing the prevalence of self-medication within Africa's high education institutions agrees with some of the reasons cited by respondents as reasons for self-medication. The study highlighted that most people opted for self-medication because of the following reasons: difficulties in accessing healthcare facilities, long delays at the facility level, huge medical consultation charges, financial constraints, availability of medicinal products and poor quality of care and lack of confidence in public healthcare facilities. These factors can be further grouped into Accessibility, Availability, Affordability and Acceptability, as shown in the diagram below.
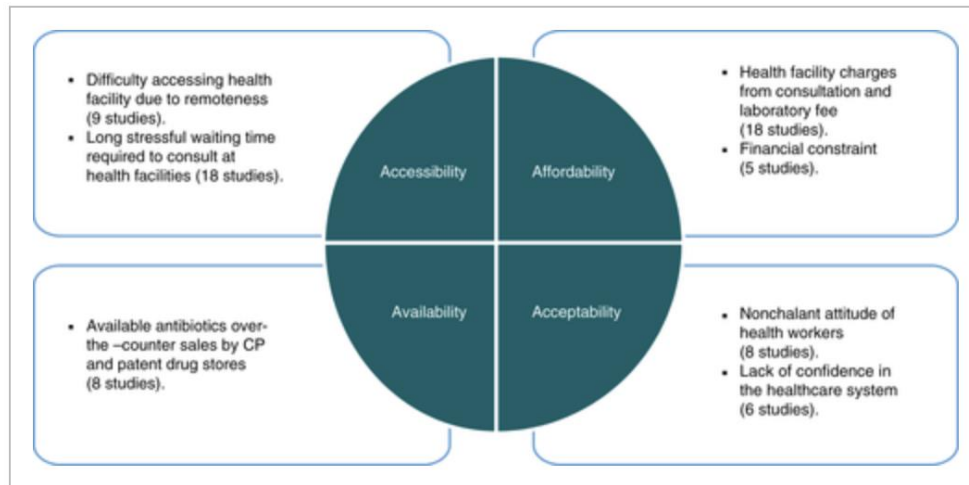
Figure 9: Enabling factors for Self-medication Source: (Yeika et al., 2021)

The study further identified some of the most preferred self-medication options, including prescription re-use, prescription sharing among family members, on-counter prescription, and consulting healthcare workers. However, as this study noted that prescription re-use and over-the-counter drugs were the most common self-medication options, all respondents had an underlying factor. Each respondent alluded to consulting medical websites and mobile applications to understand their illnesses. This brought forth the role of technology in enabling self-medicating patients to understand their systems before opting for a specific self-medication option and medicinal products. Unlike other self-medication options listed by respondents, re-diagnosis was the most preferred means of acquiring medical prescriptions before purchasing medicinal products.

The study noted that most respondents of the millennial era had embraced self-medication, and above all, female respondents proved more comfortable self-medicating than male respondents. With the rise of the internet and social media, these demographics enjoy the availability and accessibility of health-related information and advertisement. Technologies such as WebMD, "Your health companion", "the symptoms checker", and Google search engine have become popular in this demographic (Kunjukunju, 2021). Feedback collected from respondents showed that most respondents were conversant with Google Search Engine and other symptoms checking tools. A typical use case of these e-self-medication tools would be as follows: Respondent feels

ill. They search through the web for symptoms similar to what they are feeling. Afterwards, they narrow down to a probable illness after which they either lookup for medication or home remedies. For medication, they either walk to pharmacies or purchase from online e-pharmacies. This study agrees with the findings made by Kunjukunju (2021), showing a considerable prevalence of e-self-triage systems within the identified demographics.

5.4   Theme 4: AI Self Medication tools

Data collected by this study has indicated that most respondents who self-medicate felt comfortable engaging these digital solutions in seeking medical diagnosis and advice. This is attributed to the unending challenges within the healthcare sector in Kenya have gradually contributed to the population's lack of trust in public healthcare facilities. As a result, there has been a rise in the establishment of private medical facilities that aim to tap into the ever-growing healthcare deficit within the population. Over time, the Kenyan people have decided to be highly involved in their healthcare, thus opting for self-medication. Technological advancement has seen a growth in digital healthcare tools focusing on offering personalized healthcare services to end-users. Most innovations have tapped onto the vast capabilities of Artificial Intelligence in consolidating health information and triangulating it with end users' data in offering medical assessments to end-users. This advancement has seen end users searching for healthcare information through the internet, e.g. Google, WebMD, and Online symptoms checker. Today, there are numerous digital tools available in the form of mobile applications, web applications, and search engines to mirror patient to doctor interaction..

The study found that, almost half of the respondents reported experiencing diagnostic error which is similar to the response acquired by this study. It was noted that diagnostic errors or accuracy of these tools varied from one tool to another as the architecture and end-user interactions varied from tool to tool. Meyer et al. (2020) in a study to understand the perspectives of patient/end users on AI-based self-medication tools revealed issues around correctness, effectiveness and danger of overreliance on these tools. It is unclear how the AI-based models and underlying patterns match patients' inputs to existing symptoms and diseases in most devices. Harada, Katsukura, Kawamura, and Shimizu (2021) evaluated the correctness of the AI-based symptoms checker against the accuracy of the diagnosis provided by the physician and noticed a 2 percent error of margin. The

study revealed that clinical data and type of AI model directly influence AI-based symptoms checker's correctness.

Additionally, this study noted that end users' experience in interacting with technological solutions such as AI-based symptoms checkers directly influences the correctness of prescriptions. Respondents within this study indicated that the accuracy of the diagnosis acquired from the AI tools relied on their understanding of the symptoms and the AI-based self-diagnosis tool's operation. Therefore, operational expectancy and patients' understanding of their symptoms directly influence the accuracy of prescriptions given by the AI-based medical prescription tool. Respondents with a history of self-medication would correctly utilize the AI-based self-triage systems seamlessly as they better understand their health.

Insights acquired from respondents' feedback expressed issues around the effectiveness of some of the AI based self-triage systems. Most respondents acknowledged that they used e-diagnosis tools to understand their health status but had reservations about using the tools as a single source of prescription and diagnosis. Respondents noted that AI-based symptoms checkers heavily rely on end-user inputs' correctness; hence, their effectiveness cannot be independently established. However, most respondents stated that the availability of AI self-medication tools contributed to their effectiveness. These tools can be accessed from all devices with internet access capabilities influenced their accessibility and, above all, their reliability.

Additionally, most AI-based self-medication tools have proved easy to use, thus being reliable and effective by most respondents. Coupling this feedback with some of the recommendations respondents put forward regarding enhancing e-self-medication tools, it is evident that existing systems are not meeting end-users' expectations. The study gathered the following elements: language, access, medical data and integration with healthcare as critical factors contributing to the effectiveness of AI-based self-triage systems. Existing AI-based self-medication systems are made available in English; hence they are regarded as effective to end-users who can articulate their symptoms in English and possess the ability to translate the prescription given by the tool. Richardson et al. (2021), in establishing patients' perception on the use of AI in healthcare, noted that the language used in the AI systems is critical in enhancing the use and correctness of the system. In a non-English speaking country like Kenya, it is essential to incorporate both English and at least Kiswahili to strengthen equitable and correct use of the self-triage system. Most

respondents recommended using both mobile and web applications in accessing AI self-triage systems. However, mobile phones, both smart and feature phones, were preferred by most respondents as they provided a sense of personalization. The effectiveness of the self-triage systems is also influenced using access an availability of the self-triage system.

Additionally, respondents noted that existing self-triage systems, e.g. Ada, Google, WebMD, are based on medical data generated from respective regional, national triage systems. Therefore, these systems are not practical or useful enough in providing medical diagnosis for patients in Kenya as medical data varies from region to region. Lastly, respondents alluded that existing self-triage systems would be more useful if they could use the triage information, including prescriptions in pharmacies or even referred to medical practitioners. Currently, there are less or no effort in adopting self-triage systems within the healthcare sector, which hinders their effective.

5.5 Theme 5: Requirements for AI Self-Medication tools

The study found that the adoption of AI-based patient triage systems within the health sector might require the introduction or adjustment of existing technology, policy documents and the medical environment. This study established that the existing efforts around healthcare digitization are centered on digitization of medical records and internal processes disregarding the need to leverage on technology in availing healthcare to the citizenry. Wolff, Pauling, Keck, and Baumbach (2021) explain that proper implementation and adoption of AI in healthcare may require consideration of several factors: policy, technology and medical and economic impact measurement. These factors cut across all underlying system challenges within any health sector similar to Kenya. There exist huge technological gap that hinders the realization of a National Triage system to facilitate systems such as AI based self-triage systems. Kafle et al. (2018) explains that the infrastructural requirements of an AI based self-triage system involves medical data, Machine Learning predictive analytics model, natural language processing, web application and mobile application. Evidently, there are huge technological gap and might need heavy investment to ensure the system runs smoothly and is accessible to all end-users. A critical component of AI driven patient triage systems is medical data, this study noted that decentralization of medical systems in Kenya has resulted to absence of patient triage data posing a significant hinderance towards realization of an AI algorithm for patient diagnosis. However, availability of technology is not enough in ensuring proper adoption of self-triage systems, Wolff et al. (2021) notes that there is need to address issues

around technological integration, privacy and security and above all information sharing. The overall architecture of the AI based self-triage system should guarantee privacy of data and security of the system and address concerns around AI biasness.

There is need to have policy that provide guidance to custody and ownership of data which stipulates data use, information sharing and all aspect data security. This study established those existing regulations such as Data protection policy 2018 will be essential in providing data protection and privacy guidelines for AI based self-triage systems. However, there is need for more specific regulations around AI based self-triage systems and this can be achieved by undertaking a privacy impact assessment to ensure effectiveness of the regulations. Respondents cited that the AI self-triage systems must adhere to the Healthcare bill that enforces handling and processing of medical data. Wolff et al. (2021) explains that policy setting for AI based patient-triage systems are centered on promotion of existing standards and building capacity of existing institutions in compliance checking. In jurisdiction where AI self-triage systems have been fully adopted, there are emphasis on patient data protection, safe diagnosis and patient data sharing. According to Hardcastle and Ogbogu (2020) proposes key areas of policy requirements that will be relevant for the realization of AI based self-triage systems. Hardcastle and Ogbogu (2020) proposes the need to put in place regulations that ensures equitable access to healthcare services including self-triage systems. Majority of respondents encountered incorrect diagnosis from AI self-triage systems, therefore there is need for policy guidelines that safeguard the citizenry from incorrect diagnosis. Currently, the Healthcare Bill is not adequate in providing guidance to service providers and end users from issues of mis-diagnosis. This study has proposed the revision of the healthcare bill to address issues of patient misdiagnosis from not only AI based self-triage systems but from all eHealth decision support system.

the study noted that mapping healthcare service streams onto digital technologies use cases help in improving their effectiveness within the healthcare sector. About this study's findings, a majority of respondents recommended AI based self-triage systems should be mapped onto the health sector to allow medical referrals upon diagnosis, advanced e-diagnosis and doctor's appointment for secondary illnesses. Similarly, Tilahun, Gashu, Mekonnen, Endehabtu, and Angaw (2021) explains that use of digital health technologies such as mHealth, eHealth, telemed, telehealth has proved essential in supporting patient diagnosis, treatment thus improving service

delivery at a community level. The study noted that full integration to healthcare may require partnership with government institutions, public and private stakeholders.

5.6   Interrelationship between categories

Concepts and themes uncovered within this study are in one way or another interlinked in order to shape the thinking and direction of the study. The diagram below presents a conceptional framework for the implementation of AI self-triage systems within the Kenyan health sector. The study has uncovered the factors that hinder access to quality healthcare, inefficiencies at healthcare facilities that influence the citizenry preference to self-medication. Additionally, self-medication options have been identified. E-prescription was identified as the most popular self-medication option hence the study identified concerns around e-Prescription and requirements for adoption. Development of the conceptual model involved taking up a broader outlook of the concepts unearthed by the study and applying theoretical thinking in arriving at a conceptual model. In relations to the project's objectives, the model maps the challenges within the healthcare system and its contribution to the rise in self-medication. Also, key requirements and expectations of AI self-triage systems as per end-users' feedback and how they influence adoption and use within the Kenyan population. Adom, Hussein, and Adu-Agyem (2018) explains that, conceptual models represent the researchers believes and it is linked with the concepts that are used in promoting and systemizing the knowledge of the research. Conceptual models are essential in understanding ad establishing a world view thus providing a realistic picture of what of how ideas in a study relate to each other
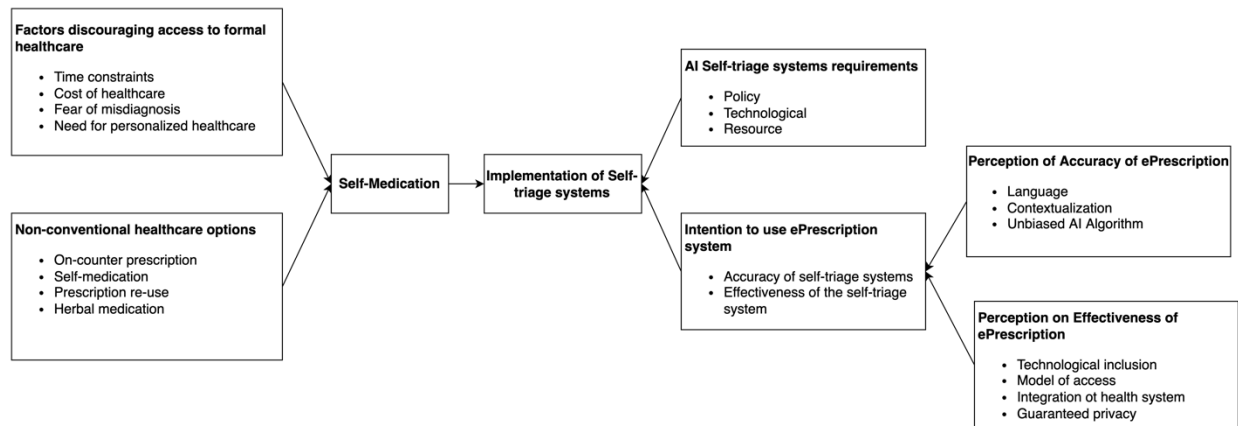

Figure 10 Framework for Implementation of AI self-triage system in the Kenyan Health sector

The core objective of the study was to develop and recommend a framework for implementation and roll-out of AI self-triage tool in the Kenyan health sector. The above framework has been drawn from the relationship of themes and codes that are underlying in the collected data. The framework outlines the relationship between factors that hinder access to formal healthcare and the rise in the rate of self-medication within the Kenyan population. It has been noted that time constraints, cost of healthcare, the fear of misdiagnosis and the need for personalized healthcare have pushed the population away from accessing health services from medical centers. The existence of non-formal medication such as on-counter prescription and self-medication options speaks to the societal readiness for the implementation of AI self-medication.AI-based ePrescription tools are the most preferred means of self-medication as they offer sound medical recommendations to self-medicating persons. The framework proposes that consideration of key requirements and end users' perception in developing and implementation of an AI self-triage system effectively within the health system. Policy, resource and technological infrastructure have been identified as the key requirements for the implementation of AI self-triage systems within the healthcare sector. Policy on matters self-medication, patient protection from misdiagnosis and data protection have been identified as policy pre-requisites for AI implementation. There is need for IT infrastructure, accurate medical data and AI algorithm accessible from various devices should be in place to cater for the technical requirements for the realization of AI self-triage systems. Proper human resource spanning from medical team, IT team and legal team to address various technical, medical and legal issues before and after implementation. End-users experience with the existing ePrescription tools brought to light insights on how AI self-triage tools would be accurate and effective. The study found that AI-self triage tools would be more accurate to the Kenyan population if at all the language caters for all demographics, the medical data and medical recommendations are contextualized to the Kenyan population and above all the AI algorithm should be unbiased. Additionally, the effectiveness of these tools could be achieved if technological inclusion is achieved, AI tools are integrated within the healthcare system, highly access from any device and date privacy is guaranteed.

6 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter presents the summary, conclusions, recommendations, and the study's contribution to existing knowledge. Additionally, this segment undertakes the overall analysis of the study's objectives and questions and maps it onto the conceptual framework.

6.2 Summary findings

The study commenced by undertaking a literature review in the health sector in Kenya to uncover issues around access to healthcare and technological prevalence within the healthcare sector. Being a qualitative study, the study identified five themes: Issues around access to quality healthcare, self-medication prevalence, concerns around AI self-triage systems and requirements for implementation of AI self-medication systems within the Kenyan Health sector. The study noted that cost issues, inaccessible healthcare professionals, inefficiencies at healthcare facilities and lack of personalized healthcare are hindrances to access to quality healthcare. Depending on their age and financial capabilities, the public navigate differently around access to healthcare as some opt to visit the hospital, the counter prescription, and self-medicate. In assessing the prevalence of self-medication within the healthcare sector, the study considers the technological related inefficiencies within healthcare facilities that hinder the public from accessing quality healthcare services. Time constraints were among the hindrances to access to healthcare The majority of respondents highlighted those inefficiencies at healthcare facilities as contributors to delays in access to healthcare services.

Challenges to access to healthcare and inefficiencies at healthcare facilities contributed by low technological adoption have pushed for the existence of unorthodox means of access to healthcare. The study found self-medication, over-the-counter prescription and prescription re-use as means of access to healthcare. The focus was placed on self-medication, and the study probed for self-medication approaches within the research population and, above all understand the existing tools for self-medication. Low symptoms severity and ability to understand the symptoms were among the factors considered by respondents before applying the self-medication approach. Respondents who preferred self-medication expressed experience using Google Search Engine, WebMD, Quora, and other online symptoms checkers.

The majority of the respondents expressed concerns about the correctness and effectiveness of the AI-based self-medication tools. However, the study found huge concerns around the correctness and effectiveness of the AI-based self-medication tools. 25% of the respondents in this study got an incorrect diagnosis from their preferred AI-based self-medication tool. Concerns around the correctness of prescriptions were coupled up with issues of language and complexity of the tools centered on effectiveness. The study found that existing AI-based self-triage systems have been developed to use English; this might exclude a vast demographic that doesn't understand or speak English. The absence of a Kenyan based self-triage system brought to light the ineffectiveness of the existing models as non-Kenyan medical data guide them and, most of the time, not meant for non-English speaking end-users. The study established the relationship between the correctness of medical data, the language of the system/application and its ability to provide correct prescriptions to end-users.

The research population was highly receptive to AI self-triage systems as they mimicked the interactions between the doctor and patient in primary health diagnosis. Mostly, the younger population who are techno-savvy positively embraced using AI-based self-triage systems in self-medication. The study noted that facilitating conditions such as policy and technological infrastructure may influence the adoption and use of AI self-triage systems within the Kenyan health sector. As most respondents expressed concerns about the privacy of their medical data and the overall security of the AI self-triage system, the study noted the need to have policy regulations that safeguard end-user data. Additionally, there was the need to protect end-users from an incorrect diagnosis. Hence the study found that Kenya lacks laws that protect against misdiagnosis in AI self-triage systems.

Regarding privacy, the study proposed adopting existing data protection regulations and enforcement of the medical bill onto the implementation framework of self-triage systems. To ensure the effectiveness of the self-triage systems, the study has found that MOH and its stakeholders need to collaborate in establishing national triage data, healthcare system interoperability, and expert-based unbiased AI algorithms for patient diagnosis. This shall enhance the correctness of patient diagnosis algorithms and enforce the correct use and improvement of medical data. Inequities around access to technology within the Kenyan population are pegged toward the household income level. Hence the implementation of AI self-triage systems within the

Kenyan Population may require the adoption of feature phones and national language to ensure technological equity. It was found that existing regulatory bodies might not be effective enough in offering oversight on the development and adoption of AI self-triage systems due to their skills gap; hence this study noted that the establishment of a regulatory body containing IT and medical skills personnel would be an essential prerequisite to adoption and use of AI self-triage systems in Kenya.

Mapping research findings to research objectives

In the introductory segment, the study presented the overall objective of the study is to explore aspects around implementation and use of AI self-triage digital mHealth solution for achievement of primary healthcare. In summary, specific goals include evaluating mHealth solutions supporting access to healthcare, assessing requirements needed for implementation, assessing the public readiness for adoption of AI self-medication systems, and proposing a model for implementation of AI-based self-triage systems.

Mapping research findings to research Questions

The following questions guided the study:

1. ***How does the Kenyan population presently use eHealth and telemedicine applications to access primary healthcare?***

   The study found that there was increased use of Telemedicine and eHealth technologies at the facility level due to COVID-19. Due to the unavailability of eHealth implementations centred on the providence of primary healthcare services, most Kenyan populations have adopted commercialized applications for reproductive health, symptoms checking, and medical advisory. The study found that Telemedicine in Kenyan is not widely adopted, especially in public facilities, due to system challenges. However, the study noted that the study population was receptive to the use of technology in accessing primary healthcare.

2. ***What is required for seamless implementation and use of "an automated, online" self-triage system in the Kenya Health sector?***

   In probing the requirements for the adoption and use of AI self-triage systems in Kenya, the study found the following: There is a need to establish a technological infrastructure

that will see the establishment of a national triage data, AI medical diagnosis algorithm, and end-user support system for better adoption of AI self-triage systems. Existing regulations, Medical Bill, Data Protection Act and GDPR are not effective enough in guaranteeing end-users' privacy of their medical records hence the need for more specific rules around use of AI-self-triage systems. A regulatory body needs to be established to safeguard the population from un-certified AI self-triage systems and offer end-user protection from misdiagnosis.

3. ***How ready is the Kenyan health system for the implementation and use of AI Self-triage systems to deliver primary healthcare?***

   The Kenyan health system is not ready to adopt AI-based self-triage methods for patient diagnosis. This is evident from mapping the existing state of the Kenyan health systems onto the critical requirements for the use and adoption of AI self-triage systems. There are substantial technological gaps spanning from triage data, IT infrastructure, and the absence of AI models for patient diagnosis. Additionally, existing regulations are not effective enough to protect patients from misdiagnosis and provide regulatory oversight on the development and roll-out of AI-based self-triage systems. The absence of required regulations, infrastructure and systemic challenges within the healthcare industry are among the factors hindering the integration of AI self-triage solutions within the healthcare industry.

   On the contrary, the Kenyan population is receptive to using AI self-triage systems. This can be seen by the increased use of open-source AI self-triage systems for medical diagnosis among the younger population and the rise in the adoption of eHealth applications within the healthcare industry. Additionally, digital literacy across all demographics is on the rise, thus necessitating innovative primary healthcare solutions among the citizenry.

6.3   Conclusion

In Kenya, there is a considerable healthcare deficit resulting from challenges of access to quality healthcare among the population. Systemic challenges such as inadequate funding, shortage of medical supplies, and the ever-decreasing doctor to patient ratio have resulted in increased healthcare costs and inaccessibility of quality healthcare for the ordinary citizen. These challenges have pushed the citizenry to take up unorthodox healthcare options, including self-medication. The

study has revealed that most Kenyans feel safe self-medicating compared to the on-counter prescription has become a norm for seeking medication. Hospital visits are slowly becoming expensive and set aside for more serious illnesses. In a population where self-medication is the most preferred means of accessing healthcare, AI self-triage systems which mimic doctor-patient interactions would play a big role in pushing for safe and correct self-medication. From the study, AI self-triage applications such as online symptoms checker, Ada Health, and others are used. Most respondents have admitted to using recommendations and prescriptions from the application for primary health treatment.

The study has established that respondents who use AI self-triage systems have reservations concerning their correctness, language used, and overall effectiveness in using the prescriptions in procuring non-prescribed medication. Additionally, the study has established that there are no efforts within the healthcare industry toward incorporating AI self-triage systems in primary health consultations, acquisition of mediation or medical referral for more severe cases. This research shows that the Kenyan population is receptive to applications such as AI self-triage systems. Hence there is a need to put a regulatory body, laws and IT infrastructure to support the implementation and adoption of digital health solutions such as AI self-triage systems.

6.4   The implication of the study

This section outlines the critical contributions made by this study to the academic field, and the methodological, theoretical, and practical implications of the research.

6.4.1   Theoretical contribution

Existing theories are centered around a positivist view of adopting digital health solutions within the Kenyan healthcare sector. However, this study has executed a series of steps stipulated by Grounded theory in building a theoretical framework that proposes a comprehensive approach for implementing and adopting AI self-triage applications within the healthcare system. The study has generated a substantive idea that has been unearthed from the interrelationship of concepts and themes acquired from in-depth probing of the Kenyan population. Through grounded theory, the study has proposed a theoretical framework that is more contextualized toward the existing challenges and opportunities within the Kenyan health sector.

6.4.2 Contribution to knowledge

The study contributes to the existing knowledge regarding the process, practice, and methodology around applying grounded theory in developing a comprehensive model for implementing and adopting AI-self triage applications within a healthcare system. The study was meant to bridge the existing information gap concerning the implementation and adoption of AI-based digital health solutions within the Kenyan healthcare industry. Therefore, the study findings and the uncovered model may provide necessary insights to stakeholders within the healthcare sector.

6.4.3 Methodological contribution

The adoption of Grounded Theory in establishing prospects and challenges around the adoption and implementation of AI self-triage systems within the health sector has embraced the set standards for the generation of a substantive theory. Exploring existing concepts and knowledge from respondents' experiences and uncovering their relationships formed the core of this study. The correct standards for collecting and analyzing qualitative data were embraced, resulting in the utilization of both automated and manual data analysis and coding. Therefore, a study contributes to the best practices around collecting and analyzing qualitative data and applying grounded theory in theory development.

6.4.4 Contribution to Policy

Insights acquired from this study directly influence policy formulation within the Kenyan Health sector. The investigation began by establishing the unorthodox means adopted by the population in navigating around access to quality healthcare blockers. It has been found that self-medication through on-counter prescriptions is among the most preferred means of access to healthcare. From a policy perspective, these findings may advise efforts geared towards reducing self-medication or advocacy for safe self-medication through the use of digital health solutions. Additionally, issues identified concerning the use and adoption of AI self-triage systems may influence the advancement of existing policies around data protection and sharing, eHealth integration to healthcare, equitable access to technology, and eHealth infrastructure investment. The study has discovered that red the existing policies concerning eHealth have not captured aspects of Artificial Intelligence and the advocacy around implementation and algorithm biasness. Therefore, these findings may be used to advance current regulations and laws concerning the use of digital health solutions in primary healthcare providence.

6.4.5   Contribution to practice

Stakeholders within the healthcare sector are increasingly embracing digital health solutions resulting in a shift from traditional healthcare approaches. Some of the critical stakeholders within the health sector include donor organizations, government through MOH, private investors and medics. As these groups of persons embrace digital health solutions in achieving effectiveness and efficiency in healthcare providence, there is a need to consider best practices for developing and implementing eHealth solutions. Findings of this study advocate for the consideration of critical factors that necessitate the effective implementation of eHealth solutions such as AI self-triage systems. The success of the proposed framework for implementation and use of AI self-triage systems should consider the dynamic nature of the Kenyan health-sector funding and politics. Key factors to consider should be policy, technical and regulatory requirements and end-user capabilities & capabilities. Therefore, this framework provides the foundation for the implementation and adoption of AI-based eHealth applications within the Kenyan health sector.

6.5   Recommendations

This research recommends that healthcare investors both private and public including the government should consider the proposed framework for the implementation and adoption of AI-based self-triage systems. Additionally, the ministry of health ought to revise its eHealth policy to include key proposals put forward by the model. Regulatory bodies such as KMPDU, Pharmacy, and Poisons board should accommodate the use of technology for medical diagnosis as a means of advocating for safer self-medication. To roll out an AI-based self-medication tool, there is a need to push for medical data interoperability and the establishment of a National Triage System. Therefore, the ministry of health at all levels of government should push for the harmonization and consolidation of medical data which is a key ingredient in developing an AI model for patient diagnosis.

6.6   Limitation of the study

Artificial intelligence within the healthcare industry is relatively new in Kenya. Currently, eHealth innovations are not AI-based; hence there are limited studies and exploration of the potential of AI within the Kenyan health sector. Existing studies are centered around the assessment of eHealth adoption and implementation without much emphasis and no specific focus on AI. Therefore, most of the references for this study have been from research studies from developed countries. The

study contextualized existing literature within the Kenyan context considering the uniqueness of a developed country's healthcare sector.

6.7   Suggestions for further study

The research study intended to establish the potential of AI in offering primary healthcare and identify the challenges and options around the implantation of AI-based self-triage systems within the Kenyan healthcare sector. Insights acquired from the study were data-driven, which led to the development of a comprehensive model for creating and adopting AI-based self-triage for primary healthcare providence in Kenya. The study correctly identified the right demographics and sought advanced input from sector stakeholders. Future studies should conduct similar studies within other developing countries within the region to validate this model. Additionally, the model can be tested quantitively, leading to a generalization and in-depth assessment of the factors of adoption embodied within the model.

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8   APPENDICIES

8.1   Interview Guide

8.1.1   General Public

Section A

Personal Information

1. Name: (Provide a Code)
2. Age Group (18 to 25 or 25 to 35)
3. Residency

Section B (Assess prevalence of health technology)

Define eHealth,mHealth & Telemedicine before asking these questions.

i.   Could you describe to me when you last sought healthcare services (Medical consultation, diagnosis, prescriptions etc)?

ii. Could you explain your interaction with technology while accessing healthcare services?

iii. Which other health technology are you aware of?

iv. How did you get to know about these tools?

v.   Could you explain to me how you access/operate and use these technologies?

vi. How do you find it helpful in meeting your healthcare needs?

vii. Why do you opt to use the above system/application?

viii. What reservations do you have about the above application or system?

ix. Would you wish to continue using the above tool for future healthcare needs?

Section B (Establish a background in Self Medication

i.   How do you access healthcare services?

ii. What led you to adopt the above mentioned healthcare access approach?

iii. What is your understanding of self-medication?

> *Clarify: (Self-medication is the use of medicinal products by the consumer which is not prescribed by the physician)*

i.   When was the last time you self-medicated or did something closer to self-medication?

ii. What was your reason for self-medication?

(Probe for these key words: costly medical consultation, time-saving, re-using prescriptions & no-trust in doctor)

i.   Which self-medication options have you used in the past?

(Mobile apps, Online symptoms checker, on-counter prescription (pharmacy) and prescription re-use)

i.   What motivated your choice for the above self-medication option?

ii.   How effective, convenient and accurate has your self-medication approach been?

Section B (Probe for E-Diagnosis)

(For respondents who expressed understanding of automated e-diagnosis tools (apps, websites))

i.   What's your understanding or e-diagnosis?

ii.   Which e-diagnosis tools are you aware of or have you used in self-triaging?

iii.   Why do you use the mentioned e-diagnosis tool?

iv.   How accurate is the tool in giving you correct diagnosis or prescriptions?

v.   How helpful do you find the medical diagnosis identified by the tool?

Section C (Why e-diagnosis)

i.   Could you explain to me what led you to self-medication?

ii.   How did you get to know about e-self medication?

8.1.2 Medics

Section A

Personal Information

1. Name: (Provide a Code)
2. Age Group (18 to 25 or 25 to 35)
3. Profession
4. Residency

Section B (Medics' view on E-diagnosis)

(For medics who understand or have experience in use of e-diagnosis tools for patient diagnosis)

i.   How have you utilized e-diagnosis tools in your work?

ii.   Which e-diagnosis tools are you aware of or have interacted with in your line of work?

iii.   How effective was the tool in helping you undertake patient diagnosis?

iv.   How accurate were the prescriptions?

v.   What is challenging around the use of e-diagnosis tools in your line of work?

8.2   Informed Consent

Informed Consent to Participate in a Research Study

Name: Job Isabai

Registration Number: P54/38226/2020

On behalf of:

University of Nairobi

School of Computing and Informatics

Title of Research Project: The Implementation of AI Self-Triage systems as a Digital Health Solution for Primary Healthcare in Kenya: Challenges and Prospects

Name of Principal Investigator: Angubasu Job Isabai

Phone Number of Principal Investigator:

PURPOSE AND BACKGROUND

Job Isabai of UoN's School of Computing is researching challenges and prospects of adopting. The purpose of your participation in this research is to help the Researcher understand available e-diagnosis options and assess the variability of existing AI self-triage tools. You were selected as a participant in this study because you are a Nairobi city dweller, you are aware of self-medication and health-tech tools that support self-medication.

PROCEDURES

If you agree to participate in this research study, the following will take place:

- We shall gather your demographic information (Occupation, Residency, Gender, Age)
- We will then schedule a data collection session, either virtual or physical, within a time and date of your liking.
- Data collection shall be through in-depth interviews where we will discuss topics such as Self-medication, health technology, access to healthcare, e-self-triage systems, and AI self-medication tools.
- Before the interview, please have a look at the videos below:
  - Video on Self Medication : Self-medication in Low-income Areas
  - Video on Available Self Medication Tech Tools:
    - https://www.youtube.com/watch?v=hE6nq3vDrv0 → Ada App Pitch
    - https://www.youtube.com/watch?v=OcRGUlGUoxU → Live Demo of the Ada App.
    - https://symptomate.com/diagnosis/#0-66 → Symptomate
    - Google
- Focus of the interview shall be on:
  - Effectiveness of the above tools
  - Adoption in Kenya
  - Integration into healthcare system
  - Policy and Regulation requirements for ease of adoption.

RISKS

If you feel uncomfortable, unconvinced, and unwilling to share information, you can decline the request to participate in this study.

CONFIDENTIALITY

The records from this study will be kept as confidential as possible. No individual identities will be used in any reports or publications resulting from the study. All interview transcripts,

summaries, and recordings will be given codes and stored separately from participants' names or other direct identification. Research information and files will be kept in encrypted formats at all times. Only research personnel will have access to collected information, and only those with an essential need to see names or other identifying information will have access to that particular record. After the study is completed, the collected data will be destroyed.

BENEFITS OF PARTICIPATION

There will be no direct benefit to you from participating in this research study.

CONSENT

You are deciding whether or not to participate in a Research Study. Your signature below indicates that you have decided to participate in the study after reading and understanding all of the information above, and you understand the information in this form. We shall provide you with a copy of this form.

Signature (Respondent) _____ Date _____

Signature (Interviewer) _____ Date _____

8.3   Sample of Interview Scripts

Interviewer: 0:09

Oh. Today we are going to look at going to handle a few questions. And thank you for accepting to be one of the respondents in this research. So I know that I've already shared with you all the materials that is the consent form, and some of the questions that we look at. But before that, I'd like to paint a picture of our background of what we are going to discuss. The aim of the research, is that we are trying to establish if artificial intelligence, these are the chatbots if they can be applicable in patient diagnosis. We are trying to plug in artificial intelligence as a health technology so as to enable us to bridge that gap between patients and doctors and at the same time, deliver quality health care. So our intention in this research is just try to your understanding or your story, in either interacting with some of these tools, or some of the challenges or stories that you have in regards to access to health care within the Kenyan health system. Is that clear? Now before we start with the questions.

Respondent: 1:57

Yes, technology tools, okay. Yes.

Interviewer: 2:02

Okay. So I'll first state what is artificial intelligence before we start. So artificial intelligence, this is where the technology mimics or mirrors a human being, in terms of response and everything. So, people have developed chatbots out here are technologies out here that really act and think or even respond as human beings. Some of them have been used as conversational agents where you talk with a technological tool, you converse with it, you give it information, it decodes then response to you. So think about that tool, and contextualize it to healthcare. Any healthcare technology that is utilized in context of healthcare some of them are called Health Tech. So they exist in two formats. They can be either on mobile; we refer them to M health. Okay, some that exists in form of internet infrastructure computing, etc. We refer them as a health. Therefore, we are going to mention these terms as we move forward in our interview, but I'm just laying a background

of some of the things that will start okay. So, let us start this. So the first segment of the interview we are going to discuss, you can just process if you have ever interacted with any technology in accessing healthcare. Therefore, the first question is

Interviewer: 3:59

Could you explained to me your experience when you last sought medical service, either medical consultation, diagnosis or prescription, what did you do? What was the story behind it? Or what was the interaction? Where did you go? Who did you interact with, etc. Just keep it short and brief.

Respondent : 4:27

My past medical interaction, I will say I Googled my symptoms. After checking my symptoms on Google. I proceeded to go to pharmacy to ask pharmacy attendants about my symptoms and the treatment that I can receive for the symptoms.

Interviewer: 4:56

Okay, thank you. So this means that You, you felt ill? So you decided first to understand your symptoms? Or the causes of this level of illness? So you decided to engage Google first to understand, then there you mean that you went and engaged a pharmacist to either get medication. Which other technology did you interact with?

Respondent: 5:41

I just Googled, I can't remember the website but I just Googled,

Interviewer: 5:50

In your interactions with let's just step back. Have you ever stepped in a hospital? Have you ever met a medical professional? For medical consultation? Yes. If yes, then how was the interaction with the doctor? How long did it take if you can just roughly explain it?

And what was the level of illness if you compare it to the previous time that you went to a pharmacy?

Respondent: 6:15

Can you repeat the last part?

Interviewer: 6:30

If you can compare the level of illness between that time you went to hospital and the time that you used Google and went to a pharmacy, between the two, which, which was a severe case, and what can you pick from the two which is the easiest option or the safest option?

Respondent: 7:17

This is the safest option. I'd rather go to a hospital and speak to a doctor than going to the pharmacy because pharmacy can diagnose you or wrong. Wrong, wrong sickness. Because my interaction with the first pharmacy I interacted with the pharmacy gave me she gave me a prescription. But it was for another illness and not the one I was suffering.

Respondent: 7:57

In contrary when I go to hospital the doctor. The doctor will diagnose me correctly and propose that I do a test in order to get correct drugs and treatment.

Interviewer: 8:30

So so yeah, the reason why I wanted us to compare the two is level of illnesses and just to establish if maybe there was a push, if maybe you felt like you're seriously ill, that's why you went to the hospital, or your illness was mild. That's why you chose to Google and went to the pharmacy. So just wanted to understand that.

Respondent: 8:46

Oh,

Interviewer: 9:13

At the hospital, did you interact with any technology?

Respondent: 9:17

No I did not interact with any technology.

Interviewer: 9:46

How did you find google usefulness?

Speaker: 10:08

I found it useful, kind of useful. Though, it didn't give me the exact, it was giving me what I say. My idea or it was giving me a rough idea. Not exactly the not exactly what I wanted or what I was suffering for, but it was giving me a rough idea.

Interviewer: 10:40

Okay, then, how did you? How did you get to a point where you decided to use Google? Did anyone tell you about these? Or oh, how did you end up using Google? Google your symptoms? Or is it something we just decided to do?

Respondent: 11:00

It was something I decided to do, because I was ill. And I wanted to find out what my symptoms, what illness I was suffering for. So I googled the symptoms to find out what else? What was it? What was I going through?

Interviewer: 11:18

Okay, so then that means that since then, Have you have you have you used it on a frequent basis? Or it was just one off?

Respondent: 11:28

I've used it on a frequent basis.

Interviewer: 11:33

How is Google's correctness?

Respondent 11:43

Every time I use this, it just gives me a rough idea. Picture.

Interviewer: 12:01

Do you have any reservation Do you feel like you can continue using google? Or you feel like maybe as you move forward, this might not be the best idea to use Google.

Respondent: 12:27

Like I say, it's not the best idea, but it gives you a rough, a rough a rough idea of what your symptoms are about. So I think it's something you can keep using

Unknown Speaker 12:41

So at least we've covered the first part, this just try to understand your interaction with technology in regards to healthcare, so just trying to understand if you at least, interacted with technology and handled some health related use cases. So in the next segment, we're going to look at one critical aspect and this is forms the background of the basis of our research, that is self medication. So medication starts from this angle, where a patient sees like, or a patient diagnose themselves, identify a disease or identify an illness then acquire medicine that can can at least either prevent or treat or at least at least help you recover from the illness. So this is this has become prevalent in Kenya.

Interviewer: 17:39

How do you access health care services?

Respondent: 19:21

One of the ways I access healthcare is through pharmacists. I go for on the counter prescription. Yes, that's how I access drugs,

Interviewer: 19:38

Do you go to hospitals something of the thought?

Respondent: 19:43

It's very rare for me to go to a hospital. So the only the easiest way I access through a chemist or a pharmacist

Interviewer: 20:01

If you if you if you don't mind, what led you to opt in to pharmacies and not hospitals?

Respodent: 20:10

Because when I get ill is not that severe. Ah, yes.

Interviewer 21:06

At the pharmacy? Did you order a specific medicine?

Respondent: 21:53

It was not a specific medicine?

Interviewer: 21:56

Then the question would be if you order the specific medicine, how did you know that is the correct decision?

Respondent: 22:02

Because I've been using the same medicine for the same illness.

Interviewer: 22:12

So in other terms, we can say that you are reusing a prescription? Yes. Yeah, there was an existing prescription because someone gave you this medication before and it worked for you. So mostly, when you have the same symptoms, you just go for the same medication, right?

Unknown Speaker 22:29

Yes.

Interviewer: 22:31

Okay, then. Ideally, what would what motivates you to decide to go to a pharmacy? You said that, because your illness are not that serious, right? Is there any other motivation, either costs, etc? Is there any other thing that pushes you away from the hospital? Or is also my choice?

Respondent: 22:56

Easy access?

Interviwer: 23:06

Just let me understand what is the experience at the hospital?

Respondent: 23:12

At the hospital you have to be patient. Yeah, you have to be tested first. After testing, you have to see the doctor. The doctor, you see that process is low. So do not go to the chemists is only one process.

Interviewer: 23:42

So you, if you were to rate the chemists route, like going to the pharmacy, procuring a medicine and all that. You say that it's efficient, right? It's easy. It's accessible, right? Yeah. Don't you worry about correctness or the, the correctness of the prescription that you get the pharmacy level?

Respondent: 24:18

Ah, I, okay. You can see, I'm not worried because it depends on the level of seeking and the level of sickness or what can I say, this sickness or the level on how you're sick? Is it severe? Is it just headaches to see if we can?

Interviewer: 24:44

So initially, I introduced to you how chatbots, how chatbots, how AI algorithms can interact with human beings run through and predict the form of disease they have based on their symptoms. And I shared with you videos, examples, or other Babylon, so these applications are being used out there. So instead of you queuing for medical consultation, at a hospital, you interact with an application, then from there, it sends you to the correct doctor that you want.

Respondents: 26:18

Does application have doctors?

Interviewer: 26:21

Yeah, no, the application does not have a doctor. So the application is about an artificial intelligence bot. So it acts like a doctor. So it asks you, how do you feel? You really have a headache. So if you have a headache, it asks for more, it continues to ask those questions that doctors ask. Then afterwards, after it all, it narrows down and tells you that okay, these are the symptoms, you might be having this illnesses. Okay, it it tries to try to do it tries to diagnose you, because what doctors do is they always the same thing that applications been taking up the symptoms, combining them, giving you a medical diagnosis they give you either you're suffering from this, take this medication. So what the application does is exactly that. Okay. So the next session, we're going to talk about this applications. Think about a world where these applications existed.

Interviewer: 27:48

My question is, Google is one of them, because you've used Google. Okay. So my question is, are you aware that Google itself can narrow down other than just giving you a rough idea of your symptoms, it can narrow down to the exact disease that you are undergoing. And this is not just Google, but other tools that are out there. Have you ever interacted with any other tool that can do what I've just explained?

Respondent: 28:28

No.

Interviewer: 28:32

Then that means that we can just continue evaluating Google because you've interacted with it. So say that Google gives you a rough idea of your medical diagnosis. In future, let's say, a future where maybe Google can provide more. A question is, would you use it fully to a point of getting a medical prescription from Google?

Respondent: 29:04

Yes, I would use it depending on the sickness, the illness,

Interviewer: 29:10

Okay, so the key factor here is depending on the level of illness that you have, right, yes. But so far with the interaction with Google you've never ever faced any. Could you explain if you've ever faced any situation where Google is purely wrong?

Respondent: 29:38

Oh, no google has never been incorrect.

Interviewer: 29:39

Between the two tools, Google and the doctor, which one would you trust with your prognosis?

Respodent: 30:32

Oh, just the doctor. Why? Because with a doctor, you will have to test me I will have to test my blood blood pressure. Those things fast with Google. The Google has not tested me. They have just given me an roughly like. So I'll trust the doctor?

Unknown Speaker 31:10

Oh, yeah. So that the the example that I just put forward is for an illness that that is serious, right? Let's say for? Or illnesses like, just mild illnesses? Between the two, which one would you have? Would you wish to go to a doctor? Would you wish to go or to engage Google? If you had just maybe a running stomach? When someone is not? Yeah, but having someone who's serious, let's say, let's say let's say COVID? Like symptoms?

Respondent: 31:48

COVID? Like symptoms?

Interviewer: 31:52

So which one would you prefer?

Respondent: 31:59

In under two seconds, I'll go to the pharmacist.

Interviewer: 35:03

How would it be? If you can just access these tools, get get prescriptions, etc? How would it be for you?

Respodent: 35:28

For me, I think it will be easy.

Respondent: 35:32

Okay, first, do I have to pay for these tools?

Interviewer: 35:37

No, all these tools are three are free, they are free to access for everyone on mobile. So no one needs to pay for anything.

Respondent: 35:50

But after using the app I will have to go to the pharmacy.

Interviewer: 35:59

If this AI self-diagnsis tools existed? Would it lead you to more use? Would you really embrace them?

Respondent: 36:34

I think I'll not embrace it. 100%. Why? Because it's not giving me the treatment, okay, they're just giving me that rough idea of the treatments, but they're not. You're not giving me any treatement, like, I'll still have to go to the pharmacist, I will still have to go to the doctor, for example, I'll search for my symptoms, you have given me the illness, and the treatment, when I go to the house to hospital.

Respondent: 37:09

Maybe maybe the sickness is severe, or it needs me to go to the hospital. When I go to the hospital, I'll still need to be tested. To be tested, and then treatment. There may be a difference between you what the technology has given me the app, whatever it is at the hospital. So I will use it not 100%.

Interviewer: 37:54

So yes, I agree with the you're not using it 100%. But remember, is like there's this there's a vast number of people out here that have, or they cannot afford to go to the hospitals. Or they have a habit of not going to hospitals.

Interviewer: 38:18

So if this tool was there, if this tool was made available, think about these people, how they, how they survived? Would they embrace them fully? Or will they have sufficient themes? Same as yours?

Respondent: 38:35

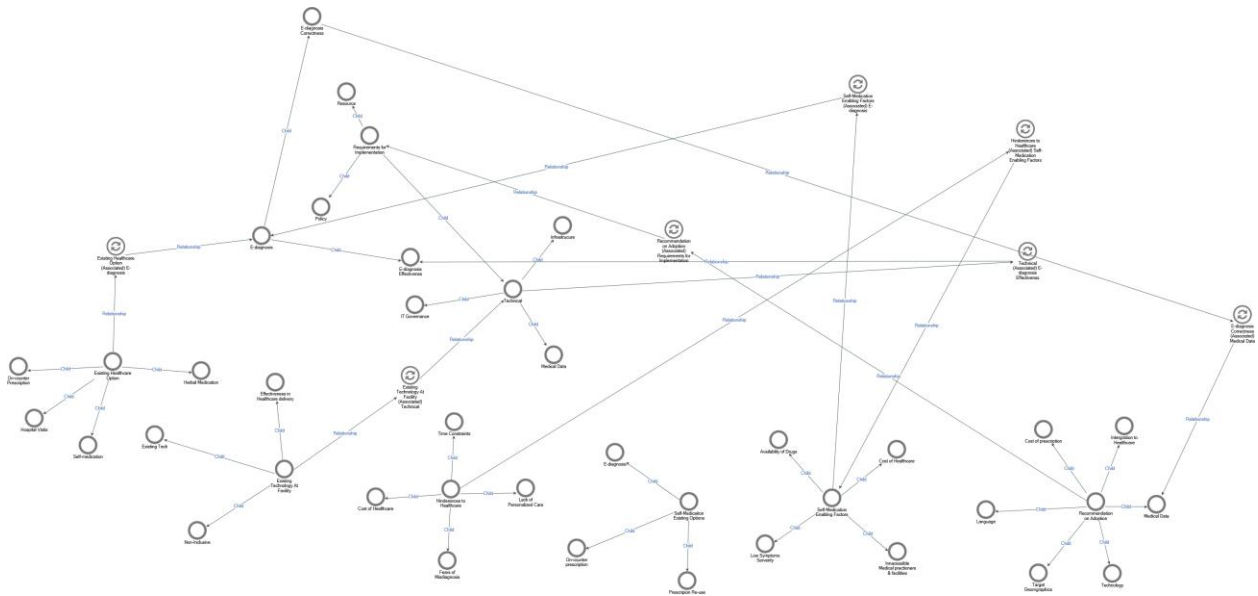I think they'll have the same sentiments as I.

9   EXTRACT FROM NVIVO

Figure 11 Project map extract from NVIVO